नालको NALCO

OWNER / PURCHASER
National Aluminium Company Limited
(***A Government of India Enterprise***)
CIN: L27203OR1981GOI000920
CONSULTANT
Development Consultants Pvt. Ltd. (DCPL)

NOTICE INVITING TENDER (NIT)

FOR

DESIGN, ENGINEERING, SUPPLY, ERECTION AND COMMISSIONING OF ALUMINA UNLOADING AND TRANSPORTATION SYSTEM (AUT)

Tender Ref. No: NALCO/CORP/P&T/CONT/2025/052 Dated: 23.10.2025

SUB: "DESIGN, ENGINEERING, SUPPLY, ERECTION AND COMMISSIONING OF ALUMINA UNLOADING AND TRANSPORTATION SYSTEM (AUT) ON LUMP SUM TURKEY BASIS".

Notice Inviting Tender

National Aluminium Company Ltd.
(A Government of India Enterprise)
"NALCO BHAWAN", P1, NAYAPALLI BHUBANESWAR-751013, ODISHA

NALCO has appointed M/s Development Consultants Pvt. Ltd. (DCPL) as EPCM Consultant for implementation of this project. DCPL on behalf of National Aluminium Company Ltd. (NALCO) invites bids from eligible bidders for **Design, Engineering, Supply, Erection and Commissioning of Alumina Unloading and Transportation System (AUT)** on LSTK basis for Smelter Plant at Angul, Odisha.

1	Tender Ref. No. & Date	**NALCO/CORP/P&T/CONT/2025/052 Dated: 23.10.2025**
2	Bid Security/Earnest Money Deposit (EMD)	**₹ 25,00,000/-**
3	Availability of NIT on the CPP Portal and website of NALCO	Date: 23.10.2025
4	Pre Bid query submission end date (through email only)	Date: 04.11.2025
5	Pre Bid Meeting Date & Place	Date: 07.11.2025, Time 11:00 AM
6	Last date of online submission of Bid	Date: 20.11.2025, Time 4:00 PM
7	Un Priced Part 1 bid opening date	Date: 21.11.2025 Time 4:00 PM
8	Announcement of Technically Qualified Bidders in the CPP Portal	To be announced later
9	Opening of Financial Bids	To be announced later at CPP Portal

1. Digitally signed single stage two-part bids are invited under the Domestic Open Tender basis, as per the procedure of the CPP Portal, in the prescribed format. Bids are invited from reputed and capable agencies that meet the qualifying criteria specified in the **Pre-Qualification Criteria** attached as (Annexure-I) and possess relevant experience. The

salient features of the tender are as detailed in the **Proposal Details section** of the Notice Inviting Tender (NIT).

2. The entire set of Bid & NIT/Tender documents duly signed by the Bidder needs to be uploaded in CPP Portal before the scheduled time of bid submission. Bids will be received up to last date and time specified or extended subsequently, as the case may be through e-tendering at CPP Portal, NALCO shall not be responsible for any expenses incurred by the bidders in bidding process in connection with the preparation & submission or any other expenses for their bids. The bidder should go through entire NIT/tender documents prior to bidding.
3. All other details can be seen from the Tender Document available on the on the CPP Portal (https://eprocure.gov.in/eprocure/app) and on the website of NALCO (https://nalcoindia.com). This Tender is on E-Tendering MODE and hence the bidders shall upload the bids on CPP Portal only. NIT published on the website of NALCO is for information only.
4. At any time prior to the deadline for submission of bids as well as up to priced bid opening, the Owner may, for any reason whether at its own initiative or in response to a clarification or modification requested by any prospective Bidder(s), modify the tender by way of an Addendum/amendments/corrigendum. Any Addendum / Amendment/corrigendum thus issued shall be part of the Tender and shall be binding on all Bidders. Bidder are requested to visit this website regularly to view/download notifications on Addendum/amendments/corrigendum before submission of their bid. NALCO shall not be responsible, for any omission or ignorance by any bidder in seeing the notifications on Amendments and/or Clarifications in the process of submission of their bid.
5. Clarifications, if any, regarding this tender can be obtained from Tender Inviting Authority.
6. Bidder(s) are advised to quote strictly a per terms & conditions of the tender documents and not to stipulate any deviations/exceptions.

Sd/-
Tender Inviting Authority on behalf of NALCO
Development Consultants Pvt. Ltd.

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PROPOSAL DETAILS

1	Name of the work/ service:	Design, Engineering, Supply, Erection and Commissioning of Alumina Unloading and Transportation System (AUT) on lump sum turkey basis.
2	NIT Reference Number	NALCO/CORPP/P&T/CONT/2025/052 Dated: 23.10.2025
3	Mode of Tendering (E-tendering)	Single stage Open Two Part, Part: - I Bid (Techno Commercial): Documents supporting to qualify BQC Experience & Financial, EMD and No- Deviation i.e. acceptance of Technical Specification, all bid conditions including scope. Part - II: Price bid
4	Location of the Work	Smelter Plant, National Aluminium Company Limited Angul, Odisha
5	Divisibility & Splitting of work	Not Applicable
6	Contract Duration	26 Months after Placement of LOA/BOA/Purchase Order
7	Minimum Workable Offer	Not Applicable
8	Pre-Bid Meeting Place:	Smelter Plant, NALCO, Angul, Odisha
9	Validity of Offer	06 (six) months from the bid due date/extended due date if any.
10	EMD	Rs. 25 lakh (Rupees Twenty Five Lakh only).
11	Warranty Period	Ref Cl. 11.0 of SCC
12	Integrity Pact	Applicable
	Details of Independent External Monitor	Ref. Cl 16.2.2 of ITB
13	Taxes & Duties.	GST shall be paid extra as per Applicable
14	Consortium Bidding	Permitted, subject to fulfilling the criteria as given Annexure-1
15	Price Variation Clause	Applicable (ref. SCC clause:29 & Annexure-B of SCC)
16	Interest bearing Mobilization Advance	Applicable
17	Contract-cum-Performance Bank Guarantee	Applicable at the rate of 10% of total contract value excluding GST (re. SCC clause:12)
18	Tender Inviting Authority	Mr. Sumanas Bhattacharyya, Dy. General Manager,

		M/s. Development Consultants Pvt. Ltd. Development Consultants House, 4th Floor Block DG-4, Sector-II, Salt Lake City Kolkata – 700 -091 Tel. No. : (033) 4012-5485 Mobile : 9830465906 E-mail : sumanasb@in.dclgroup.com
19	Contact Person for Bidding Process related queries	Mr. Sumanas Bhattacharyya, Dy. General Manager, M/s. Development Consultants Pvt. Ltd. Development Consultants House, 4th Floor Block DG-4, Sector-II, Salt Lake City Kolkata – 700 -091 Tel. No. : (033) 4012-5485 Mobile : 9830465906 E-mail : sumanasb@in.dclgroup.com
20	Site Contact person	Sri Bedabrata Arya, DGM(Mech), CRG, Smelter Plant, Email: bedbrata.arya@nalcoindia.co.in M- 9437094729
21	NALCO Corporate office contact person	1. Sunil Kumar Mishra General Manager (Civil) T&C, Email: sunil.mishra@nalcoindia.co.in M-9437495307 2. Matruprasad Behera Asst. General Manager (Civil), P&T Department Email: matruprasad.behera@nalcoindia.co.in M-9437963594
22	Address of NALCO	**Head Office:** Nalco Bhawan, P1, Nayapalli, Bhubaneswar-751013, Odisha **Site:** Smelter Plant, S&P Complex, Angul, Odisha
23	Address for physical Submission of required original documents	Mr. Sumanas Bhattacharyya, Dy. General Manager, M/s. Development Consultants Pvt. Ltd. Development Consultants House, 4th Floor Block DG-4, Sector-II, Salt Lake City Kolkata – 700 -091

PART –A
General Information

1. **Company Information**

1.1. National Aluminum Company Limited (NALCO), incorporated in 1981, is a premier Navaratna Public Sector Enterprise under administrative control of Ministry of Mines of Govt. of India in the field of Alumina/Aluminium having integrated multi-locational facility of Bauxite Mining, Alumna Refining, Aluminum Smelter, Power Generation and Port. NALCO has one of the major Aluminum production facilities consisting of Bauxite Mines, Alumina Refinery, Aluminium Smelter and Captive Power Plant, all located in the state of Odisha.

1.2. More details on NALCO can be viewed on company's website www.nalcoindia.com

2. **E-Procurement**

2.1. The bidder wishes to participate in the published tender should have his firm registered in the E-procure government portal (CPPP). Accordingly, bidder should do the registration in the tender site http://eprocure.gov.in using the option available. Then the Digital Signature registration has to be done with the e-token, after logging into the site. The e-token may be obtained from one of the authorized Certifying Authorities of Govt. of India such as MTNL / SIFY / TCS / nCode/ eMudhra / NIC etc. After that, bidder will login to the site through using his user ID & Password chosen during registration. The e-token that is registered should be used by the bidder and should not be misused by others.

3. **Bidding Process**

3.1. Bids needs to be uploaded and digitally signed in e-procurement site of CPP Portal (www.eprocure.gov.in) before the scheduled time of bid submission.

3.2. Bids will be received up to last date and time specified or extended bid due date, as the case may be through e-tendering at www.eprocure.gov.in.

3.3. NALCO shall not be responsible for any expenses incurred by bidders in connection with the preparation & submission of their bids, and other expenses incurred during bidding process.

3.4. The bidders are advised to submit the tender document online well in advance before the prescribed time to avoid any last-minute hitch / problem.

3.5. After the bid submission, the acknowledgement number generated by the e-tendering system should be printed by the bidder and kept as a record of evidence for online submission of bid for the tender.

3.6. Further, bid shall be evaluated based on documents furnished. So bidder must ensure that all relevant documents are furnished at the time of submission of offer.

3.7. This NIT is in two parts. The part -A is mainly General information, instructions to bidder, contract details, Scope of Work including detailed Technical specification, various forms, etc. and Part-B is price format. The bidder should go through full NIT before submission of bid.

3.8. Bidders are required to submit the hard copy of the followings in a sealed envelope and should reach to the office of Tender Inviting Authority by Speed Post/ Courier/By Hand before the due date & time of bid opening.

3.8.1. EMD in original: The bidders intending to participate in the tender should furnish Earnest Money Deposit for value as indicated in proposal details. In case of consortium bidding, the lead partner or other partner with authorization from the lead partner will submit the EMD. Copy of the same are also required to be uploaded in CPP Portal along with Bid documents.

3.8.2. EMD is a pre-requisite other-wise the Tender will be normally rejected. However the Public Sectors, Government agencies and the Firms registered with DGS&D/NSIC /District Industries Centers(DICs) / Khadi & Village Industries Commission(KVIC)/ Khadi & Village Industries Board (KVIB)/Coir Board/ Directorate of Handicrafts and Handloom or any other body specified by Ministry of Micro, Small & Medium Enterprises ,others for which specific exemption has been granted by NALCO such as Ancillary Industries etc and all Startups recognized by Department of Policy and Promotion (DIPP), Ministry of Commerce and Industry, Govt of India are exempted from payment of EMD. If the bidder desires the bidder may submit attested copy of certificate such as NSIC / MSME /other category mentioned above (for the service /work for which they are registered) for claiming EMD exemption. Bidder's claiming exemption for submission of EMD has to submit Bid Security Declaration as per attached format at Annexure-IXA

3.8.3. Affidavit in Original towards Litigation History duly signed after the NIT publication date.

3.8.4. The signed & sealed copy of "The Integrity Pact (Annexure-XXVI).

3.9. After downloading / getting the tender schedules, the bidder should go through them carefully and then submit the documents as asked. If there are any clarifications, this may refer online through the tender site, or through the contact details. Bidder should consider the corrigendum published before submitting the bids online. Bidders in their own interest should get ready in advance to submit the bid documents as indicated in the tender schedule. These documents should be in PDF / XLS / RAR formats. If there is more than one document, they can be clubbed together.

3.10. Bidder should clearly fill up the PQC Technical (Detailed work order and execution statistics) (Form B of Annexure-I), Financial Criteria (Form C of Annexure-I) and Details of present / concurrent commitments of the tenderer (Annexure–VIII) for his offer evaluation. Suppression of credential / facts may lead to penal action as per procedure defined in owner's internal Manual.

3.11. It is mandatory for the bidder to fill up the Annexure-XVII (Preference to Make in India 2017), Annexure-XVIII (Restrictions under Rule 144 (xi) of GFR 2017), Annexure-XX and Annexure-XXI (regarding declaration of the relatives in Nalco) and Annexure–IV (Deviation statement to the tender terms and conditions) and Annexure–VI (Declaration by the bidder) while submitting the offer.

3.12. Bidder should check his mail and CPP portal for any information regarding tender from time to time.

3.13. Nalco reserve the right to seek any document / information at later stage in respect of evaluation of bid which the bidder must submit failing which the bid may be rejected.

4. **Bid Pre -qualifying Criteria Evaluation (PQC)**

4.1. Evaluation will be done strictly based on documents uploaded by the bidders at tendering online platform CPPP.

4.2. In-house work experience, shall not be considered as valid experience for the purpose of pre-qualification.

4.3. In case of noncompliance to the PQC requirement, i.e. any shortfall documents arise out of submitted technical as well as commercial credential submitted within tender submission date, NALCO may its own discretion request bidder to upload shortfall documents within a stipulated date. No new documents would be called up as part of PQC experience documents.

4.4. In case any specific adverse report is received against any bidder and proved to be correct after enquiry about the statement made / credential submitted along with the offer documents in respect of capabilities, spare capacities, performance, completion certificates and criminal background of the bidder, the offer submitted by such bidder shall be rejected and penal action as deemed fit may be initiated.

4.5. Present / Concurrent commitment: - The present / concurrent commitments of bidder on various jobs under execution by the bidder will be considered to assess the spare capacity available with the bidder. The bidder must confirm that they have disclosed all the works being executed by them in the offer. If the annualized present / concurrent commitments of the bidder plus annualized estimated value of the work (for single agency)/ annualized estimated maximum percentage of work in split case under consideration (for multiple agency) exceeds four times the average annual financial turnover during the last three financial years of the bidder, then the bid of such a bidder shall not be considered for further evaluation. Suppression of fact /data regard to jobs under execution will be considered as gross violation and rejection of bid including penal action such as banning/ blacklisting, as deemed fit.

4.6. The bidder has to submit complete list of present / concurrent commitments on all jobs under execution by them, which will be taken into account to assess the spare capacity available with the bidder.

4.7. Present / Concurrent Commitment of the bidder shall be evaluated as on the last day of the Month previous to bid due date of submission, based on the confirmation / declaration of the bidders that they have disclosed all works being executed by them. Bidders shall exclude all stalled project for which there is no progress in last one year giving reason for no progress considering above cutoff date. In case any adverse report / complaint is received against bidder and on enquiry found correct, offer shall be rejected and bidder shall be liable for appropriate legal action.

4.8. In-house information for assessment of capability of bidder and their performance on jobs completed / in progress at NALCO shall be considered for evaluation purpose. In case of poor performance, the offer from such bidders shall not be evaluated.

4.9. Nalco reserve the right to seek any document information at later stage in respect of evaluation of bid which the bidder has to submit failing which the bid may be rejected.

5. **Award / Ordering**

5.1. In normal circumstances the party in whose favor the work is awarded shall be issued with LOI/LOA/BOA/Purchase Order. The party shall have to enter into an agreement in writing on non-judicial stamp paper of appropriate value as laid down in the GCC. The agreement normally consists of LOI/LOA, BOQ at the accepted rate, complete bid documents, Schedule of Agreed Variation (if any) etc. The documents such as, correspondences, minutes of meeting, (if held with the party) etc. shall also form part of the contract agreement if required.

6. General Conditions of Contract (GCC) will be a part of the NIT. Attached Separately.

Annexure –A1

INSTRUCTIONS TO BIDDERS

1. **GENERAL**

1.1. DCPL, acting as the EPCM Consultant on behalf of NALCO invites Bids under single stage two bid system, for the entire work covered under the Bidding Document – "Design, Engineering, Supply, Erection and Commissioning of Alumina Unloading and Transportation System (AUT)" on LSTK basis. All bids are to be completed and returned in accordance with and within the time provided in these Instructions to Bidders. This Bidding Document is on National Competitive Bidding Basis.

1.2. It shall be the bidder's responsibility to have a thorough understanding of the reference documents, site conditions and specifications included in the Bidding Document and take the same into account while submitting his bid for the above work.

1.3. Notwithstanding the sub-division of the documents into these separate sections and columns, every part of each shall be deemed to be supplementary to and complementary to every other part and shall be read with the contract. The Bill of Quantities shall be read in conjunction with the drawings, Conditions of Contract and the Specifications as these documents are jointly explanatory and descriptive of the works included in the Contract.

1.4. The Bidder shall carefully study the provisions contained in the Bidding Document and specifications and quote his prices accordingly.

2. **BIDDING DOCUMENT, CLARIFICATIONS AND AMENDMENTS**

2.1. **Bidding Document:** The Bidding Document shall consist of NIT i.e. General Information, Instruction to Bidders (ITB), scope of works and Technical specifications, Special condition of contract(SCC), General condition of contract(GCC), etc. and should be read in conjunction with any amendment(s) and/or clarification(s) issued subsequently.

2.2. The Bidder is expected to examine the complete Bidding Document. Failure to furnish all information required as per the Bidding Document or submission of a bid not substantially responsive to the Bidding Document in every respect could result in rejection of the Bid.

2.3. Bidding documents are exclusive documents of 'OWNER' and once downloaded are non-transferable and shall at all times remain the exclusive property of 'OWNER' with a license to the intending Bidder to use the Bidding Documents for the limited purpose of submitting the bid.

2.4. Bidder should submit their offer as per procedure detailed of this tender document. Bidder should upload all document requested in the envelope-1 and the price part to be furnished in the price bid in excel format uploaded on the e-procurement portal (Part 2).

2.5. Although the details presented in this bidding document have been compiled with all reasonable care, it is the Bidder's responsibility to ensure that the information provided is adequate and clearly understood.

2.6. **Amendment to Bidding Document**

2.6.1. Owner may, for any reason whether at its own initiative or otherwise, issue Amendments and/or Clarifications during the bidding period which shall be hosted on e-procure website (www.eprocure.gov.in) and become part of Bidding document. Bidder should take note of all amendment and/or Clarifications while submitting their bid.

2.6.2. The bidder is advised to visit the websites from time to time to verify updates/ Amendments and/or Clarifications to the tender documents, if any.

2.7. **Confidentiality of Document**

2.7.1. Bidder shall treat the Bidding document and contents thereof as confidential and should not use for any other purpose except for participation in the bid.

3. **SITE VISIT:**

Bidder is advised to visit and examine the site and its surroundings at their own cost and shall familiarize themselves on the existing facilities and environment, and shall collect all other information which it may require for preparing and submitting the bid and entering into the contract. Claims and objections due to ignorance of existing conditions or inadequacy of information will not be considered after submission of the bid and during implementation/execution of the order.

4. Pre-bid Meeting:

A Pre-bid meeting shall be held on date mentioned in Proposal detail in Physical / Hybrid mode. Following points are to be noted:

a) All prospective bidders should submit a List of clarification required before the pre-Bid meeting if they require any clarification on the tender documents/drawings etc.

b) If the bidder feels that The Tender specification is with sufficient details they can attend the "Pre Bid meeting" without submitting the "List of clarification".

c) It may be noted that no clarification will be replied or entertained by the owner during "Pre-bid meeting" if not submitted earlier, except in exceptional cases.

d) Any failure by bidder to comply with the aforesaid requirement shall not excuse the bidder, after subsequent award of contract, from performing the work in accordance with the contract.

e) The Addendum/Corrigendum to the tender documents based on the Pre-bid discussion, (if any) shall be uploaded on CPP Portal e-procure web site (www.eprocure.gov.in) only. Bidders may download the same from site.

f) Bidders are expected to resolve all their clarification/ queries to the bidding document and submit their bid in total compliance to biding document without any deviation/ stipulation/ clarification.

5. PERIOD OF VALIDITY OF BIDS:

5.1 Bid shall remain valid for acceptance for a period of 6 (Six) months from the due date/ extended due date of the bid. The Bidder shall not be entitled to revoke or cancel its bid or change the bid except and to the extent required by Owner in writing during the bid validity period.

5.2 Notwithstanding the above, the OWNER may solicit the bidder's consent to an extension of the period of bid validity beyond the above period. The request and the responses thereto shall be made in writing.

5.3 In case the validity of offers expires during the processing of the case, all the techno-commercially accepted bidders shall be requested to extend the offer validity with same price and terms & condition of the tender. The offers of such bidders shall be rejected if they do not extend the validity unconditionally.

6. **Compliance to Bidding Requirement**

6.1.1. The Bidders are required to submit offers strictly as per the terms and conditions/ specifications given in the Bidding document without any deviations.

6.1.2. However, in exceptional cases, if the Bidder wishes to stipulate any deviations to bidding requirements, they shall indicate the same as per the format for exceptions/

deviations in Annexure-IV. Bidder shall note that clarifications/ queries/ deviations mentioned elsewhere in the offer shall not be given any cognizance.

6.1.3. If any exception/ deviation is acceptable to OWNER, the same shall be issued to all bidders through an amendment. Bidders shall withdraw all other deviations/ exceptions, not incorporated in amendment, failing which offer of such bidders shall not be acceptable.

6.2. Bidder is advised that OWNER intend to fully evaluate the technical and un-priced commercial submissions.

6.3. It is important that Bidder clearly demonstrates its experience and capability, giving to OWNER a high level of confidence that if awarded, the Bidder will be able to perform the works within the stipulated Time Schedule and quoted price and meeting all other requirements listed in the Bidding document.

6.4. Bidder is requested to furnish the complete and correct information required for evaluation of his bid. If the information with regard to resources or any other information/ documentation forming basis of evaluation is found incomplete/ incorrect, the same may be considered as adequate ground for rejection of the bid.

7. **EARNEST MONEY:**

7.1. The tenderer must pay Earnest money (EMD) as given in the Proposal Detail. Tenders not accompanied with earnest money deposit will be rejected. The earnest money shall be paid in the shape of account payee demand draft / banker's Cheque/ pay order from any Nationalized or Schedule bank in favour of **National Aluminum Company Ltd** payable **at Bhubaneswar** or through online bank transfer or Bank Guarantee in Prescribed format from NALCO approved bankers.

7.2. The Bank Guarantee so furnished by the tenderer shall be only in the proforma prescribed by NALCO and valid for three months more than the bid validity period i.e in case bid validity is six months, the BG should be nine months from the date of opening of the tender. The issuing Bank should be advised to send a direct confirmation to NALCO, clearly indicating the Tender No., towards issue of the Bank Guarantee. The Bank Guarantee for Earnest Money Deposit shall remain un-discharged for such a period as may be specified for keeping the tender open. The validity of the EMD BG may have to be extended by the bidder on request of NALCO,

till the tender is finalized. No interest shall be paid by **NALCO** on the Earnest Money deposited by the tenderer.

7.3. The Public Sectors, Government agencies and the Firms registered with NSIC/ MSME, and other such as Ancillary Industries etc. for which specific exemption has been granted by Nalco shall be exempted from submission of EMD. Bidder shall submit the attested documentary evidence in support of the same. Bidder's claiming exemption for submission of EMD has to submit Bid Security Declaration as per attached format at Annexure-IXA

7.4. **Guidelines for submission of EMD online for tenders**

7.4.1. Through online bank transfer. The transaction confirmation document generated through online transaction, giving details of transaction is required to be provided as a separate document. The credit of EMD in NALCO Bank account would be confirmed before acceptance of bid. If the transaction is not reflected or reflected with wrong reference as on TOD or credited subsequently, then the bid shall be considered to be unaccompanied by any EMD and the bid will be liable for rejection. Bidder submitting EMD through online mode shall submit Annexure-IX after making the payment of EMD to NALCO on the same day of payment by NEFT/RTGS/E-Transfer, along with copy of Transaction Slip/Receipt, by **email to:** sunil.mishra@nalcoindia.co.in, awadhesh.gupta@nalcoindi.co.in

7.4.2. A copy of the Annexure-IX and Transaction slip/receipt of the Bank shall also be submitted along with Tender Document in Techno-Commercial Documents.

7.5. EMD of the unsuccessful bidder shall be released after acceptance of Techno commercial offers by competent authority / award of work as the case may be. EMD of successful bidder shall be returned after signing of agreement and submission of Contract cum Performance Deposit / Contract cum Performance Bank Guarantee.

7.6. The EMD shall be forfeited without any notice on any of the following situations.

7.6.1. On withdrawal of offer after expiry of submission date & time of bid offered.

7.6.2. At any point of time if it is found that the party has committed any fraud/ submitted any false declaration in his offer.

7.6.3. In case the bidder / contractor is disqualified from the bidding process in terms of section 3,4 & 5 of Integrity pact.

8. **PRE-QUALIFICATION CRITERIA (PQC):** Offer of the firm fulfilling the Pre-Qualification Criteria as mentioned in **Annexure- I** shall be evaluated as detailed in Evaluation Method of the bid document

8.1. The bidders are required to submit documentary evidences for technical experience and financial capabilities as part of Pre-Qualification Criteria (PQC).

8.2. It may be noted that the details of documents submitted in support of the PQC for Technical & Financial capabilities are to be specified in formats attached as Form-A. Form-B & Form-C along with Annexure-. If no references are found in the stated Annexures and the bidder gets disqualified, non-cognizance of such documents by NALCO, even if attached somewhere else as part of bid documents, will not be seen as a deficiency in proper evaluation of such documents. Hence, bidders may ensure that such documents are invariably referred in the below-mentioned Annexures.

8.2.1. Technical/Experience Criteria: Annexure-I

8.2.2. The work experience should be of “Working directly” and possess relevant experience as per the details given under experience criteria.

8.2.3. The Experience/Completion Certificates shall be considered only when it bears the Name and Designation of Issuing Authority. This is only applicable for Experience/Completion Certificates issued after 30/06/2022.

8.2.4. Financial Criteria: Annexure-I

8.2.5. Solvency certificate from bank indicating credit limit enjoyed & financial soundness.

8.2.6. The bidder should possess independent EPF, ESI, PAN & PAN based GST registration certificates respectively from the concerned Regional Provident Fund Commissioner for PF, Independent Account Code from concerned Regional Director ESIC for ESI, Direct Tax Authorities for PAN and Indirect Tax Authorities for GST, as applicable.

8.2.7. Litigation history for criminal background: Annexure-VII

8.3. The present / concurrent commitments of bidder on various jobs under execution by the bidder will be considered to assess the spare capacity available with the bidder. Bidders are required to fill Annexure-VIII for calculation at our end. Suppression of fact and figures will liable to cancellation of bid and penal action as per rule.

8.4. **Consortium Bidding:** Permitted

9. **CONFLICT OF INTEREST**

9.1. A Bidder shall not have a conflict of interest that may affect the Selection Process or the Consultancy (the "**Conflict of Interest**"). Any Bidder found to have a Conflict of Interest shall be disqualified.

9.2. Each Bidder shall submit only one bid either by himself, or as a partner in a joint venture or consortium, if so permitted in the Bidding Documents. A Bidder who submits or participates in more than one bid in this bidding will be disqualified from the bidding.

9.3. In the event of disqualification, NALCO shall forfeit and appropriate the Bid Security as mutually agreed genuine pre-estimated compensation and damages payable to NALCO for, *inter alia*, the time, cost and effort of NALCO including consideration of such Bidder's Proposal, without prejudice to any other right or remedy that may be available to NALCO hereunder or otherwise.

9.4. NALCO requires that the agency provides professional, objective, and impartial advice and at all times hold NALCO's interest paramount, avoid conflicts with other assignments or its own interests, and act without any consideration for future work. The agency shall not accept or engage in any assignment that would be in conflict with its prior or current obligations to other clients, or that may place it in a position of not being able to carry out the assignment in the best interests of NALCO.

10. **PREPARATION AND SUBMISSION OF BID**:

10.1 The Bidder is required to submit digitally signed bids through the CPP Portal. The Bidder shall along with its techno-commercial Bid submit one set of the Tender Document duly signed and stamped on each page in original, in token of its acceptance.

10.2 The Bidder should submit the Bids in Part-1 & Part-2 as mentioned below, in the CPP Portal, within the stipulated Bid Submission due date & time. Bids submitted outside CPP Portal shall not be accepted.

10.2.1 Part – 1: Techno-Commercial Unpriced Bids:

a. EMD Instrument (On line transfer details / Bank Guarantee). If Exemption claimed requisite documents along with bid security declaration.

b. Proof of credentials for qualifying pre-qualification criteria (Experience & Financial) along with filled up formats as Form-A, Form-B & Form-C of Annexure-I, with all

supporting documents (Copy of work order, completion certificate, performance certificate, Financial statement of last three financial year, etc.).

c. Pre-contract Integrity Pact as per Annexure-XXVI

d. Duly filled up formats i.e. Mandatory information of bidders (Annexure-II), Exemption / deviation Statement (Annexure-IV), Forwarding letter and undertaking (Annexure-V), Declaration of bidder (Annexure-VI), Litigation History & Criminal Background (Annexure-VII), Details of present commitment (Annexure-VIII), Social accountability policy (Annexure-XIV), Compliance of General Environment (Annexure-XV), Social Accountability 8000 compliance format (Annexure-XVI), Declaration for Preference to Make in India (Annexure-XVII), Restriction on procurement (Annexure-XVIII), Anti Profiting declaration (Annexure-XIX), Declaration of Relative in NALCO (Annexure-XX & Annexure-XXI), Bank Mandate form (Annexure-XXII), Solvency Certificate, etc. along with checklist format as per Annexure XXV duly filled.

e. All Technical details, Drawings, Data Sheets, Catalogues / Literatures etc.

f. Un-priced copy of price bid without price figures (which will be exact copy of priced BOQ except for replacement of only price figures wherever appearing by word “quoted”).

g. Tender documents along with corrigendum / addendum, if any dully digitally signed as token of acceptance to tender’s terms & conditions.

Note - The Part-I Bid (i.e. Un-priced Bid) shall be uploaded in “BQC / TECHNICAL” folder in Central Public Procurement Portal (CPPP) of Government of India https://eprocure.gov.in/eprocure/app.

For Technical Bid, the bidder must prepare all the required documents and then upload the soft copies of the documents in CPP Portal.

10.2.2 Original hard copy (as uploaded in soft copy at CPP Portal) of the following document/s in a sealed envelope (cover-1), (the sealed envelope should be super scribed with the tender no.) should be sent to the address mentioned at Proposal details:

a. Original EMD documents

b. Integrity Pact (As per Annexure - XXVI)

c. Original copy of certificates/ undertakings/ affidavits/ declaration asked for in NIT.

d. Original copy of any other information/details/documents/data required as per our NIT Documents.

e. A certificate by the bidder stating that the hard copy of documents/certificates submitted is same as the on-line documents/certificates uploaded by them in Central Public Procurement Portal (CPPP).

10.2.3 **Part-II Bid (i.e. Priced Bid) ("FINANCE"):** The Part-II Bid i.e. Priced Bid should contain the prices strictly as per the Excel format as indicated in the bid document (BOQ/Schedule of Price/Price bid) of the tender documents. Prices shall not appear anywhere else in the offer.

Note- The Part-II Bid (i.e. PRICED BID) shall be uploaded in "FINANCE" folder in Central Public Procurement Portal (CPPP) of Government of India https://eprocure.gov.in/eprocure/app. All fields in the BOQ must be filled by the bidders.

11. **NUMBER OF BIDS:**

A Bidder shall not submit more than one Bid either directly or indirectly. Alternative bids will not be considered.

12. **BID OPENING AND EVALUATION**

12.1. **Opening Part-I of bid**

12.1.1 On the bid due date and time mentioned in 'Notice Inviting e-Tender' or extended bid due date as the case may be, the techno-commercial unpriced bids i.e. Part-I of the bid will be opened by tender inviting authority or his representative on the CPP Portal e-procure site following e-tendering procedure. In the event the specified date of bid opening being declared a holiday for owner, the bid shall be opened at the appointed time on the next working day.

12.2. **Clarification and Additional Information**

12.2.1 During evaluation of Part-I bid, NALCO, may request Bidder for any clarification on the bid, additional or outstanding documents. Bidder shall submit all additional documents as requested without any delay. In case of delay NALCO reserve the right to evaluate the offer based on the available document or may reject the offer because of non-compliance.

12.2.2 Post bid correspondences may be made over e-mail. The bidders are advised to furnish authorize e-mail id along with an alternative e-mail for all communications in

the format for bidder information. Mail received from the authorized or the alternative mail ids shall only be accepted.

12.3. **Techno-Commercial Discussions**

12.3.1 Techno commercial discussions with Bidder shall be arranged, if needed. Bidder shall depute his authorized representative(s) for attending such discussions with authorization to attend the discussions and sign the minutes of meeting on behalf of his organization. The authorized representative(s) must be competent and empowered to settle all technical and commercial issues with the exception of Price implication, wherever applicable.

12.4. **Condition for Bid Evaluation:**

12.4.1 Bid is the responsibility of Bidder and no relief or consideration can be given for errors and omissions made by the Bidder inadvertently or advertently for what so ever reason. Bid with incomplete information is liable for rejection.

12.4.2 NALCO reserves right to call for original of the supporting documents for verification if so deemed fit and also cross-check for any details as furnished by the bidder from their previous clients etc. Bidder shall have no objection whatsoever in this regard.

12.4.3 Non-submission of details/ documents may lead to rejection of bid.

12.4.4 The bid shall be evaluated as per Pre-qualifying criteria spelt out in the Tender document. The bidder not meeting the PQ requirement shall not be evaluated further and shall summarily be rejected. Techno-commercial part of those bidder shall be evaluated those who meet PQ Criteria.

12.4.5 Performance of Bidder on works executed/ under execution in NALCO may also be taken into consideration before selecting the Bidder for opening of his Techno Commercial bid.

12.4.6 In the techno commercial evaluation, only the techno commercial conditions (if any) spelt out by the bidder for the subject tender will be evaluated.

12.4.7 Bidder shall not be allowed to submit any Price Implication or Revised Price after submission of Bid, unless there is change in the stipulations of the Tender Document and such changes are incorporated through an Addendum / Amendment. In case Exceptions and Deviations submitted by Bidder along with Bid are not considered as acceptable and no Addendum / Amendment is issued, then in such a case the Bidders would be required to withdraw such Exceptions/Deviations in favour of

stipulations of the Tender document, and Bidders would not be eligible for submission of Price Implication/Revised Price. In case of withdrawal of deviations to NIT specification, if any bidder insists for revision in price before opening of price bid and Nalco agrees for the same, the submission of price implication shall be in offline mode from the bidder in a sealed envelope/password protected file through e-mail within a stipulated time. The submission of price implication shall be intimated for information to all other techno-commercially acceptable bidders.

12.4.8 In case of necessity due to post tender changes in specifications/scope of work/terms & conditions of NIT etc. before price bid opening, corrigendum shall be issued regarding the changes to all concerned techno-commercially qualified bidders and they shall be permitted to submit the corresponding price implication if any in offline mode in Sealed envelope /password protected file through e-mail within a stipulated time.

12.4.9 The price implication submitted in offline mode by the bidders shall be opened and uploaded in CPP portal (preferably as part of techno-commercial evaluation summary while configuring price bid opening) before opening of original price bids for information of all the participating bidders. The evaluation will be done taking into account the original on-line price bid along with offline price implications.

12.4.10 In no case bidder shall be allowed to submit revised price bid post bid submission date.

12.5. **Opening of Price Bid**

Part-II - Price Bids of only those bidders, whose bids are techno commercially acceptable shall be opened following e-tendering procedure on CPP Portal after publishing the date of opening of Price Bids on the web site.

12.6. **Process to be confidential**

Information related to the examination, clarification, evaluation and comparison of bids and recommendations for award of contract shall not be disclosed to Bidder or other person not officially concerned with such process. Any effort by Bidder to influence the Owner's processing of bidding or award decisions may result in rejection of such Bidder's bid.

13. **OWNER'S RIGHT TO ACCEPT / REJECT BIDS, NEGOTIATION AND AWARD OF WORK:**

13.1. The OWNER/CONSULTANT reserves the right to accept or reject any bid and/or to annul the bidding process and/or reject all bids at any time prior to award of Contract without thereby incurring any liability to the affected bidder(s) or any obligation to inform the affected bidder(s) of the ground of OWNER's/CONSULTANT's action.

13.2. Bidders are requested to quote their best prices considering the fact that price negotiation, if required, may be held only with the lowest bidder. As a result of negotiation, Bidder may offer rebate on his earlier quoted price. However, no uncalled for or voluntary rebate offered shall be considered for evaluation.

13.3. The OWNER shall not be obliged to award the Contract to the lowest evaluated bidder if the OWNER apprehends that it will not be in the interest of the OWNER or the work to award the Contract at the lowest evaluated price or to the lowest evaluated bidder.

13.4. **Award of Work:**

Successful L1 Bidders may note that, Letter / Fax of Acceptance or work order issued to them is based on acceptance of their offer and the contract is binding on the bidder. Bidder may return a copy of the same duly signed by the authorized representative as a token of acknowledgement of receipt.

14. **EXECUTION OF AGREEMENT:**

14.1. The successful bidder shall have to execute an agreement on non-judicial stamp paper of Rs.100/- purchased in the name of the bidder from any registered stamp vendor under the jurisdiction of the Orissa Court, in the specific format of NALCO.

The Contract document shall consist of the following:

a) Original Bidding Document issued with its enclosures including General Conditions of Contract, Special Conditions of Contract, Drawings, Specifications etc.

b) Amendment(s)/Addendum/corrigendum, if any issued, to Bidding Document.

c) The Brief Order of Acceptance issued by the Owner.

d) Pre-Contract Integrity Pact

e) Any other document as may be decided by the Owner.

14.2. No bill shall be payable unless the agreement is signed.

15. **LANGUAGE:** The bid and all correspondence incidental and related to bid shall be written in English language. Any printed literature and document submitted in any other language shall be accompanied by authenticated English translation, in which case, for the purpose of interpretation of the bid, English translation shall govern. Responsibility for correctness in translation shall lie with the agencies.

16. **INTEGRITY PACT:**

16.1. Bidders are required to unconditionally accept the "Integrity Pact (IP)" (executed on plain paper), as per format attached at Annexure-XXVI, and submit the same duly signed on all pages by the Bidder's Authorised Signatory in a separate sealed envelope along with EMD and other documents at the address specified. Same shall also be uploaded in CPP Portal along with the unpriced offer. Bidder's failure to comply with the aforesaid requirement regarding submission of Integrity Pact (IP) shall lead to outright rejection of their offer as being non-responsive and shall not be opened.

16.2. **Independent External Monitor [IEM]**

16.2.1 In respect of this Tender, the Independent External Monitor (IEM) would be monitoring the Bidding Process and execution of Project Agreement to oversee implementation and effectiveness of the Integrity Pact Program.

16.2.2 NALCO has a panel of Independent External Monitor (IEM), the details are as follows:

a. Smt. Deepa Krishan IRS (Retd.), E-mail: deepakrishan@gmail.com

b. Dr. Meeran C Borwankar IPS (Retd.), E-mail: mcborwankar@gmail.com

c. Mr. Hare Krushna Dash IAS (Retd.), E-mail: hkdash184@hotmail.com

16.2.3 Bidder may write to the panel of IEMs through E-mail only for matters related to the Integrity Pact giving details of the Tender reference, name of the Tender issuing officer and Nalco's Unit for quick identification of the Tender by the IEM.

16.2.4 Queries of general nature, on terms and conditions etc. should not be addressed to the IEMs and may be referred to the Tender Inviting Authority (TIA).

16.3. The Format of the Integrity Pact to be signed and submitted by the Bidders as per Annexure-XXVI

17. **CONTRACT CUM PERFORMANCE SECURITY / CONTRACT CUM PERFORMANCE BANK GURANTEE (CPBG): -**

17.1. The Contractor may submit Bank Guarantee against Contract cum Performance Security as CPBG as applicable and indicated in NIT. The contractor shall submit a Bank Guarantee in NALCO's approved format from NALCO's approved bankers only.

17.2. The BG will not carry any interest.

17.3. The CPBG shall remain valid for three months beyond the warrantee period.

17.4. The issuing Bank must agree that the issued Guarantee shall be invokable Bhubaneswar i.e. NALCO place of business. Accordingly issued Bank must intimate detail address of their branch at Bhubaneswar, Odisha.

17.5. The successful Bidder, to whom the work will be awarded, shall be required to furnish Contract cum Performance Security / CPBG within 21 days from the issue of Letter of Acceptance.

17.6. In case the successful bidder fails to submit Contract cum Performance Security / CPBG within a period of 21 days from the date of issue of work order/ LOA, the penalty @ 10% per annum will be applicable from the date of issue of LOA till the date of submission of Contract cum Performance Security / CPBG

17.7. The Contract cum Performance Security / CPBG will be returned to the agency without any interest subject to fulfilment of all contractual obligations by the Agency after completion of all contractual obligation, settlement of final bill and successful completion of warrantee period.

18. **ORDER OF PRECEDENCE:**

18.1. If conflicts between documents, comprising the contract arise, the following shall prevail in the order:

- FOI/LOI/LOA/WO including any agreed variation.
- Schedule of rates/Bill of Quantity
- Technical specifications
- Drawings
- Special Conditions of Contract
- Instruction to Bidders
- General Condition of Contract
- Relevant Indian Standards

19. **GUARANTEES, LIABILITIES & PENALTY**

19.1. **CARE AND DILIGENCE:** The Agency shall exercise all reasonable skill, care and diligence in the discharge of the services agreed to be performed by him. If in the performance of his services, the agency has discretion exercisable as between the Client and any third party, the agency shall exercise his discretion fairly.

19.2. The agency shall guarantee that the work and services as specified and described in the Contract shall be executed in accordance with sound and established engineering practices, using international standards, Indian codes and regulations, wherever applicable.

19.3. For delay analysis, maintaining of Hindrance Register is essential.

20. Bidders may note that Letter of Acceptance (LOA) / Brief Order / Work Order placed, is in acceptance of their offer by NALCO and shall be binding on them. However, the bidder has to return a copy of LOA / Brief Order / Work Order duly signed by them or their authorized representative as a token of receipt of the same within fifteen days of issue of the same for our records.

21. Any communication such as Letter, BO, LOA, WO etc. shall be communicated to the Bidder through **Registered post/ Speed post/ e-mail/ Hand delivery.** Any communication through any one or more of above modes shall be valid and binding on the Bidder.

22. Financial implications of the agreed deviation as per assessment of NALCO will be loaded on the price quoted by the bidder. Deviation not accepted by NALCO will have to be withdrawn by the bidder otherwise such bids may be disqualified/rejected.

23. **TAXES & DUTIES:**

23.1. Rate variation in Taxes and any new promulgated taxes after last date of the submission of price bid only on the goods and/or services applicable to invoices raised on NALCO within the contractual delivery date /period (including extension approved if any) shall be on NALCO's Account against submission of documentary evidence.

23.2. It would be the responsibility of the agency to get the registration with the respective Tax authorities under provision of GST. Any taxes being charged by the Agency would be claimed by issuing proper TAX Invoice in a GSTN (Goods & Services Tax Network) acceptable format indicating details elements of all taxes charged and necessary requirements as prescribed under the respective tax laws and also to

mention his correct and valid GSTN number along with NALCO's GSTN number as applicable for particular supply on all invoices raised on NALCO under GST Regime.

23.3. The agency would be liable to reimburse or make good of any loss/claim by NALCO towards tax credit rejected /disallowed by any tax authorities due to non-deposit of taxes or non-updating of the data in GSTIN network or non-filling of returns or noncompliance of tax laws by the agency by issuance of suitable credit note to NALCO. In case, Agency does not issues credit note to NALCO, NALCO would be constrained to recover the amount including interest payable along with statutory levy/Tax, if any, payable on such recovery.

23.4. Tax element on any Debit Note / Supplementary invoice, raised by the Agency will be reimbursed by NALCO as long as the same is within the permissible time limit as per the respective taxation laws and also permissible under the Contract terms and conditions. Agency to ensure that such debit Notes are uploaded while filing the statutory returns as may be prescribed from time to time.

23.5. The Agency will be under obligation for quoting/charging correct rate of tax as prescribed under the respective Tax Laws. Further the Agency shall avail and pass on benefits of all exemptions/concessions/benefits/waiver or any other benefits of similar nature or kind available under the Tax Laws. In no case, differential Tax Claims due to wrong classification of goods and/or services or understanding of law or rules or regulations or any other reasons of similar nature shall be entertained by NALCO.

23.6. In case, NALCO's Input Tax Credit (ITC) is rejected on account of wrong levy of tax i.e. payment of Integrated Tax in place of Central Tax+ State/Union Territory Tax or vice versa, the Agency is liable to make good the loss suffered by NALCO by issuance of suitable credit note to NALCO. In case, Agency does not issue credit note to NALCO, NALCO would be constrained to recover the amount including interest payable along with statutory levy, if any, payable on such recovery.

23.7. NALCO shall reimburse GST levied as per invoice issued by the Agency as prescribed under section 46 of the CGST Rules 2017 and respective states Act and Rules.

23.8. To enable NALCO to avail ITC, the Agency/supplier shall furnish/submit any and all certificates, documents and declarations as are required by NALCO to avail of the ITC with respect to GST reimbursed by NALCO on materials sold to NALCO.

23.9. The HSN Code under which the goods/service will fall should be clearly mentioned along with the Rate at the time of submission of invoice for releasing payment.

23.10. In case, NALCO is not able to take Input Tax Credit due to any noncompliance/default/negligence of the seller, the same shall be recovered from the pending bills/dues (including Contract Performance BG etc).

23.11. Seller shall be responsible to indemnify NALCO for any loss, direct or implied, accrued to NALCO on account of supplier's failure to discharge his statutory liabilities like paying taxes on time, filling appropriate returns within the prescribed time etc.

23.12. Any benefit by way of reduction in rate of tax or increase in input tax credit arising due to introduction of GST shall be passed on to NALCO through reduction in supply value by way of commensurate reduction in Bill value.

23.13. Any deductions/penalties levied on Agency as per the terms of the contract shall attract GST and the Agency is liable to pay the same at applicable rate along with the penalty/deduction amount.

24. **TAX DEDUCTION AT SOURCE UNDER GST**

24.1. As per section 51 of CGST Act 2017, Nalco shall deduct at source @ 1% CGST & @ 1% SGST for intra state transaction and @2% IGST in the case of interstate transaction from the payment made or credited to the supplier of taxable goods and/or services, provided if the contract value is exceeding Rs.2,50,000/-.

24.2. However, no deduction shall be made if the location of the supplier & the place of supply is in a state or union territory, which is different from the recipient's registration state.

25. **DEDUCTION OF INCOME TAX & ANY OTHER TAX :**

25.1. Notwithstanding anything contained elsewhere in the contract, NALCO shall deduct at source from the payment due to the contractor, the taxes as required or as amended from time to time or under any statute. The amount so deducted shall be deposited by NALCO with the appropriate Authorities as per Law. It is for the contractor to deal with THE appropriate Authorities directly in respect of any claim or

refund relating to the above deductions and NALCO shall not be liable or responsible for any claims or payments or reimbursement in this regard.

25.2. Income Tax as applicable at the prevailing rate on the gross amount billed shall be deducted from the agency's bills.

25.3. Income Tax TDS, as applicable at the prevailing rate on the gross amount billed shall be deducted from the contractor's bills.

25.4. Any other statutory tax, as applicable shall be deducted at source.

26. **STATUTORY PROVISIONS:**

26.1. The agency shall abide by various statutory provisions to the satisfaction of Central/State Government Authorities. The agency has to comply with provisions made in various statutes such as The Contract Labor (Regulation & Abolition) Act 1970, the payment of Bonus Act 1965. The Employees compensation Act 1923, The Employees Provident Fund & Misc. provisions Act 1952, The Employees State Insurance Act 1948, The Payment of wages Act 1936, The Minimum wages Act 1948, The Industrial Disputes Act 1947, The Factories Act 1948, and the Orissa factory Rules and all the rules made there under at his own cost.

26.2. PF Account and ESI Code: Applicable for the Present Work

27. **PAYMENT OF WAGES TO ENGAGED LABOUR AT SITE: Applicable**

27.1. Payment of wages to the labour employed by the contractor shall be as per the Central Government notification fixing minimum wages for different categories of labour in Central Public Enterprises from time to time along with additional component as decided by NALCO time to time. The contractor shall have to make labour payment accordingly, along with applicable statutory benefits.

27.2. As per statutory provisions, contractors will have to pay the monthly wages of contract labourers latest by 10th of subsequent month as well as deposit the statutory contributions within due date. In case of failure to do so, NALCO as principal employer will pay wages/release the payments to the concerned labourers at any time after the 10th of subsequent month without any further intimation.

27.3. If the date of payment is beyond 10th of subsequent month or there is direct payment, Nalco reserves the right to recover up to 25% as administrative charge on the amount of labor payment plus GST on administrative charges in the RA/Final Bill.

27.4. The contractor failing to make payment of labour wages as per applicable Law, may be debarred / banned for conducting future business with NALCO.

28. **LABOUR LAWS:** The successful bidder shall abide by all applicable statutory provisions in respect of workmen deployed by him to the satisfaction of Central & State Government Authority. The contractor shall comply with the provisions of all statutes and amendments thereof at their cost for different legislations as under. The contractor shall have to abide by and comply with any Modification/ Change/ Amendment to the existing laws or introduction of any new law relating to the work and rules framed there under from time to time. The list is indicative and not exhaustive as Building & other Construction Workers (RE & CS) Act 1996, Child Labor (Prohibition & Regulation) Act 1986, Employees' Provident Fund and Miscellaneous Provisions Act, 1952. Employees' State Insurance Act, 1948, Factories Act, 1948, Industrial Dispute Act 1947, The Inter-state Migrant Workmen (Regulation of Employment and Conditions of Service) Act, 1976, The Maternity Benefit Act 1961, Minimum wages Act 1948, Payment of Wages Act 1936, Payment of Bonus Act 1965, Payment of Gratuity Act, 1972, Employees' Compensation Act 1923**,** Contract Labour (R&A Act, 1970), etc.

29. Attendance of contract's workers shall be regulated by entering the entry / exit every day in an attendance register to be maintained by contractor.

30. **SUPERVISION:**

30.1. The Agency shall have to work as per direction of the Manager-in-charge, and shall report to him daily regarding day-to-day progress. The Agency shall give full access to the Manager-in-charge / authorized representative of NALCO / Consultant to inspect day-to-day work executed by the Agency. Besides, the contractor shall have to engage his own supervisor at their own cost to ensure proper workmanship and good quality work, which is a part of the scope of work.

30.2. Under prevailing statute, the supervision should be carried out by a person holding valid license issued by appropriate statutory body.

31. **CIRCUMSTANCES OF SUSPENSION / BANNING OF BUSINESS:**

31.1. **Suspension / Banning of Business** of any agency/ firm/ Consultant working with the Company may be resorted to in following cases:

31.1.1. If the Proprietor or Partner or Director of the Firm is convicted by a Court of Law, following prosecution under the normal process of Law for an offence involving moral turpitude in relations to business dealings;

31.1.2. If security considerations including the question of loyalty to the State warrant as per recommendations of Ministry of Home Affairs.

31.1.3. If there is justification for believing that the Proprietor or Partner or Director (or Employee) of the Firm has been guilty of malpractices such as bribery, corruption, cheating, fraud, substitution of bid or theft or any other illegal activities while carrying out the work etc.

31.1.4. If the Firm refuses/fails to return the Company's dues without adequate cause;

31.1.5. If the Firm is blacklisted by any Department of the Central Government/ State Government.

31.1.6. If the Firm is a confirmed evader of Central / State taxes/duties for which NALCO has received notice from the concerned department of Central / State Govt.

31.1.7. Misbehavior/ threatening of departmental supervisory staff during work execution.

31.1.8. Constant non-achievement of milestones on insufficient and imaginary grounds and non-adherence to quality specifications despite being pointed out.

31.1.9. Persistent & intentional violation of important conditions of contract.

31.1.10. Submission of false/ fabricated/ forged documents for consideration of a bid.

31.1.11. If declared bankrupt or insolvent.

Annexure-I

PRE-QUALIFICATION CRITERIA (PQC)

A) EXPERIENCE CRITERIA	
Eligibility Criteria	**Documentary Proof Required**
The bidder should have experience of having successfully completed "Similar Work" during the last fifteen years ending on last day of the month previous to the one in which NITs are invited, should be either of the followings: The work experience should be of "Working directly" and possess relevant experience as per the details given under experience criteria. "Working directly" implies, working as a Contractor under above authorities who is the Principal Owner of the work. "**Similar Work**" means The bidder must have carried out Design / Engineering, Supply, Erection, Testing and Commissioning of material handling system of minimum: **a)**100 TPH capacity (single unit) with pipe conveyors of minimum 0.5 km distance **AND** **b)** 333 TPH capacity (single unit) pneumatic unloading from road vehicles/ rail wagons **AND** **c)** The material handling (through Pipe conveyor) and Pneumatic unloading having all the above equipment installed by the bidder should be in successful operation for at least one year since commissioning. Note: Relaxation on 15 years' time frame can be claimed by the bidder if they have executed similar job (mentioned in the Experience criteria) in NALCO.	The bidder has to submit copy of the following documents duly attested by a Notary public/concerned Embassy of the country in case of foreign vendor. a) Copy of Work Order & Amendments if any, Scope of supply & Bill of Quantity. Separate Work Order copies for material handling through pipe conveyer and pneumatic unloading shall be accepted. b) Completion/ Commissioning Certificate indicating the date of commissioning and satisfactory post commissioning Performance Certificate issued by the Client in Letterhead and signed by authorized signatory with Contact Reference. c) In case of use of credentials from OEM/OES/OPM, authorization from them shall be submitted by the bidder. d) If the Indian entity does not have any manufacturing facility in India, they may supply with a certificate/ Agreement from OEM/OES/OPM for back to back guarantee/warranty support for the supply, Spares and after sales support. e) Bidders may be JV/Consortium and participate in the Tender complying terms and conditions of NIT. f) NALCO may use internal documents for evaluation of Bids. **Note**: Completion / Commissioning / Performance Certificate shall be considered only when it bears the Name, Designation and Contact Reference of Issuing Authority. This is only applicable for Completion/ Commissioning /Performance certificate issued after 30/06/22.
B) FINACIAL CRITERIA	
Eligibility Criteria	**Documentary Proof Required**
1) Average annual financial turnover of the bidder during the last three Financial years	a) The bidders have to submit the copies of audited financial statements / profit & loss

ending with 31st March of previous Financial Year should be at least **Rs.31.94 Cr** (Rupees Thirty-One Crore and Ninety-Four Lakhs only). Note: Turn Over shall be escalated @ 10% per annum (simple Interest) to bring them at the current price level. The turnover of the latest previous year shall not be considered for any weightage. 2) The bidder should have minimum positive working capital of **Rs.12.28 Cr**. OR The bidder should make exclusive credit limit available from one or more Scheduled Commercial Banks for the proposed work and submit a line of confirmation from the bank/banks as a documentary evidence. 3) The bidder should have minimum positive Net Worth of **Rs.24.56 Cr**. Note: For bids received prior to 30th June of any year, the financial figure for the previous to previous year may also be considered for evaluation. Whereas for bids submitted after 30th June, the bidder may also submit financial statement for the previous year certified by Chartered Accountant / Auditor of the entity for consideration of their bid.	accounts of the relevant years duly certified by Charted Accountant / Auditor of the entity in support of both the eligibility criteria. b) Letter from your Banker on Credit Limit under Para2 (For alternative condition) address to NALCO w.r.t. Tender document.

Note:

i. Net worth is defined as = "Equity share capital Plus Reserves excluding Revaluation Reserves Minus Miscellaneous Expenditure to the extent not written off and carried forward Loss".

ii. The bidder shall submit copies of audited annual report / audited balance sheet including profit & loss account with relevant schedules thereto of the relevant years in support of the above qualifying criterion, along with the bid.

iii. In case the bidder does not have the audited financial statements of the latest financial year, in that case the P/L & Balance sheet to be provided along Notes to the same along with the calculation of net worth as per the formula given in sl.no.i. above, duly certified by a Chartered Accountant. The UDIN of the CA should be clearly mentioned in the certificate.

iv. In the case of an authorization certificate, it should be specific to the tender.

C) Other Evaluation Criteria:

(i) **Offers from following types of bidder will not be accepted:**

- Vendors banned by NALCO/Other PSUs / GOVT of India/ State Govts/ Quasi Govt. organizations.
- Those are under liquidation, court receivership or similar proceedings.
- Consultant or their subsidiary Company or companies under the management of consultant for execution of the same project for which they are working as Consultant.
- Previous and present performance of bidders at NALCO shall be considered while evaluating their offers. In case of poor performance, the offer from such bidders shall not be evaluated. (Poor performance is specified as "poor progress in execution of the work at NALCO / in any of its JV site, for reasons solely attributable to bidders due to financial constraints, inadequate resource mobilisation etc. This need to be certified by Manager-in-Charge for the work based on periodic evaluation & documentary evidence like communication to bidder regarding poor performance"

(ii) CONCURRENT COMMITMENT:

The bidder has to submit complete list of concurrent commitments on all jobs under execution by them, which will be taken into account to assess the spare capacity available with the bidder. It is accepted that bidder have disclosed all works being executed by them. For the purpose of bid evaluation, the concurrent commitments of the bidder shall be evaluated as on the last day of the Month previous to bid due date. If the annualized concurrent commitments of the bidder plus annualized estimated value of the work under consideration exceeds four times the average annual financial turnover of the bidder during the preceding three years, then the bid of such a bidder shall not be recommended for further evaluation.

Spare capacity or bid capacity shall be evaluated as on the last day of the month previous to the bid due date or extended bid due date as the case may be, based on the confirmation / declaration of the bidder that they have disclosed all works being executed by them. Bidder shall exclude all stalled project for which there is no progress in last one year giving reason for no progress considering above cutoff date. In case any adverse report/ complaint are received against any bidder and on enquiry found correct, offer shall be rejected and bidder shall be liable for appropriate legal action.

Form-A of Annexure-I

JOINT VENTURE/ CONSORTIUM CRITERIA:

Bids from Joint Venture / Consortium shall be accepted subject to fulfilling the criteria as given below:

a) Maximum 3 (three) partners/ members shall be allowed in case of Consortium.

b) The bidder should submit an agreement for Consortium duly notarized so as to be legally valid and binding on the partners / members. The agreement should contain precise indication of the responsibility of all the partners of the Consortium in respect of planning, design, construction equipment, key personal, work execution and financing of the project duly indicating the percentage in financing of Consortium by each partner. This agreement shall be irrevocable and valid till successful completion of the contract. The format for the agreement is attached in the tender document (Form-A of Annexure-I).

c) Any party can be a member only in one Consortium in a tender. In case any member participates in more than one consortium or individually, all such bids with his participation shall be rejected.

d) One of the partners / members shall be nominated as Lead Partner being in-charge and the authorization shall be evidenced by submitting Power of Attorney in his favour duly signed by legal authorized signatories of all the partners / members.

e) In the case of Consortium, the lead partner shall meet financial criteria singly and all the partners shall meet technical eligibility criteria of Bidder's Qualification Criteria jointly. However, Net worth criteria of other member(s) of the Consortium must be positive as per audited balance sheet during last financial year.

f) In case of dissolution/failure of Consortium, the contract shall be voidable at the option of the Nalco and Nalco shall have right to execute the balance job at the risk and cost of the Consortium.

g) The Lead Partner shall be authorized to incur liabilities and receive instructions for and on behalf of any and all partners of the Consortium and entire execution of the contract.

h) Lead partner of Consortium shall be fully responsible for carrying out the supervision and quality control of the work including the performance guarantee test to be executed by another partner.

i) The orders shall be placed on Lead Partner or any other consortium partner based on authorization of lead partner. However, all the partners of the Consortium shall be liable jointly and severally for the execution of the contract in accordance with the contract terms and conditions.

j) In case of consortium bidding, the lead partner or other partner with authorization from the lead partner will submit the EMD.

k) In case of consortium bidding, the lead partner will submit CPBG.

l) In the case of consortium bidding, the Integrity Pact has to be signed by each partner individually.

FORMAT FOR CONSORTIUM AGREEMENT

This Consortium Agreement is made on ____(date)_____ at ____(place)_____BETWEEN: (1)_____(Bidder-leader)_____(full address) (here in after called the First party -Bidder, which expression shall include its successor, administrators, Executors and permitted assigns, of the one part (2) ____(address of 1st associate)_____(full address) here in after called the 2nd party-Associate, (3) _____(address of 2nd associate)_____ (full address) here in after called the 3rd party-Associate, which expression shall include its successor, administrators, Executors and permitted assigns) of the 2nd part.

WITNESSETH:
WHEREAS, the owner M/s. National Aluminium Company Ltd., is a Government of India Undertaking, having its Office at Nalco Bhavan, P/1, Nayapalli, Bhubaneswar - 751 013, Odisha, (hereinafter referred to as NALCO) has floated Notice inviting tenders bearing No._____ for execution of work_____(description of work)_____, inviting offers from the interested parties; AND

WHEREAS the said Notice Inviting tender, permits submission of bid on consortium basis subject to the stipulations specified in the Notice Inviting tender; AND

WHEREAS M/s_____(name of the leader-bidder)_____ the 1st party-bidder will file the tender on consortium basis; taking the 2nd and 3rd party as the associate for the said project as detailed in the bid documents No._____ in order to meet the BQC criteria; since M/s____ (name of the leader-bidder)____ the 1st party-bidder itself is meeting all the Qualifying requirements except _____(describe the work which the associate(s) is/are required to execute)_____ AND;

WHEREAS the 2nd and 3rd party associate have the required men, materials, and establishment with them and eager to participate and execute the work covered by the NIT and WHEREAS parties to this consortium agreement have mutually agreed to execute the contract covered by the aforesaid bid document in this joint venture, if awarded to the 1st party-bidder;

NOW, therefore, it is agreed between the Parties as under:

1. M/s____ (name of the leader-bidder)____ the 1st Party bidder is the leader, of this consortium Agreement; and is answerable to the owner i.e. NALCO in all respects with regard to execution of such work. However, the associate is not absolved from any liability that may arise during the course of execution of such contract work.

2. M/s ___ (name of the leader-bidder)_____ the 1st party bidder and leader will participate in the above mentioned Bid with the Owner i.e. NALCO, and is authorized and competent to enter into negotiations and make all correspondence with the owner as he deems fit just and proper and the parties to this agreement shall be bound by the decisions or/and commitments made by the leader in that regard.

3. During the term of this Consortium agreement the parties shall not enter into any teaming arrangements with any other party for any component of the Bid covered under this Consortium Agreement.

4. This consortium agreement shall remain in force until finalization of the bid filed by the owner on a consortium basis and in case of award of work, until completion of the awarded work including the defect liability period covered by the Bid documents, as the case may be.

5. The parties to this Consortium Agreement hereby mutually agree that both (all) of them shall remain as irrevocable members of the tie-up for the complete execution and completion of this project.

6. The parties to this Consortium Agreement agree that after mutual consultation and technical discussions, they have agreed and decided with regard to preparation of the final bid, authorizing their leader to bid for the work.

7. The Parties to this Consortium Agreement shall be jointly and severally liable for the consequences of non-execution of the Contract work satisfactorily covered by the aforesaid Bid document. However, in case of any dispute or differences whatsoever between the Consortium Associates/Partners, in that event the lead bidder shall be individually liable for nonexecution of the Contract work satisfactorily covered by the aforesaid bid document apart from joint and several liability of other associate members of the consortium.

8. The parties to this Consortium Agreement do here by declare that the leader 1st party M/s. ___ (name of the leader-bidder)____ shall have the authority to conduct all business for and on behalf of any and all the partners of the Consortium during the bidding process and in the event the Consortium is awarded with the Contract, shall have the authority to conduct all business for and on behalf of any and all the partners of the Consortium during the entire Contract execution period.

9. It is hereby agreed that the leader M M/s. ___ (name of the leader bidder)____ shall be entitled to receive all instructions and communications from the owner i.e. NALCO, on behalf of the members of this Consortium Agreement. All such instructions and communications are deemed to have been made on all the parties to this consortium Agreement.

10. The parties do here by agree that all of them shall sign the Contract agreement in case of its award, with the owner i.e. NALCO.

11. The parties do here by agree that the leader (1st party) M/s. ___ (name of the leader-bidder)____ shall remain in-charge of the entire project if awarded by the owner i.e. NALCO, but however all of them shall make every endeavor to satisfactorily execute the Contract work in its entirety to the satisfaction of the owner i.e. NALCO.

12. The parties do hereby agree that the leader -1st party- M/s. ___ (name of the leader-bidder)____ shall raise periodical bills with the owner for the works executed and the leader -1st party M/s. ___ (name of the leader bidder)____ shall only be eligible to receive payments from the owner. The associate(s) does/do hereby declare that he/they does/do not have the authority to raise any bills in respect of the allotted Contract work, basing on this Consortium agreement. The associate(s) to this agreement can only make correspondence through the leader -1st party M/s. ___ (name of the leader-bidder)____ with the owner i.e. NALCO.

13. The parties do here by declare that so far as NALCO is concerned, the 2nd and 3rd Party is/are only the agents/partners of the leader-1st party M/s __ (name of the leader-bidder)__, though they are jointly and severally liable for the consequences those may arose during or after execution of the contract work in question.

14. The parties to this agreement covenant with each other that each of them shall be entitled to share the payments received from Nalco according to work executed by them respectively, without any reference to NALCO.

15. The parties to this Consortium Agreement shall mutually cooperate with each other and shall not do or cause to be done or indulge in any sort of activity, which would impede or adversely affect the progress of the awarded contract work and in its completion satisfactorily.

16. In the event of the acceptance of the Bid and on award of work on the leader on the basis of this Consortium Agreement, the Contract work shall be executed by all of the parties to this consortium agreement as per the bidding documents and as per the Work Schedule given here under.

WORK SCHEDULE

Sl. No.	Name of Bidder/member of consortium	Work Particulars	Completion schedule.

17. The leader of Consortium is hereby authorized to incur liabilities and receive instructions for and on behalf of any and all the consortium members for the entire Contract Work.

18. This Consortium agreement having been exclusively entered in to by the associates with their Leader-Bidder, the leader bidder shall alone is accountable and answerable to the associates concerning the execution of the contract work so awarded and NALCO the owner shall in no case be held liable or answerable to the associates, for all or any of the matters covered by this consortium agreement.

19. In the event of any default in the execution of the contract, i.e. execution of work in accordance with specifications and within the scheduled time by any member/ members of consortium, the rights and obligations of the consortium shall continue to be in full force without being affected by any changes, until the final bill of the contract work of Nalco is settled. The leader shall ensure the performance of the contract and if one or more associates fail to perform their respective portions of the contract, the same shall be deemed to be a default by all the members of the Consortium.

20. The parties to this consortium agreement do hereby declare that they shall not cancel or amend this agreement unilaterally without the consent of the owner, i.e. NALCO, for which consent shall be obtained in writing.

21. It is agreed that the responsibility of all partners/ members of the consortium in respect of planning, design, construction equipment, key personnel, work execution and financing of the project has been decided and defined.

22. The associated parties i.e. M/s. _____(Name of 1st Associate)_____ shall provide adequate finances, tools and tackles, transportation equipments, other plant and equipments, measuring and monitoring devices, men and machineries, etc. for proper and effective execution of the works undertaken by them as per this Consortium agreement.

23. This Consortium agreement shall be construed and governed by laws of India and the parties here by agree to submit themselves to the exclusive jurisdiction of _____ Courts within whose jurisdiction they contract work in question is to be carried out.

24. Any matter which is not stipulated in the consortium agreement shall be settled in good faith by discussion among the parties in the spirit of understanding and cooperation.

25. All disputes or differences whatsoever arising among the parties regarding this consortium agreement, shall be settled by arbitration, in accordance with the Arbitration and Conciliation Act, 1996 (as amended by 2015 Act). The Arbitral Tribunal shall consist of a sole arbitrator who shall be nominated and appointed by the Lead Bidder at the request of either party to the Consortium Agreement. The venue of Arbitration shall be at _____. With the consent of the parties the arbitrator may hold sittings at any other place other than the venue agreed for, for the convenience of the parties.

26. That during the arbitration process and after arbitration those differences/disputes which does not resolve, in those events the lead bidder shall be wholly responsible for execution of Contract satisfactorily and individually liable for consequences under the contract thereof. However, it does not mean that other associates of Consortium are discharged from their joint and several liability under this agreement.

27. In witness whereof, the parties here to have executed this Consortium Agreement in duplicate/triplicate, today the _____ day of _____ 2025 at _____.

1st Party (leader) 2nd party (associate) 3rd party (associate)
W I T N E S S E S

1.
2.

Drafted, Computer typed by me, as per the instructions of the parties. Read over and explained the contents of the agreement to the parties in the presence of witnesses, to which they admitted the same to be true and correct and as per their instructions and signed the same in my presence and in the presence of the witnesses.
Advocate
Note:
1. The agreement should be duly attested by the Notary Public.
2. Bidder should upload the scanned copy of the agreement with their On - line Part - I - Bid.

The original copy of the declaration should be submitted in cover - 1 of the hard copy offer.

****

Form-B of Annexure-I

PRE-QUALIFICATION CRITERIA- TECHNICAL (EXPERIENCE CRITERIA)
FOR LEADER BIDDER / SINGLE BIDDER

NAME OF THE LEAD BIDDER / SINGLE BIDDER: .....

SL.	DESCRIPTION	DETAILS
1	Reference Bid submitted as: a) Single Bidder or b) Lead bidder (For JV/Consortium)	
2	In case of Consortium Bid, whether Responsibility Matrix submitted	(Yes / NO / NA)
3	Single / Lead Bidder's Scope of supply and services Package:	
	- Basic Design	Yes/ No
	-Detailed Design and Engineering	Yes/ No
	- Procurement	Yes/ No
	- Shop Assembly, Inspection & Testing	Yes/ No
4	Client's Name Address Tel. No. Fax E-mail Name & Designation of Contact person	
5	Project/ Location:	
6	Copy of Purchase Order enclosed:	Yes/ No
7	Copy of Completion / Commissioning Certificate enclosed:	Yes/ No
8	Copy of Performance Certificate enclosed:	Yes/ No
9	Pipe Conveyors: a) Capacity (single unit) in TPH b) Conveying distance in meters	
10	Pneumatic Unloading (TPH): From a) Railway wagon or b) Road Vehicle	
11	Month & year of Commissioning	

NB: (i) Continuation sheets of like size and format may be used as per bidder requirement and shall be annexed to this attachment.

(ii) Completion certificate / Commissioning certificate and Performance Certificate must bear the Name & Designation of Issuing Authority. This is applicable if the certificate is issued after 30/06/2022.

(iii) Documents submitted to meet PQC shall be attested by Notary Public.

Signature of Bidder with Seal

FOR CONSORTIUM BIDDER

NAME OF THE CONSORTIUM BIDDER: .....
NAME OF THE LEAD BIDDER: .....

SL.	DESCRIPTION	DETAILS
1	Consortium Bidder's Scope of supply and services Package:	
2	- Basic Design	Yes/ No
	- Detailed Design and Engineering	Yes/ No
	- Procurement	Yes/ No
	- Shop Assembly, Inspection & Testing	Yes/ No
3	Client's Name Address Tel. No. Fax E-mail Name of Contact person	
4	Project/ Location:	
5	Copy of Purchase Order enclosed:	Yes/ No
6	Copy of Completion/ Commissioning Certificate in the Letterhead of Client enclosed:	Yes/ No
7	Copy of Performance Certificate in the Letterhead of Client enclosed:	Yes/ No
8	Pipe Conveyors: c) Capacity (single unit) in TPH d) Conveying distance in meters	
9	Pneumatic Unloading (TPH): From c) Railway wagon or d) Road Vehicle	
10	Month & year of Commissioning	

NB: (i) Continuation sheets of like size and format may be used as per bidder requirement and shall be annexed to this attachment.

(ii) Completion certificate / Commissioning certificate and Performance Certificate must bear the Name & Designation of Issuing Authority. This is applicable if the certificate is issued after 30/06/2022.

(iii) Documents submitted to meet PQC shall be attested by Notary Public.

Signature of Bidder with Seal

Form-C of Annexure-I

PRE-QUALIFICATION CRITERIA - FINANCIAL CRITERIA

To satisfy the pre-Qualifying requirements specified in NIT, we..... (Name of Bidder) give below the following details:

A. Turnover:

Financial Year	**Annual Turnover (Rs.)**
Latest Financial year (1st Year) 2024-2025	
2nd Year 2023-2024	
3rd Year 2022-2023	

B. Net Worth

Financial Year	**Net Worth (Rs.)***
Latest Financial Year 2024-2025	

C. Working Capital

Financial Year	**Working Capital (Rs.)**
Latest Financial Year 2024-2025	

Net worth is defined as = Equity Share Capital Plus Reserves Excluding Revaluation Reserves Minus Miscellaneous Expenditure to the extent not written off and carried forward loss.

NOTE:

1. Submission of audited balance sheet and profit & loss account for above three years - YES/ NO
2. Attach Self-Confirmation letter stating that you are not under liquidation, court receiver ship or similar proceeding- Confirmed/ Not Confirmed
3. **This should be certified by Chartered Accountant with UDIN.**
4. For JV/CONSORTIUM, Each member shall submit separately

SIGNATURE OF BIDDER WITH SEAL

Annexure-II

MANDATORY INFORMATION OF THE BIDDER

All Fields are Mandatory. **Enclose Certificate/documentary evidence for fields marked with ***	
Authorized Signatory *……..……..	
Legal Name of Firm as per PAN *……..…….	
Trade Name of Firm as per GST *……	
Postal address of the firm: …… House No. / Plot No : …… Street Name : …… City: …… District: …… State: …… Pin Code: …… Country: ……	
CPP Portal Login ID*: ……..	
Phone No.: ……	Mobile No.: ……
Valid email ID. : ……	
Gender: Male / Female / Other	……
Category: General / SC / ST	……
Type * Micro / Small/ Medium / Ancilary	Micro/Small/Medium…Yes/No
EPF No. : ……	ESI No. : ……
PAN No. : ……	
GSTN No : ……	
Bank Name *…… Br.Name…… Br.Place ……	
Bank A/c No (enclose cancelled cheque)*……..……..… IFS Code……..	

(**SIGNATURE OF BIDDER WITH SEAL)**

Annexure III

FORMAT FOR SUBMITTING PRE-BID QUERIES

Bidder to submit the pre-bid queries in following format in word/excel

Name of Bidder:

Address of Bidder:

Name of contact person:

Email:

Phone:

Sl. No.	Clause No.	Page No.	Provision of Document	Queries/ Suggestions

(Bidder to send their queries / suggestion in the email mentioned at Proposal Details)

Annexure-IV(A)

EXCEPTION / DEVIATION STATEMENT TO TECHNICAL SPECIFICATION

In case of no deviation, please write 'No Deviation' in the space below:

(To be filled in by the Tenderer and submitted with Techno-Commercial bid)

Bidders are requested not to take any deviation to technical specifications and submit NO DEVIATION BID. If the Bidder has got any deviation bidder shall tabulate those deviations in this schedule. It is confirmed that except those deviations, as tabulated hereunder, the complete offer agrees with the specification requirement. Any Non-Acceptable deviation(s), is/ are to be withdrawn by bidder otherwise the bid shall be rejected. Deviation/Exception stipulated elsewhere other than in this Annexure shall NOT be taken cognizance of and shall be ignored.

Sl. No	Reference of Tender Document			Subject	Deviation / Exception
	Page No.	Clause No.	Para No.		

Signature & Seal of bidder.

Annexure-IV(B)

EXCEPTION / DEVIATION STATEMENT TO THE TENDER TERMS & CONDITIONS

In case of no deviation, please write 'No Deviation' in the space below:

(To be filled in by the Tenderer and submitted with Techno-Commercial bid)

Bidders are requested not to take any deviation to terms & condition of NIT (Commercial) and submit NO DEVIATION BID. If the Bidder has got any deviation bidder shall tabulate those deviations in this schedule. It is confirmed that except those deviations, as tabulated hereunder, the complete offer agrees with the specification requirement. Any Non-Acceptable deviation(s), is/ are to be withdrawn by bidder otherwise the bid shall be rejected. Deviation/Exception stipulated elsewhere other than in this Annexure shall NOT be taken cognizance of and shall be ignored.

Sl. No	Reference of Tender Document			Subject	Deviation / Exception
	Page No.	Clause No.	Para No.		

Signature & Seal of bidder.

Annexure-V

FORWARDING LETTER AND UNDERTAKING

From:

_____
_____
_____

To
Tender Inviting Authority
National Aluminium Company Ltd.

Sub: Letter of Undertaking.

1. Having carefully examined all the Tender Documents under reference no. …… Date: …… we offer to complete the works in conformity with all the terms and conditions as detailed in the Tender Documents.
2. We hereby confirm that we have downloaded the complete set of tender documents along with the set of enclosures hosted in www.eprocure.gov.in website. We confirm that the bid document has not been edited or modified by us. In case, it is observed by NALCO that the bid document has been edited or modified, we agree for the rejection of the bid by NALCO.
3. We undertake, if our tender is accepted, to commence the work from the effective date of contract and to carry out work as stipulated in the contract.
4. We have submitted the Earnest Money Deposit (EMD) amount through BG/RTGS as instructed by you.
5. We agree to abide by this Tender initially for a period of Six (6) Months as validity of offer from the date of opening of Tender and it shall remain binding on us and may be extended at any time before the expiry of that period.
6. Further we agree to the Pre-Contract Integrity Pact which is part of this tender and has signed the Pre-Contract Integrity Pact as at Annexure-XXVI duly filled up for further necessary action at your end.
7. Should this Tender be accepted, we hereby agree to abide by and fulfill all Terms and Conditions of Tender Document as accepted by us and in default thereof, to forfeit and pay to NALCO such sums of money as stipulated in conditions contained in Tender Documents. We understand that NALCO is not bound to accept the lowest or any Tenders received and NALCO reserves the right to reject any or all tender without any liability.
8. This Tender together with written “Acceptance” thereof, shall constitute a binding CONTRACT between NALCO and us, till a formal contract is executed.

Date_____day of _____ Signature _____

(**SIGNATURE OF BIDDER WITH SEAL**)
Mob: ……..
Email: ……...

Annexure-VI

DECLARATION BY THE BIDDER

I…… representing the bidder, do declare on behalf of the firm as hereunder:

* That, I am the PROPRIETOR of the bidder's firm. I undertake to submit proof of ownership as and when demanded by NALCO.

OR

* That I am the authorized signatory to the tender documents holding valid Power of attorney.

A certified copy of the valid power of Attorney is enclosed with the offer.

NOTE: Strike out whichever is not applicable.

(a) That, we do not have any FINANCIAL/PROFESSIONAL stake in any of the other bidders participating in this tender;

(b) That, this firm has not been blacklisted/debarred/banned in any unit of NALCO/Other PSUs / GOVT of India/ State Govts/ Quasi Govt. organizations.

(c) That, we are not in any arbitration/legal cases with NALCO and no cases are pending in court of law.

(d) That, the proprietor/partners/directors/ employees of the firm have never been a part of any blacklisted/debarred/banned firms or company in any unit of NALCO/Other PSUs / GOVT of India/ State Govts/ Quasi Govt. organizations.

(e) That, we have never been prosecuted by any statutory authority

(f) That, any change in the constitution of the firm shall be made with prior clearance from NALCO.

(g) That, we have studied all the clauses/sub-clauses terms and conditions of the tender documents including GCC and our offer fully comply with the requirements spelt out in the tender documents.

(h) We undertake to abide by and comply with all the safety and environmental regulations in force in NALCO during the execution of work.

(i) We undertake to abide by and comply with all the applicable provisions of laws governing contract workers engaged by you for this work.

(j) We undertake to receive payment through E-payment mode.

(k) The **Annexure-XX** and **Annexure-XXI** regarding relatives working in NALCO are filled up and enclosed.

(l) The **Annexure-VIII** regarding present / concurrent commitment of the tenderer are also properly filled up and enclosed (Applicable for Project Contracts only).

(m) We declare that all supporting documents of the offer submitted are attested by a Gazetted officer / Notary public.

(n) I/we declare that the document down loaded by me/my company is/are not tampered in any form.

(o) That I have submitted EMD in absence of which my bid will be rejected.

I further declare that all above statements are true. If at any time during pre-ordering/post ordering stage of the contract, it is found otherwise, action as deemed fit by NALCO including 'rejection of my offer"/ 'banning/blacklisting' me/my firm / my company etc. may be taken. The same will be binding on me / firm / company represented by me. I also hear by authorize and request any bank, person, firm, corporation, Govt. Officers etc. to furnish pertinent information as deemed necessary and as requested by Nalco to verify this statement or regarding my/our competency and general reputation.

Date:_

(**SIGNATURE OF BIDDER WITH SEAL**)

Annexure-VII

AFFIDAVIT BEFORE THE NOTARY PUBLIC

I ……, aged about …… years, S/O: ……, At-……, PO- ……, Dist-……., Pin-……,, State: ……, Designation: …… of M/s. …….. have not been convicted by a court of Law for an offence involving moral turpitude in relation to business dealings during the past seven years for acceptance of the offer. I do hereby solemnly affirm and state as follows:

INFORMATION REGARDING CURRENT LITIGATION, DEBARRING EXPELLING OF BIDED OR ABANDONMENT OF WORK BY THE BIDDER

1.	(a)	Is the bidder currently involved in any litigation relating to the works?	Yes/No
	(b)	If yes, give details:	
2.	(a)	Has the bidder or any of its constituent partners been debarred/ expelled by any agency in India during the last 5 years.	Yes/No
	(b)	If yes, give details:	
3.	(a)	Has the bidder or any of its constituent partners failed to perform on any contract work in India during the last 5 years.	
	(b)	If yes, give details:	
4.	(a)	Arbitration cases pending	
	(b)	If yes, give details:	
5.	(a)	Disputed incomplete works.	
	(b)	If yes, give details:	
6.	(a)	Pending civil cases against the firm or its Proprietor/Partner(s)/Director(s) involving moral turpitude in relation to business dealings.	
	(b)	If yes, give details:	
7.	(a)	Pending criminal cases against the firm or its Proprietor/Partner(s)/Director(s) involving moral turpitude in relation to business dealings.	
	(b)	If yes, give details:	
8.	(a)	Punishments awarded under civil cases or criminal cases involving moral turpitude in relation to business dealings	
	(b)	If yes, give details:	

Note: If any information in this schedule is found to be incorrect or concealed, qualification application will be summarily be rejected.

(Signature of the bidder and Seal)

Annexure-VIII

DETAILS OF PRESENT COMMITMENTS OF THE TENDERER
(Last day of Month Previous to Bid Due Date)

I/We _____, age_____years, son of _____ do hereby solemnly affirm and declare as follows for and on behalf of Firm _____

SR. NO.	FULL POSTAL ADDRESS OF CLIENT & NAME OF OFFICER INCHARGE	DESCRIPTION OF THE WORK	VALUE OF CONTRACT	DATE OF COMMENCEMENT OF WORK	SCHEDULE COMPLETION PERIOD	%AGE COMP. AS ON DATE	EXPECTED DATE OF COMPLETION	AMOUNT OF BALANCE WORK DURING THE PERIOD ON NEXT 12 MONTHS FROM DATE OF THE DECLARATION	REMARKS
1									
2									
3									
4									
5									
6									
7									

It is certified that the above particulars furnished are true and correct. If any information given is found to be misleading at a later date NALCO will have the authority to take necessary action per provision of the contract and as per laid down procedure of the Company.

SIGNATURE OF BIDDER : _____
NAME OF BIDDER : _____
COMPANY SEAL : _____

Annexure-IX

FOR ONLINE SUBMISSION OF EARNEST MONEY DEPOSIT [E.M.D.]

PART – A

DETAILS TO BE FURNISHED BY NALCO

1)	TENDER NO WITH DATE	NALCO/CORP/P&T/CONT/2025/052 Dated:23.10.2025
2)	DESCRIPTION OF TENDER	**Design, Engineering, Supply, Erection and Commissioning of Alumina Unloading and Transportation System (AUT)**
3)	EMD AMOUNT (IN RS) & IN WORDS	**₹ 25 Lakh (Rupees Twenty Five Lakh only).**
4)	SBI ACCOUNT NO	10044880013
5)	SBI BRANCH CODE	STATE BANK OF INDIA, SME BRANCH, NALCO CORPORATE OFFICE CAMPUS, NALCO BHAVAN, P/1 NAYAPALLI, BHUBANESWAR-751013
6)	SBI IFSC CODE	SBIN0009817

PART – B

DETAILS TO BE FURNISHED BY VENDOR

1)	NAME OF THE PARTY	
2)	NALCO VENDOR CODE IF ANY	
3)	AMOUNT DEPOSITED	
4)	DATE OF DEPOSIT	
5)	NAME OF BANK & BRANCH	
6)	BRANCH CODE	
7)	IFSC CODE	
8)	UTR NO	(ENCLOSE COPY)
	DATE	

Annexure-IX A

Bid Securing Declaration Form

From: _____
_____

To _____,
_____,
National Aluminium Company Ltd.
P/1 NALCO Bhawan, Nayapalli, Bhubaneswar

Sub: Tender for "**Design, Engineering, Supply, Erection and Commissioning of Alumina Unloading and Transportation (AUT)**"

Ref: Tender No. **NALCO/CORP/P&T/CONT/2025/052 Dated:23.10.2025**

Having carefully examined all the Tender Documents under reference we hereby accept that if we withdraw or modify our bid during the period of validity etc. We shall be suspended for a period of two years to participate any tender of NALCO from the date of withdrawal or modification.

Date_____day of _____ Signature _____

(NAME IN BLOCK LETTERS AND CONTACT DETAILS)

Annexure – X

BANK GUARANTEE FOR EARNEST MONEY DEPOSIT

(To be executed on non-judicial stamped paper of appropriate value)

B. G. No._____ Date: _____

1. WHEREAS M/s National Aluminium Company Limited (A Government of India Enterprise), having its Unit/Office at .....(UNIT/OFFICE ADDRESS ISSUING THE TENDER) (hereinafter called "The Company" which expression shall unless repugnant to the subject or context includes its legal representatives, successors and assigns) has issued Tender paper vide its Tender No…….. dt.....……for .....(hereinafter called "the said tender") to M/s. ……(hereinafter called the said Tenderer(s)" which expression shall unless repugnant to the subject or context includes their legal representatives, successors and assigns and as per terms and conditions of the said tender, the tenderer shall submit a Bank Guarantee for ` ……..(Rupees ……..only) towards earnest money in lieu of cash.
2. WE ……Bank having its branch office at ……..do hereby undertake to pay the amount due and payable under this guarantee without any demur, merely on a demand from the Company stating that in the opinion of the company which is final and binding, the amount claimed is due because of any withdrawal of the tender or any material alteration to the tender after the opening of the tender by way of any loss or damage caused to or would be caused or suffered by the Company by reason of any breach by the said tenderers(s) of any of the terms and conditions contained in the said tender or failure to accept the Letter of Intent Agreement or that the amount covered under this Guarantee is forfeited. Any such demand made on the Bank by the Company shall be conclusive as regards the amount due and payable by the Bank under this guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding `…… (Rupees……..only).
3. We undertake to pay to the Company any money so demanded not withstanding any dispute or disputes raised by the tenderer(s) in any suit or proceeding pending before any office, court or tribunal relating thereto our liability under this present guarantee being absolute and unequivocal. The payment so made by us under this bond shall be a valid discharge of our liability for payment there under. Our liability to pay is not dependent or conditional on the Company proceeding against the tenderer.
4. The guarantee herein contained shall not be determined or affected or suspended by the liquidation or winding up, dissolution or change of constitution or insolvency of the said tenderer(s) but shall in all respect and for all purposes be binding and operative until payment of all money due or liabilities under the said contract(s)/ Order(s) are fulfilled.
5. WE ……..Bank Ltd. further agree that the guarantee herein contained shall remain in full force and effect during the period that would be taken for the finalization of the said tender and that it shall continue to be enforceable till the said tender is finally decided and order placed on the successful tenderer(s) and or till all the dues of the company under or by virtue of the said tender have been fully paid and its claims satisfied or discharged or till a duly authorised officer

of the company certifies that the terms and conditions of the said tender have been fully and properly carried out by the said tenderer(s) and accordingly discharges the guarantee.

6. That the Company will have full liberty without reference to us and without affecting this guarantee to postpone for any time or from time to time. The exercise of any of the power of the Company under the tender.
7. Notwithstanding anything contained herein before, our liability shall not exceed Rs…….. (Rupees……only) and shall remain in force till……..Unless a demand or claim under this Guarantee is made on us within three months from the date of expiry, we shall be discharged from all the liabilities under this guarantee.
8. We …… Bank, further agree that this Guarantee shall be invocable at our place of business at _____(Bank Name),……..….(Branch name and address of the Branch), Bhubaneswar, Odisha, Pin-751…
9. We……Bank, lastly undertake not to revoke this guarantee during its currency except with the previous consent of the Company in writing. We further undertake to keep this Guarantee renewed from time to time at the request of Tenderer(s).

Date……. ……..Bank
Corporate Seal of the Bank By its constitutional Attorney
IFS Code: ……

Signature of duly Authorised person
On behalf of the Bank With seal & signature code

Details of Persons Issuing the BG:

Name----------
Address for Correspondence: ----------
Telephone & Fax No.
E-mail :

Note: -

1) BGs to be furnished from any of the approved banks of NALCO and processed through SFMS.
2) BG confirmation must be sent to our Banker through SFMS with the following details.

Beneficiary	: NATIONAL ALUMINIUM COMPANY LIMITED
Banker	: State Bank of India, SME Branch, NALCO Corporate Office, P-1, Nayapalli, Bhubaneswar-751013
A/C No.	: 10044880013
IFSC Code	: SBIN0009817
Email	: sbi.09817@sbi.co.in

Annexure – XI

PROFORMA FOR CONTRACT CUM PERFORMANCE GUARANTEE BY SELLER/ CONTRACTOR.

(To be executed on non-judicial stamped paper of appropriate value)

B. G. No…… Date……..

1. WHEREAS National Aluminium Company Limited (A Government of India Enterprise) having its Unit/Office at …… (UNIT/OFFICE ADDRESS WHERE THE WORK IS EXECUTED) (hereinafter referred to as "The Company" which expressions shall unless repugnant to the subject or context includes its legal representatives, successors and assigns) has entered into a contract with M/s. …….. has placed a purchase order on M/s……..(hereinafter referred to as "Contractor(s)/Seller(s)" which expression shall unless repugnant to the subject or context includes their legal representatives, successors and assigns) for ……..(work/assignment description) on the terms and conditions as set out inter alia, in the Company's contract No./ P.O. No. ……..dated ……and various documents forming part thereof hereinafter referred to as the "said contract" which expression include all amendments, modifications and/ or variations thereto and whereas the Contractor(s)/Seller(s) has agreed for due execution of the entire contract and guarantees its performance including any parts executed through any other agencies/subcontractors.

   AND WHEREAS one of the conditions of the "said contract" is that "contractor(s)/seller(s) shall furnish to the Company a Bank Guarantee from a bank for ….% (…….percent) of the total value of the "said contract" against due and faithful performance of the "said contract" including defect liability obligations and the performance guarantee obligations of the contractor(s)/seller(s) for execution/ supplies made under the "said contract."

2. We ……Bank having its branch office at ……..……..do hereby agree and undertake to pay the amount due and payable under this guarantee without any demur merely on a demand from the Company stating that in the opinion of the Company, which is final & binding, the amount claimed is due by reason of default made by the Contractor(s)/Seller(s) in performing any of the terms & conditions of the said Contract including defect liability obligations, in fulfilling the performance guarantee obligation or loss or damage caused to or would be caused to or suffered by the Company by reason of any breach by the said Contractor(s)/Seller(s) of any of the terms & conditions of the contract. Any such demand made on the Bank by the Company shall be conclusive as regards the amount due and payable by the Bank under this guarantee. However our liability under this guarantee shall be restricted to ` ……..… (Rupees……only).

3. We undertake to pay to the Company any money so demanded not withstanding any dispute or disputes raised by the contractor(s)/Seller(s) in any suit or proceeding pending before any office, court or tribunal relating thereto our liability under this present guarantee being absolute and unequivocal. The payment so made by us under this bond shall be a valid discharge of our

liability for payment there under. Our liability to pay is not dependent or conditional on the Company proceeding against the Contractor(s)/Seller(s).

4. The guarantee herein contained shall not be determined or affected or suspended by the liquidation or winding up, dissolution or change of constitution or insolvency of the said Contractor(s)/Seller(s) but shall in all respect and for all purposes be binding and operative until payment of all money due or liabilities under the said contract(s)/Order(s) are fulfilled.

5. We ……..Bank further agree that the guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the said Contract(s)/Order(s) and that it shall continue to be enforceable till all the dues of the company under or by virtue of the said Contract(s)/Order(s) have been fully paid and its claims satisfied or discharged or till a duly authorised officer of the Company certifies that the terms and conditions of the said Contract(s)/Order(s) have been fully and properly carried out by the said contractor(s) and accordingly discharges the guarantee.

6. We ……Bank further agree with the Company that the company shall have the fullest liberty without our consent and without affecting in any manner our obligations hereunder to vary any of the terms and conditions of the said Contract(s)/Order(s) or to extend the time of performance by the said Contractor(s)/Seller(s) from time to time or to postpone for any time or from time to time any of the powers exercisable by the Company against the said Contractor(s)/Seller(s) and to forbear or enforce any of the terms and conditions relating to the said Contract(s)/Order(s) and we shall not be relieved from our liability by reason of any such variation, or extension being granted to the said Contractor(s)/Seller(s) or for any forbearance, act or omission on the part of the Company or any indulgence by the Company to the said Contractor(s)/Seller(s) or by any such matter or thing whatsoever which under the law relating to sureties would, but for this provision, have affect of so relieving us.

7. Notwithstanding anything contained herein before, our liability shall not exceed Rs…….(Rupees……only) and shall remain in force till……..Unless a demand or claim under this Guarantee is made on us within three months from the date of expiry, we shall be discharged from all the liabilities under this guarantee.

8. We _____Bank further agree that this Guarantee shall be invocable at our place of business at_____(Bank Name), _____(Branch Name and address of the branch), Bhubaneswar , Odisha-751_____.

9. We……Bank, lastly undertake not to revoke this guarantee during its currency except with the previous consent of the Company in writing. We further undertake to keep this Guarantee renewed from time to time at the request of Contractor(s)/Sellers(s).

Date……. ……Bank

Corporate Seal of the Bank By its constitutional Attorney

Signature of duly Authorized person

On behalf of the Bank With seal & signature code

Details of Persons Issuing the BG:
Name----------
Address for Correspondence: ----------
Telephone & Fax No.
E-mail:
IFSC Code:

Note: 1 : BGs to be furnished from any of the approved banks of NALCO.
Note 2:BG confirmation must be sent to our Banker through SFMS with the followings details:

Beneficiary	: NATIONAL ALUMINIUM COMPANY LIMITED
Banker	: State Bank of India, SME Branch, NALCO Corporate Office, P-1, Nayapalli, Bhubaneswar-751013
A/C No.	: 10044880013
IFSC Code	: SBIN0009817
Email	: sbi.09817@sbi.co.in

Annexure – XII

BANK GUARANTEE FOR ADVANCE PAYMENT

(To be executed on non-judicial stamped paper of appropriate value)

B. G. No._____ Date:_____

1. In consideration of National Aluminium Company Limited (A Government of India Enterprise), having its Unit/Office at _____ (UNIT/OFFICE ADDRESS WHERE THE WORK IS EXECUTED) (here in after called "The Company" which expression shall unless repugnant to the subject or context includes its legal representatives, successors and assigns) having agreed to make an advance payment of Rs……(Rupees……..only) to M/s. ……. (here in after called "the said Contractor(s)/Seller(s)" which expression shall unless repugnant to the subject or context includes their legal representatives, successors and assigns) from the demand, terms and conditions of Contract/Order No…….. dated. …… for …… (work/assignment description) on production of a bank guarantee equivalent to 110% of the advance payment indicated above.

2. We ……..Bank having its branch office at do hereby agree and undertake to pay the amount due and payable under this guarantee without any demur, merely on a demand from the Company stating that in the opinion of the Company which is final and binding, the amount claimed is due by way of loss or damage caused to or would be caused to or suffered by the Company by reason of non-payment/adjustment of any part of the said advance or any dues to the company or any breach by the said Contractor(s)/seller(s) of any of the terms and conditions contained in the said contract(s)/orders(s) or by reasons of the Contractor(s)/Seller(s) failure to perform the said Contract(s)/Order(s). Any such demand made on the Bank by the Company shall be conclusive as regards the amount due and payable by the Bank under this guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding Rs…….. (Rupees… only).

3. We undertake to pay to the Company any money so demanded not withstanding any claim dispute or disputes raised by the contractor(s)/Seller(s) in any suit or proceeding pending before any office, court or tribunal relating thereto our liability under this present guarantee being absolute and unequivocal. The payment so made by us under this bond shall be a valid discharge of our liability for payment there under. Our liability to pay is not dependable or conditional on the Company proceeding against the Contractor(s)/Seller(s).

4. The guarantee herein contained shall not be determined or affected or suspended by the liquidation or winding up, dissolution or change of constitution or insolvency of the said tenderer(s) but shall in all respect and for all purposes be binding and operative until payment of all money due or liabilities under the said contract(s)/order(s) are fulfilled.

5. We ..... Bank further agree that the guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the said Contract(s)/Order(s) and that it shall continue to be enforceable till all the dues of the Company under or by virtue of the said Contract(s)/Order(s) have been fully paid and its

claims satisfied or discharged or till a duly authorized officer of the Company certifies that the terms and conditions of the said Contract(s)/Order(s) have been fully and properly carried out by the said Contractor(s)/Seller(s) and accordingly discharges this guarantee.

6. That the company/Company will have the fully liberty without reference to us and without affecting this guarantee to postpone for any time or from time to time the exercise of any of the power of the company under the Contract(s)/Order(s).

7. Notwithstanding anything contained herein before, our liability shall not exceed Rs ..... (Rupees..... only) and shall remain in force till.....Unless a demand or claim under this Guarantee is made on us within three months from the date of expiry, we shall be discharged from all the liabilities under this guarantee.

8. We ..... Bank further agree that this Guarantee shall be invocable at our place of business at..... (Bank Name), (Branch name and address of the branch), Bhubaneshwar, Odisha-751XXX.

9. We ..... Bank, lastly undertake not to revoke this guarantee during its currency except with the previous consent of the Company in writing. We further undertake to keep this Guarantee renewed from time to time at the request of Contractor(s)/Sellers(s).

Date… ..... Bank
Corporate Seal of the Bank By its constitutional Attorney

Signature of duly Authorised person
On behalf of the Bank With seal & signature code

Details of Persons issuing the
BG: Name----------
Address for Correspondence: ----------
Telephone & Fax No.-------
E-mail :- - - - - - - - -

Note: -

1) BGs to be furnished from any of the approved banks of NALCO and processed through SFMS.
2) BG confirmation must be sent to our Banker through SFMS with the following details.

Beneficiary	: NATIONAL ALUMINIUM COMPANY LIMITED
Banker	: State Bank of India, SME Branch, NALCO Corporate Office, P-1, Nayapalli, Bhubaneswar-751013
A/C No.	: 10044880013
IFSC Code	: SBIN0009817
Email	: sbi.09817@sbi.co.in

Annexure-XIII

LIST OF STANDARDISED BANKS FOR BG

Any domestic Guarantee issued by PSU Bank (or) Private Bank (or) Foreign Bank operating in India must be operational and invocable in Bhubaneswar only. For Guarantee to be operational in Bhubaneswar the issuing bank must designate a specified Bank Branch in Bhubaneswar.

List of PSU Banks

Sl. No	Name of the Bank
1	Bank of Baroda
2	Bank of India
3	Bank of Maharashtra
4	Canara Bank
5	Central Bank of India
6	Indian Bank
7	Punjab & Sind Bank
8	Punjab National Bank
9	State Bank of India
10	UCO Bank
11	Union Bank of India

List of Private Banks

Sl. No	Name of the Bank
1	HDFC Bank Ltd.
2	ICICI Bank Ltd.
3	Axis Bank Ltd.
4	Kotak Mahindra Bank Ltd.
5	Yes Bank
6	IndusInd Bank Ltd.
7	The Federal Bank Ltd.
8	The Jammu & Kashmir Bank Ltd.
9	The South Indian Bank Ltd.
10	The Karur Vysya Bank Ltd.
11	The Karnataka Bank Ltd.
12	IDFC Bank
13	RBL Bank
14	Tamilnadu Mercantile Bank Ltd.
15	City Union Bank Ltd.
16	IDBI Bank

List of Foreign Banks

Sl. No	Name of the Bank	BIC
1	Abu Dhabi Commercial Bank Limited	ADCB AE AA
2	Australia & New Zealand Banking Group Limited	ANZB AU 3M
3	Bank of America NA	BOFA US 3N
4	Bank of Bahrain and Kuwait B.S.C.	BBKU BH BM
5	Bank of Ceylon	BCEY LK LX
6	Barclays Bank PLC	BARC GB 22
7	BNP Paribas	BNPA FR PP
8	Citibank N.A.	CITI US 33
9	Commonwealth Bank of Australia	CTBA AU 2S
10	Credit Agricole Corporate & Investment Bank	BSUI FR PP
11	Credit Suisse AG	CRES CH ZZ
12	DBS Bank Ltd.	DBSS SG SG
13	Deutsche Bank AG	DEUT DE FF
14	Doha Bank	DOHB QA QA
15	FirstRand Bank Ltd.	FIRN ZA JJ
16	Industrial Bank of Korea	IBKO KR SE
17	Industrial & Commercial Bank of China Limited	ICBK CN BJ
18	JP Morgan Chase Bank	CHAS US 33
19	KEB Hana Bank	KOEX KR SE
20	Krung Thai Bank Public Company Ltd.	KRTH TH BK
21	Mashreqbank PSC	BOML AE AD
22	Mizuho Bank Ltd.	MHCB JP JT
23	National Australia Bank Ltd.	NATA AU 33
24	Sberbank	SABR RU MM
25	Shinhan Bank	SHBK KR SE
26	Societe Generale	SOGE FR PP
27	Sonali Bank Ltd.	BSON BD DH
28	Standard Chartered Bank	SCBL GB 2L
29	Sumitomo Mitsui Banking Corporation	SMBC JP JT
30	The Bank of Nova Scotia	NOSC CA TT
31	The Bank of Tokyo-Mitsubishi UFJ, Ltd.	BOTK JP JT
32	The Hongkong and Shanghai Banking Corp.Ltd.	HSBC HK HH
33	The Royal Bank of Scotland PLC	RBOS GB 2L
34	United Overseas Bank Ltd.	UOVB SG SG
35	Westpac Banking Corporation	WPAC AU 2F
36	Woori Bank	HVBK KR SE

******

Annexure - XIV

SOCIAL ACCOUNTABILITY POLICY

We at NALCO are committed to provide a socially accountable work environment to all employees and uphold ethical business practices by respecting employees' rights.

We shall achieve these by adopting a companywide culture, which will help to promote:

- Involvement of all employees in sustenance of SA 8000 standard;
- Continual improvement initiatives in all social issues;
- Learning and training opportunities to all employees;
- Fulfillment of relevant statutory rules & regulations, ILO requirements, applicable international instruments and their interpretation.

****

ENVIRONMENT POLICY

In recognition of the interests of the society in securing sustainable industrial growth, compatible with a wholesome environment, NALCO affirms that it assigns high importance to promotion and maintenance of a pollution-free environment in all its activities.

OBJECTIVES:

- To use non-polluting and environment-friendly technology.
- To monitor regularly air, water, land, noise and other environmental parameters.
- To constantly improve upon the standards of pollution control and provide a leadership in environment management.
- To develop employees' awareness on environmental responsibilities and encourage adherence to sound environmental practices.
- To work closely with the Government & local authorities to prevent or minimize adverse consequences of the industrial activities on the environment.
- To comply with all applicable laws governing environment protection through appropriate mechanisms.
- To actively participate in social welfare and environmental development activities of the locality around its Units.

****

OCCUPATIONAL HEALTH & SAFETY POLICY

NALCO is committed to maintain a Safe, Healthy and Sustainable work environment in all its operations. This shall be achieved by:

- Focusing on prevention of Accidents and Occupational Health issues.
- Complying with all legal requirements & other requirements related to Safety and Occupational Health of persons and establishing clearly defined goals & procedures to achieve the same.
- Ensuring Safety & Health of all employees and contract workers in its premises, including those involved in transportation, cleaning and other such activities.
- Conducting Periodic Safety Audits, Environment Audits, Health Check-ups and Risk Assessment by both internal and external qualified persons.
- Considering aspects related to Safety and Health of personnel as well as environmental issues at the time of procurement of equipment and selection of technologies.
- Ensuring health of persons in the peripheral locations, likely to be affected by our operations.

- Periodically monitoring and reviewing safety & occupational health issues at relevant levels, including the highest levels.
- Communicating Safety Hazards and health related issues to all concerned through suitable means, including training.
- Involving the workmen in Policy implementation as well as identification of potential issues.
- Considering Health & Safety performance of individuals at different levels during their career advancement as per NALCO's policy.
- Establishing and maintaining suitable set-up with competent persons to monitor and bring to the notice of the management any issues related to unsafe conditions & practices.
- Striving for continual improvements, exceeding statutory compliance levels, wherever feasible.

****

ENERGY POLICY

Enhancing Energy Performance, comprehensively optimising Energy Use, Energy Consumption and Energy Efficiency, is a major imperative for an Energy Intensive industry like ours. In recognition of this, we will focus on continual improvement of all round Energy Performance with special focus on areas of significance by way of having in place Energy Objectives based on the enshrined Guiding Principles.

Guiding Principles:

- To endeavour for reduction in Specific Consumption of Energy in all forms in areas of significance.
- To ensure availability of correct information in time and to make available necessary resources for achieving the Objectives and Targets.
- To comply with all applicable legal and other statutory/ regulatory requirements related to our energy use, consumption and efficiency.
- To espouse Energy Efficient Technology encompassing procurement of Energy Efficient products & services and design for energy performance improvement.
- To carry out Energy audits and Energy reviews at planned intervals, to improve energy performance.

****

Annexure - XV

STATEMENT OF COMPLIANCE WITH GENERAL ENVIRONMENTAL REQUIREMENTS

To
National Aluminium Company Ltd.,
_____

This is with reference to your Tender Reference no. _____ dtd._____for items _____ _____.

I □We confirm that our product(s) **manufacturing**/assembly **sites** at _____ _____ possess valid **consents**/ licenses/authorizations eg _____ _____ from _____ _____

Or

□ No consents/ licenses/authorizations from the Statutory Authorities is required/ applicable as _____ _____

II. We confirm that our product(s) shall not contain more than max. allowable limit (as per Regulations) of asbestos materials, arsenic and its compounds, lead and its compounds, mercury and its compounds, cadmium and its compounds.

III. We confirm that our product(s) **packaging** will use materials of bio-degradable nature or re-cyclable nature to the maximum possible extent, and will not use environmentally damaging or hazardous materials.

IV. We confirm that our product(s) packaging will be adequate for preventing leaks/ spills/ exposure during handling or transportation.
Packaging brief description: _____ _____ _____

V. We confirm that our product(s) **labeling and marking** shall be as per recognized national/international standards and will include all relevant symbols/instructions for handling, safety, disposal etc as needed.

VI. □ A 'buy-back' scheme is available for the type of product(s) on offer which is enclosed
OR
□ Presently, no 'buy-back' scheme is available for the type of product(s) on offer.

Date: (**SIGNATURE OF BIDDER WITH SEAL**)

Annexure - XVI

Social Accountability 8000 Compliance Format

A. Basic information		
Name of the organization		
Address		
Telephone No		
Name of the Proprietor		
Nature of Business		
License Number and date of expiry		
Employees	Staff (Total Number)	Workmen (Total Number)
• Permanent		
• Casual		
• Badli		
• Temporary		
• Contracted		
B. Information regarding Social Accountability		
▪ What is the minimum age required to join your organization?		_____ Years
▪ What types of certificates (Like mark sheet, birth certificate) you keep with you?		Original Copy / Xerox
▪ Do you require to keep any kind of deposit inform of cash at the time of employment?		Yes/No
▪ Do you provide safe & healthy work environment as per statutory requirement?		Yes/No
▪ If directly not provided by you, do you get health & safety benefits from NALCO?		Yes/No
▪ Are you certified for SA 8000? If Yes, please submit a copy of SA8000 Certificate along with this filled up questionnaire		Yes/No
▪ Have you undergone Code of Conduct Audit (COC Audit) in last 2 years ? If yes, please submit a copy of Code of Conduct Audit Report along with this filled up questionnaire		Yes/No
▪ Have your sub-suppliers been certified for SA 8000?		Yes/No

▪ Have your sub-suppliers undergone Code of Conduct Audit (COC Audit) in last 2 years?	Yes/No
▪ Do you provide personal protective equipment(s) to your employees free of cost?	Yes/No
▪ Do you provide safety training to your employees?	Yes/No
▪ Do you ensure canteen facility for your employees?	Yes/No
▪ If not, do you get the facilities from NALCO	Yes/No
▪ What types of medical benefits you provide to your employees? _____ _____ _____	
▪ Do you allow trade union and collective bargaining in your organization?	Yes/No
▪ If no, how do you ensure freedom of expression? _____ _____ _____	
▪ In case of non-performance of any employee, how do you deal with such situations? _____ _____ _____	
▪ What are the procedures of hiring/promotion/ remuneration in your organization? _____ _____ _____	
▪ Do you provide appointment letter to your employees?	Yes/No
▪ Do you maintain a documented terms and conditions of employment?	Yes/No
▪ Do you maintain a disciplinary procedure?	Yes/No
▪ If no, how do you terminate your employee? _____ _____ _____	
▪ How do you ensure that your employees are not discrimination on the basis of cast creed, gender, religion, age and dieses? _____	

_____ _____	
▪ How many shift you have?	_____ shifts
▪ What is the official working time?	_____ hours
▪ Which day is off day in your organization?	_____
▪ In case, a person works in off day or holiday, how is he/she compensated? _____ _____ _____	
▪ Do you pay overtime to your employees as per law?	Yes/No
▪ What is the lowest amount (salary/wage) you pay to your employees?	Rs._____/-
▪ Is there any case of deduction in wage?	Yes/No
▪ In case, it is yes, what are the general reasons for such deduction? _____ _____ _____	
▪ Is there any apprentice period in your organization?	Yes/No
▪ If yes, what is the apprentice period in your organization?	_____
▪ Do you have any international certification	Yes/No
▪ If yes, please specify _____ _____ _____	
▪ Do you receive, handle or promote goods and/or services from supplier/subcontractors or sub-suppliers	Yes/No
▪ Do you receive, handle or promote goods and/or services from supplier/subcontractors or sub-suppliers who are classified as home worker?	Yes/No
▪ If yes, what steps you have taken to ensure that they get similar level of protection as afforded to directly employed employees? _____ _____ _____	
▪ Have you taken care to look into issues related to child labor	Yes/No

Forced labor, health & safety, working hours and remuneration of your suppliers	

We do hereby declare that our organization is committed to social accountability. We will promptly implement remedial/corrective actions identified against the requirement and promptly inform your organization. We also declare that the sub-contractors/sub supplier's performances are monitored by us. Moreover, we declare that if invited, we shall participate in awareness program as well as monitoring program organized by you.

We declare that the above-mentioned information is correct.

Signature:

Designation:

Date: Seal of the organization

ANNEXURE-XVII

PREFERENCE TO MAKE IN INDIA
ORDER NO. P-45021/2/2017-PP (BE-II) DT. 16.09.2020

1.0 For the purpose of this order dtd. 16.09.2020: -

1.1 Local content means the **amount of value added in India** which shall, unless otherwise prescribed by the nodal ministry, **be the total value of the item procured** (excluding net domestic indirect taxes) **minus the value of imported content in the item** (including all customs duties) **as a proportion of the total value, in percent**.

1.2 Class- I local supplier means a supplier or service provider whose goods, services or works offered for procurement has local content equal to or more than 50%, as defined at clause 1.1 above.

1.3 Class- II local supplier means a supplier or service provider whose goods, services or works offered for procurement has local content equal to or more than 20% but less than 50%, as defined at clause 1.1 above.

1.4 Non-local supplier means a supplier or service provider whose goods, services or works offered for procurement has local content less than 20%, as defined at clause 1.1 above.

2.0 '**Margin of purchase preference**' means the maximum extent to which the price quoted by a "Class-I Local supplier" may be above the L1 for the purpose of purchase preference. The margin of purchase preference shall be 20% against the tender.

3.0 Subject to the provisions of the above order and to any specific instructions issued by the Nodal Ministry or in pursuance of this order, purchase preference shall be given to 'Class-I Local supplier' in procurement undertaken by procurement entities in the manner specified here under: -

4.0 **CASE-I (FOR DIVISIBLE QUANTITY):** All the provisions of the order No.P-45021/2/2017-PP(BE-II) dtd. 16.09.2020 as revised from time to time shall be applicable for this tender towards purchase preference.

However, in case of participation by MSE & ancillary units, the tender quantity reserved for MSE & ancillary units as per purchase preference policy of NALCO for MSEs as mentioned at cl __ of tender document shall take precedence over the purchase preference against the above-mentioned order **(to be mentioned, if applicable- Not applicable for this tender**).

4.1 In the procurement of goods or works which are divisible in nature, the 'Class-I Local Supplier' shall get purchase preference over 'Class-II local supplier' as per the following procedure:

a) Among all qualified bids, the lowest bid will be termed as L1. If L1 is 'Class-I local supplier', the contract of full quantity will be awarded to L1.

b) If L1 bid is not a 'Class I local supplier', 50% of the order quantity shall be awarded to L1. Thereafter. the lowest bidder among the 'Class I Local supplier' will be invited to match the L1 price for the remaining 50% quantity subject to Class-I local supplier's quoted price falling within the margin of purchase preference and contract for that quantity shall be awarded to such 'Class-I Local supplier' subject to matching the L1 price. In case such lowest eligible 'Class-I Local supplier' fails to match the L1 price or accepts less than the offered quantity, the next higher 'Class-I Local supplier', within the margin of purchase preference shall be invited to match the L1 price for the remaining quantity and so on and the contract shall be awarded accordingly. In case some quantity is still left uncovered on 'Class-I Local supplier, then such balance quantity may also be ordered on the L1 bidder.

4.2 'Class-II local supplier' will not get purchase preference in any procurement undertaken by procuring entities.

4.3 **CASE-II (FOR NON-DIVISIBLE QUANTITY):** All the provisions of the order No.P-45021/2/2017-PP(BE-II) dtd. 16.09.2020 as revised from time to time shall be applicable for this tender towards purchase preference.

4.4 In the procurement of goods or works which are not divisible in nature, the 'Class-I Local Supplier' shall get purchase preference over 'Class-II local supplier' as per the following procedure:

a) Among all qualified bids, the lowest bid will be termed as L1. If L1 is 'Class-I local supplier', the contract will be awarded to L1.

b) If L1 bid is not a 'Class I local supplier', the lowest bidder among the 'Class I Local supplier' will be invited to match the L1 price subject to Class-I local supplier's quoted price falling within the margin of purchase preference and contract shall be awarded to such 'Class-I Local supplier' subject to matching the L1 price.

c) In case such lowest eligible 'Class-I Local supplier' fails to match the L1 price, 'Class-I Local supplier' with the next higher bid within the margin of purchase preference shall be invited to match the L1 price and so on and contract shall be awarded accordingly. In case none of the 'Class-I Local supplier' within the margin of purchase preference matches the L1 price, the contract may be awarded to the L1 bidder.

4.5 'Class-II local supplier' will not get purchase preference in any procurement undertaken by procuring entities.

5.0 **Verification of local content.**

5.1 The 'Class-I local supplier'/ 'Class II-local supplier' at the time of tender, bidding or solicitation shall be required to indicate percentage of local content and provide self-certification that the item offered meets the local content requirement for 'Class-I local supplier'/ 'Class II-local supplier', as the case may be. They shall also give details of the location(s) at which the local value addition is made. **Declaration to be given in the format given in the following format.**

5.2 In case of procurement for a value in excess of Rs. 10 Crores, the 'Class-I local supplier'/ 'Class II-local supplier' shall be required to provide a certificate from the statutory auditor or cost auditor of the company (in the case of the companies) or from a practicing cost accountant or practicing chartered accountant (in respect of suppliers other than companies) giving the percentage of local content.

5.3 Decisions on complaints relating to implementation of this order shall be taken by the competent authority which is empowered to look into procurement-related complaints relating to the procuring entity.

6.0 **Only "Class-I local suppliers and Class-II local suppliers", as defined under the order, shall be eligible for participation against this tender. The offers of 'Non-Local Suppliers' shall not be considered for evaluation against this tender.**

7.0 **However as per office order no. P-45021/102/2019-BE-II-Part(1), dated. 04/03/2021 of Ministry of Commerce and industry, the bidder can't claim themselves as class-I local supplier/class-II local suppliers by claiming the services such as transportation, insurance, installation, commissioning, training and after sales service support like AMC/CMC etc. as local value additions.**

(Declaration by the bidder on their letter head)

FORMAT OF MAKE-IN-INDIA DECLARATION CERTIFICATE

(In compliance to the Public Procurement (Preference to Make-in-India) Order 2017 issued by Department of Promotion of Industry and Internal Trade (Public Procurement Section), Ministry of Commerce and Industry, Government of India, dated 16.06.2020, 04.03.2021 & 19.07.2024 (as amended).

TO WHOMSOEVER IT MAY CONCERN

M/s……..certifies that the following component wise breakup indicated below is in line with the Make in India policy with respect to the value addition to the total price quoted by us against the Tender Ref. No……..

M/s…….. also solemnly declare that component wise breakup given below are true and correct and understand that "*false declarations will be breach of Code of Integrity under Rule 175(1)(i)(h) of General Financial Rule (GFR) for which a bidder or its successors can be debarred for up to two years as per Rule 151 (iii) of the General Financial Rules along with such other actions as may be permissible under law".*

M/s…….. also solemnly declare and understand that incase the given *"data does not meet the stipulated Local content requirement and the category of the supplier changes from Class 1 to Class 2/Non-Local or from Class 2 to Non-Local, a penalty up to 10% on the contract value may be imposed".*

Sl. No.	**Name of the item**	**Name of the manufacturer**	**Country of Origin**	**% value to th**	Location (s) and address at which the Local value addition is
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
Total value (in %) to the total cost					

Note: Points to be noted while certifying the declaration:

i. For item(s) sold by Bidder as Re-seller, OEM Certificate for country of origin is to be submitted.

ii. Supply of Re-packaged/Re-furbished/Re-branded "IMPORTED" product should be treated as "Re-selling of imported products" and must not be included while calculation of Local content.

iii. Services such as Transportation, Insurance, Installation, Commissioning, Training and after sales service support like AMC/CMC, etc. must not be included as Local content.

iv. All item(s) under PLI Scheme shall be treated as deemed Class II Local supplier for that item(s) unless they have minimum local content equal to or higher than that notified for Class I Local supplier for that item.

v. In case of procurement value in excess of Rs 10 Cr, the supplier shall required to provide a certificate from the statutory auditor or cost auditor of the company (in the case of companies) or from a practicing cost accountant or practicing charter accountant (in respect of suppliers other than companies) giving the percentage of Local content.

I/We hereby declare that all the details furnished above are true. If any information is found incorrect as per points mentioned above, than I agree to actions as per Rule of GFR mentioned above.

Date :

Place :

(Signature of authorized signatory of the Bidder/Supplier with stamp)

ANNEXURE-XVIII

RESTRICTIONS ON PROCUREMENT FROM A BIDDER OF A COUNTRY WHICH SHARES A LAND BORDER WITH INDIA

Ministry of Finance of Govt. of India, Department of Expenditure, Public procurement Division vide office memorandum F. No. 6/18/2019-PPD dated 23rd July, 2020(order-Public Procurement no.1) & subsequent orders, has proclaimed the insertion of Rule 144 (xi) in the General Financial Rules (GFRs), 2017 w.e.f. 23rd July, 2020 regarding restrictions on procurement from a bidder of a country which shares a land border with India on the grounds of defence of India on matters directly or indirectly related thereto including national security. Bidders are requested to take note of the following clauses and submit their offers accordingly wherever applicable.

Bidders must submit duly sealed & signed undertaking as per format provided vide, "PROFORMA -All1" along with the technical bid.

I. Any bidder from a country which shares a land border with India will be eligible to bid in this tender only if the bidder is registered with the Competent Authority.

Validity of Registration:

In respect of tenders, registration should be valid at the time of submission of bids and at the time of acceptance of bids. In respect of supply otherwise than by tender, registration should be valid at the time of placement of order. If the bidder was validly registered at the time of acceptance/placement of order, registration shall not be a relevant consideration during contract execution.

II. "Bidder" (including the term 'tenderer', 'consultant' or 'service provider' in certain contexts) means any person or firm or company, including any member of a consortium or joint venture (that is an association of several persons, or firms or companies), every artificial juridical person not falling in any of the descriptions of bidders stated hereinbefore, including any agency branch or office controlled by such person, participating in a procurement process.

III. "Bidder from a county which shares a land border with India "for the purpose of this Order means: -

a. An entity incorporated, established or registered in such a country; or

b. A subsidiary of an entity incorporated, established or registered in such a country; or

c. An entity substantially controlled through entities incorporated, established or registered in such a country; or

d. An entity whose beneficial owner is situated in such a country; or e. An Indian (or other) agent of such an entity; or

f. A natural person who is a citizen of such a country; or

g. A consortium or joint venture where any member of the consortium or joint venture falls under any of the above.

IV. The beneficial owner for the purpose of (iii) above will be as under:

1. In case of a company or Limited Liability Partnership, the beneficial owner is the natural person(s), who, whether acting alone or together, or through one or more juridical person, has a controlling ownership interest or who exercises control through other

means. Explanation –

a. "Controlling ownership interest" means ownership of or entitlement to more than twenty-five per cent of shares or capital or profits of the company;

b. "Control" shall include the right to appoint majority of the directors or to control the management or policy decisions including by virtue of their shareholding or management rights or shareholders agreements or voting agreements;

2. In case of a partnership firm, the beneficial owner is the natural person (s) who, whether acting alone or together, or through one or more juridical person, has ownership of entitlement to more than fifteen percent of capital or profits of the partnership.

3. In case of an unincorporated association or body of individuals, the beneficial owner is the natural person(s), who, whether acting alone or together, or through one or more juridical person, has ownership or entitlement to more than fifteen percent of the property or capital or profits of such association or body of individuals;

4. Where no natural person is identified under (1) or (2) or (3) above, the beneficial owner is the relevant natural person who holds the position of senior managing official;

5. In case of trust, the identification of beneficial owner(s) shall include identification of the author of the trust, the trustee, the beneficiaries with fifteen percent or more interest in the trust and any other natural person exercising ultimate effective control over the trust through a chain of control or ownership.

V. An Agent is a person employed to do any act for another, or to represent another in dealings with third person.

VI. The successful bidder shall not be allowed to sub-contract any job related to the procurement (e.g. installation and commissioning, Annual Maintenance Contract etc.) to any contractor from a country which shares a land border with India unless such contractor is registered with the Competent Authority.

UNDERTAKING BY BIDDER

(To be typed on the letterhead of the bidder)

Ref. No : _____ Date: _____

Tender No. _____

NATIONAL ALUMINIUM COMPANY LIMITED (NALCO)

_____

_____

Dear Sirs,

I have read the clause regarding restrictions on procurement from a bidder or a country which shares a land border with India; I certify that this bidder is not from such a country or, if from such a country, has been registered with the Competent Authority. I hereby certify that this bidder fulfils all requirements in this regard and is eligible to be considered. [Where evidence of valid registration by the Competent Authority shall be attached.]"

I also agree that, during any stage of the tender/contract agreement, in case the above information/documents submitted by us are found to be false, NALCO has the right to immediately reject our bid/terminate contract at any stage and carry out further legal action on us in accordance with law.

Yours faithfully,

For (type name of the firm here)

Signature of Authorised Signatory

Name :

Designation :

Phone No.

Place :

Date :

(Affix Seal of the Organization here)

ANNEXURE – XIX

Anti-Profiteering Clause (Sec 171 of CGST Act) (Applicable for Indian Bidders)

If any new Tax/Taxes is introduced on sale of goods/services, either in lieu of existing tax/taxes or as separate tax/taxes, then the overall incidence of tax/taxes on the Vendor on account of its inputs and outputs wherever less than the incidence of existing taxes, then the Vendor shall pass on to Owner, the benefits thereof by way of commensurate reduction in the basic price w.r.t. Input Tax benefits and reduction in Tax chargeable to 'Nalco' w.r.t. Output Tax benefits in connection with goods and/or services provided.

If on the other hand, the incidence of tax/taxes is in excess of the incidence of existing tax/taxes, the Owner on submission of satisfactory proof, shall reimburse the Vendor the additional incidence of tax provided they are within the contractual completion date.

The Vendor has to provide a declaration along with the Tender that they will abide by the requirements under Cl 171 of CGST Act, 2017.

(To be submitted with BID)

ANTI-PROFITEERING DECLARATION FORMAT

(To be typed on the letterhead of the bidder)

To whomsoever it may concern

I, Mr._____, Proprietor/_____ Other authorised signatories) of M/s._____, hereby solemnly and sincerely declare that, while giving this quotation to NALCO against Tender No. _____ Dt._____, me /my firm/my company has abided by all Tax Laws and Rules including but not limited to Section 171 of the Central Goods and Services Tax Act, 2017.

I hereby solemnly and sincerely declare that, me/my firm/my company, will continue to abide by the said laws, including but not limited to Section 171 of the Central Goods and Services Tax Act, 2017, as applicable from time to time during the life of the tender and during execution of any order placed with reference to the said tender.

I further declare that, me/my firm/my company, in furtherance and in compliance to the said section, will make commensurate reduction in the basic prices w.r.t. Input Tax benefits and reduction in Tax charged to 'Nalco' w.r.t. Output Tax benefits in connection with goods and/or services provided.

I further declare that the foregoing is true and correct and the same is a legal obligation and failure to fulfil if could result in penalties under the law.

Date:_____

Place:_____

To be signed by the authorized person under the firm's seal.

Annexure-XX

Declaration regarding Relationship with Client's Director

The tenderer shall carefully study the list of directors of NALCO from the website written below https://nalcoindia.com/company/nalco-leadership/board-of-directors/

and state "Yes" or "No" to questions given below:

Sl.No.	Description	Write "Yes" or "No"
1.	Whether the tenderer is a relative of any of the directors of NALCO?	
2.	If the tenderer is a firm, any of NALCO Directors or any of their relatives is a partner in the tender's firm?	
3.	If the tenderer is a Company Registered under Company's Act 1956, whether any of NALCO's Directors is a member of Director of the Company?	

Note: If Yes to any of the above questions, please give the name of NALCO's Director and relationship of the tender / partner / member / Director as the case may be.

Sl. No.	Name	Relationship

(SIGNATURE OF THE BIDDER WITH SEAL)

Annexure-XXI

Declaration regarding Relative in NALCO

Important: Suppression of information shall be viewed seriously and action deemed fit would be taken including termination of the contract.

(Strike out which is not applicable)

1. I/We hereby declare that none of my/our relative is an employee of NALCO.
2. I/We hereby declare the following are the employee/s of NALCO is/are my/our relative/s.

Sl.No.	Name of the employee/ P.No. / Designation/Place of Posting.	Relationship with the employee.
1		
2		
3		

(PLEASE ATTACH EXTRA SHEET, IF REQUIRED)

(SIGNATURE OF THE BIDDER WITH SEAL)

Annexure – XXII

FORMAT FOR AGREEMENT

(To be executed between successful bidder & NALCO on non-judicial stamp paper of Rs. 100.00 and jurisdiction of Orissa High Court)

Contract Agreement made on this day _____ for the work "_____(DLOA No _____ Dated _____ between M/s_____ (party's name & address) _____hereinafter called the "CONTRACTOR" (which terms shall unless excluded by or repugnant to the subject or context include its successors and permitted assignees) of the one part and **M/s National Aluminium Company Limited** hereinafter called the "Owner" (which term shall unless excluded by or repugnant to the subject or context include its Successors and permitted assignees) of the other part.

Whereas:

A. The Owner being desirous of having provided and executed certain works mentioned, enumerated or referred to in the tender documents including Notice Inviting Tender/Letter Inviting Tender, General Conditions, Drawings, Plans, Time Schedule of Completion of jobs and other documents has called for Tender.

B. The contractor has inspected the site and surroundings of the works specified in the tender documents and has satisfied himself by careful examination before submitting his tender as to the nature of the surface strata, soil, sub-soil and ground, the form and nature of site and local conditions, the quantities, nature and magnitude of the work, the availability of labour and materials necessary for the execution of work, the means of access to site, the supply of power and water thereto and the accommodation he may require and has made local and independent enquiries and obtained complete information as to the matters and things referred to or implied in the tender documents or having any connection therewith, and has considered the nature and extent of all probable and possible situations, delays, hindrances or interferences to do or with the executions and completion of the work to be carried out under the Contract, and has examined and considered all other matters, conditions and things and probable and possible contingencies, and generally all matters incidental thereto and ancillary thereof affecting the execution and completion of the work and which might have influenced him in making his tender.

C. The Notice Inviting Tender/Letter Inviting Tender, General Conditions of Contract, Special Conditions of Contract, General Obligations, Specifications, Drawings, Plans, Time Schedule of Completion of jobs, Letter of Acceptance of Tender and any statement of agreed variations with its enclosures, copies for which are hereto annexed from part of this contract though separately set out herein and are included in the expression "CONTRACT" wherever herein used.

And whereas:

The Owner accepted the Tender of the Contractor for the provision and the execution of the said work at the rates stated in the Schedule of Quantities of works and finally approved by Owner (hereinafter called the "Schedule of Rates") upon the terms and subject to the conditions of contract :

Now this agreement witnesses and it is hereby agreed and declared as follows:

1. In consideration of the payment to be made to the contractor for the work to be executed by him, the contractor hereby covenants with the Owner that the contractor shall and will duly provide, execute and complete the said works and shall do and perform all other acts and things in the contract mentioned or described or which are to be implied there from or may be reasonably necessary for the completion of the said works and at the said times and in the manner subject to the terms and conditions or stipulations mentioned in the contract.

2. In consideration of the due provision execution and completion of the said work, the Owner does hereby agree with the contractor that the owner will pay to the contractor the respective amounts for the works actually done by him and approved by the Owner at the Scheduled Rates and such other sum payable to the contractor under provision of the such contract, payment to be made at such time and in such manner as provided for in the contract.

AND

3. In consideration of the due provision, execution and completion of the said work the contractor does hereby agree to pay such sums as may be due to the owner for the services rendered by the owner to the contractor, such as power supply, water supply and others as set for in the said contract and such other sums as many become payable to the owner towards the controlled items of consumable materials or towards loss, damages to the owner's equipment, materials, construction plant and machinery, such payments to be made at such time and in such manner as is provided in the contract.

It is specifically and distinctly understood and agreed between the owner and the contractor that the contractor shall have no right, title or interest in the site made available by the owner for execution of the works or in the building, structure or works executed on the said site by the contractor or in the goods, articles, materials etc. brought on the said site (unless the same specifically belongs to the contractor) and the contractor shall not have or deemed to have any lien whatsoever charge for unpaid bills nor will be entitled to assume or retain possession or control of the site or structures and the owner shall have an absolute and unfettered right to take full possession of the site and to remove the contractor, his servants, agents and materials belong to the contractor and lying on the site.

The contractor shall be allowed to enter upon the site for execution of the works only as a licensee simpliciter and shall not have any claim, right, title or interest in the site or the structures erected thereon and the Owner shall be entitled to terminate such license at any time without assigning any reason.

The materials including sand gravel, stone, loose earth, rock etc dug up or excavated from the said site shall unless otherwise expressly agreed under this contract, exclusively belong to the Owner and the contractor shall have no right to claim over the same and such excavations and materials should be disposed off on account of the Owner according to the instructions in writing issued from time to time by the *Engineer-in-charge*.

In witness where of the parties have executed these presents in the day and the year first above written.

Signed and delivered for and on behalf of Owner	Signed and delivered for and on behalf of Contractor
(**M/s National Aluminium Co. Ltd.)**	**(M/s_____(Name of party)_____)**
Date - Place –	Date – Place -
In presence of two witnesses	In presence of two witnesses
1.	1.
2.	2.

Annexure – XXIII

INTERNET BANKING / R.T.G.S. BANKING MANDATE FORM

To
National Aluminium Company Limited, NALCO BHAWAN,
P/1, Nayapalli, Bhubanesawr,
Odisha - 751013

Dear Sir,

Sub: Authorisation for release of payment due from NALCO, Odisha through Internet Banking (SBI) or through R.T.G.S. Banking.

Refer Order No……..…… date……. and/ or Tender/ Enquiry/ Letter No…….…….. date…….

(Please fill in the information in CAPITAL LETTERS. Please TICK wherever it is applicable)

1. Name of the Party. : ……
2. Address of the Party. :……
……..
City..... | | | | | | |

E-mail Id:…….
PAN:…….

Particulars of									Branch Name														
Branch Place									Branch City														
Pin Code									Branch Code.														
MICR No.																							
(9 Digits code number appearing on the MICR Band of the cheque supplied by the Bank. Please attach Xerox copy of a cheque of your bank for ensuring accuracy of the bank name and code number)																							
Account Type	Savings								Current								Cash Credit						
Account Number (as appearing in the Cheque																							
R.T.G.S. IFSC Code.																							

3. Date from which the mandate should be effective: Dt./ /20.....

I/we hereby declare that the particulars given above are correct and complete. If any transaction is delayed or not effected for reasons of incomplete or incorrect information, I shall not hold M/s National Aluminium Company Limited responsible. I also undertake to advise any change in the particulars of my account to facilitate updating of records for purpose of credit of amount through RBI EFT/ Internet/ RTGS.

.

Place: Signature of the party/ Authorized Signatory
Date: .

Certified that particulars furnished above are correct as per our records.
Bank's Stamp:
Date:

(Signature of the Authorized Official from the Bank

Annexure-XXIV

Guidelines for e-Procurement and Reverse Auction

Instructions for Online Bid Submission

(Department User may attach this Document as an Annexure in their Tender Document which provides complete Instructions for on line Bid submission for Bidders)

The bidders are required to submit soft copies of their bids electronically on the CPP Portal, using valid Digital Signature Certificates. The instructions given below are meant to assist the bidders in registering on the CPP Portal, prepare their bids in accordance with the requirements and submitting their bids online on the CPP Portal.

More information useful for submitting online bids on the CPP Portal may be obtained at: https://eprocure.gov.in/eprocure/app.

REGISTRATION

1) Bidders are required to enroll on the e-Procurement module of the Central Public Procurement Portal (URL: https://eprocure.gov.in/eprocure/app) by clicking on the link “Online bidder Enrollment” on the CPP Portal which is free of charge.

2) As part of the enrolment process, the bidders will be required to choose a unique username and assign a password for their accounts.

3) Bidders are advised to register their valid email address and mobile numbers as part of the registration process. These would be used for any communication from the CPP Portal.

4) Upon enrolment, the bidders will be required to register their valid Digital Signature Certificate (Class III Certificates with signing key usage) issued by any Certifying Authority recognized by CCA India (e.g. Sify / nCode / eMudhra etc.), with their profile.

5) Only one valid DSC should be registered by a bidder. Please note that the bidders are responsible to ensure that they do not lend their DSC’s to others which may lead to misuse.

6) Bidder then logs in to the site through the secured log-in by entering their user ID / password and the password of the DSC / e-Token.

SEARCHING FOR TENDER DOCUMENTS

1) There are various search options built in the CPP Portal, to facilitate bidders to search active tenders by several parameters. These parameters could include Tender ID, Organization Name, Location, Date, Value, etc. There is also an option of advanced search for tenders, wherein the bidders may combine a number of search parameters such as Organization Name, Form of Contract, Location, Date, Other keywords etc. to search for a tender published on the CPP Portal.

2) Once the bidders have selected the tenders they are interested in, they may download the required documents / tender schedules. These tenders can be moved to the respective ‘My Tenders’

folder. This would enable the CPP Portal to intimate the bidders through SMS / email in case there is any corrigendum issued to the tender document.

3) The bidder should make a note of the unique Tender ID assigned to each tender, in case they want to obtain any clarification / help from the Helpdesk.

PREPARATION OF BIDS

1) Bidder should take into account any corrigendum published on the tender document before submitting their bids.

2) Please go through the tender advertisement and the tender document carefully to understand the documents required to be submitted as part of the bid. Please note the number of covers in which the bid documents have to be submitted, the number of documents - including the names and content of each of the document that need to be submitted. Any deviations from these may lead to rejection of the bid.

3) Bidder, in advance, should get ready the bid documents to be submitted as indicated in the tender document / schedule and generally, they can be in PDF / XLS / RAR / DWF/JPG formats. Bid documents may be scanned with 100 dpi with black and white option which helps in reducing size of the scanned document.

4) To avoid the time and effort required in uploading the same set of standard documents which are required to be submitted as a part of every bid, a provision of uploading such standard documents (e.g. PAN card copy, annual reports, auditor certificates etc.) has been provided to the bidders. Bidders can use “My Space” or ‘’Other Important Documents’’ area available to them to upload such documents. These documents may be directly submitted from the “My Space” area while submitting a bid, and need not be uploaded again and again. This will lead to a reduction in the time required for bid submission process.

Note: My Documents space is only a repository given to the Bidders to ease the uploading process. If Bidder has uploaded his Documents in My Documents space, this does not automatically ensure these Documents being part of Technical Bid.

SUBMISSION OF BIDS

1) Bidder should log into the site well in advance for bid submission so that they can upload the bid in time i.e. on or before the bid submission time. Bidder will be responsible for any delay due to other issues.

2) The bidder has to digitally sign and upload the required bid documents one by one as indicated in the tender document.

3) Bidder has to select the payment option as “offline” to pay the tender fee / EMD as applicable and enter details of the instrument.

4) Bidder should prepare the EMD as per the instructions specified in the tender document. The original should be posted/couriered/given in person to the concerned official, latest by the last date of bid submission or as specified in the tender documents. The details of the DD/any other accepted

instrument, physically sent, should tally with the details available in the scanned copy and the data entered during bid submission time. Otherwise the uploaded bid will be rejected.

5) Bidders are requested to note that they should necessarily submit their financial bids in the format provided and no other format is acceptable. If the price bid has been given as a standard BoQ format with the tender document, then the same is to be downloaded and to be filled by all the bidders. Bidders are required to download the BoQ file, open it and complete the white coloured (unprotected) cells with their respective financial quotes and other details (such as name of the bidder). No other cells should be changed. Once the details have been completed, the bidder should save it and submit it online, without changing the filename. If the BoQ file is found to be modified by the bidder, the bid will be rejected.

6) The server time (which is displayed on the bidders' dashboard) will be considered as the standard time for referencing the deadlines for submission of the bids by the bidders, opening of bids etc. The bidders should follow this time during bid submission.

7) All the documents being submitted by the bidders would be encrypted using PKI encryption techniques to ensure the secrecy of the data. The data entered cannot be viewed by unauthorized persons until the time of bid opening. The confidentiality of the bids is maintained using the secured Socket Layer 128 bit encryption technology. Data storage encryption of sensitive fields is done. Any bid document that is uploaded to the server is subjected to symmetric encryption using a system generated symmetric key. Further this key is subjected to asymmetric encryption using buyers/bid opener's public keys. Overall, the uploaded tender documents become readable only after the tender opening by the authorized bid openers.

8) The uploaded tender documents become readable only after the tender opening by the authorized bid openers.

9) Upon the successful and timely submission of bids (i.e. after Clicking "Freeze Bid Submission" in the portal), the portal will give a successful bid submission message & a bid summary will be displayed with the bid no. and the date & time of submission of the bid with all other relevant details.

10) The bid summary has to be printed and kept as an acknowledgement of the submission of the bid. This acknowledgement may be used as an entry pass for any bid opening meetings.

ASSISTANCE TO BIDDERS

1) Any queries relating to the tender document and the terms and conditions contained therein should be addressed to the Tender Inviting Authority for a tender or the relevant contact person indicated in the tender.

2) Any queries relating to the process of online bid submission or queries relating to CPP Portal in general may be directed to the 24x7 CPP Portal Helpdesk.

General Guideline to bidders on Reverse Auction (RA)-Not applicable for this tender

1. If a bidder does not participate in the Reverse Auction, the price quoted by him in the price bid shall be considered as the valid price of that bidder. The inter-se position of the said bidder shall be considered based on their position on completion of reverse auction.

2. Price bid shall be opened at ___:____ Hrs. on__.__.___ and Reverse Auction shall commerce at about __:__ Hrs. on __.__._____ and shall remain open for minimum two hours. Date & Time of Price bid opening shall be uploaded along with technical evaluation of the tender at CPP Portal. Start & end time of Reverse Auction shall be configured at CPP Portal after price bid opening and before start of reverse auction.
3. Starting bid price shall be the L1 offer price received against the tender.
4. Bid Decremental Value shall be Rs. 50,000/-.
5. Elapsed time and Auto Extension Time shall be set as 10 Minutes.
6. Other relevant parameters shall be displayed in the CPP Portal reverse auction window.
7. CPP Portal Server time shall be the basis of Start time & Closing time for bidding and shall be binding for all.
8. Auction flow is started and is closed after completion of the process. Once the Auction process is initiated the system takes over for auto auction activity. Then, comparison chart is generated.
9. The bidders to participate in tender-cum-auction (RA) process in CPP Portal, has to log into CPP Portal (i.e. https://eprocure.gov.in/eprocure/app) with DSC to access the application and quote from their own offices/place of their choice. Once logged in, the software gives them a platform to place bids.
10. All electronic bids submitted during the reverse auction process shall be legally binding on the bidder. The bid value submitted by the bidder are digitally signed by the bidders before submitting. The bidder, after initial submission of a bid, cannot subsequently increase the bid. They can only reduce their bid by the minimum permissible decrement or it's multiples. The last bid submitted by the bidder in the Reverse Auction will be considered as the valid price bid offered by that bidder and will be the basis for evaluation/acceptance by NALCO.
11. System displays L1 landed price in auction creation form and allows TIA to edit the value as 'Start bid' price. Normally, TIAs will enter the L-1 Price as the start bid price.
12. **Elapsed time & Auto Extension Time**: Shall be set as 10 (Ten) minutes. All the bidders shall get at least 10 minutes time period to submit their fresh bids, after receipt of latest bid during reverse auction process. There will be auto extensions of time, every time, (by ten minutes) on receipt of any valid bid with in the last 10 minutes time period calculated from prevailing bid end time. For example, if bid end time is set as 11:00 Hrs. and if any fresh bid is received during 10:50 and 11: 00 Hrs. Bids end time shall be auto extended by 10 minutes to 11:10 Hrs. if bids are received during last 10 minutes of end time, bid end time keeps on auto extended by 10 minutes every time. The reverse auction will come to a close only when there is no new bid recorded in the last ten minutes slot of bid end time.

13. **Maximum Seal Percentage:** Shall be set as 3%. It is the maximum reduction that can be allowed in the bidding process in a single go. Higher reduction will not be allowed by the system. This protects any possible mistakes by bidders. For any higher discount, the bidder has to repeat the action and the system allows it.
14. Only the chronologically last bid submitted by the bidder till the end of the auction shall be considered as the valid price bid of that bidder. Any bid submitted earlier by the bidder prior to submission of his last bid will not be considered as valid price bid.
15. Final BOQ-Comparative-Chart is generated from the system by freezing the tender at the end of reverse auction process. The chart contains original offer and L1 auction price details. The log details of the entire reverse auction process will be generated by the system once the process of reverse auction is completed. The above information can also be accessed by the participating bidders, once the reverse auction is completed.
16. In case of item-rate-BOQ for placement of order on over -all-L-1 basis, after completion of auction process the rates of individual items are reduced proportionately to match the lowest landed rate quoted by the L1 bidder, in the reverse auction process.
17. In case of disruption of service at the CPP Portal end during Reverse Auction Process, the Reverse Auction Process will start all over again. In such a situation, the last recorded lowest price of prematurely ended Reverse Auction Process, will be the 'Start Bid' price for the restarted process. Disruption and restarting of Reverse Auction Process shall be intimated to all the bidders through system/SMS/e-mail through CPP Portal. All the stipulation of pre-maturely ended Reverse Auction Process will be applicable to the restarted process.
18. Bidders at their own interest should ensure uninterrupted internet connectivity at their end during the reverse auction with necessary backups to take care of any connectivity problem.

Minimum Bidder for Elimination: 4 (recommended value) - If procuring entity has received the minimum number of bids, say 4 then system will initiate the Bidder Elimination process.

Number of Bidder to Eliminate: 1(recommended value) - When the system will implement Bidder Elimination process, then system will eliminate say 1 (or mentioned number of Bidder) and start the Auction process with rest of the Bidders.

In case of Reverse Auction, H1 Bidder will be eliminated from participating in the auction even though qualified in the techno-commercial evaluation and in Forward Auction, System will eliminate L1 Bidder.

Annexure-XXV

CHECKLIST FOR BIDDER

Following information along with the attested copy/copies of all the supporting documents as applicable, are to be submitted:

SL.	Documents description	Submitted	Ref. Page No.
1.	EMD Instrument as per NIT specification	Yes/No	Pg.___to Pg.__
	Annexure IX (For online submission of EMD)		
	Bid security Declaration (For Exemption of EMD)		
2.	Documentary evidence in support of pre-qualifying criteria of the NIT		
	(a) Consortium Agreement as per Form A of Annexure-I	Yes/No/NA	Pg.___to Pg.__
	(b) Work Orders listing as per Form B Annexure-I	Yes/No	Pg.___to Pg.__
	(c) Financial Documents i.e. balance sheet, Profit & Loss Account of last three years and statement per Form C of Annexure-I	Yes/No	Pg.___to Pg.__
3.	Pre-Contract Integrity Pact duly filled and signed as per Annexure-XXVI	Yes/No	Pg.___to Pg.__
4.	E.P.F. A/c CODE along with supporting documents	Yes/No	Pg.___to Pg.__
5.	E.S.I. A/c CODE along with supporting documents	Yes/No	Pg.___to Pg.__
6.	PAN No. along with support documents	Yes/No	Pg.___to Pg.__
7.	PAN based GST registration No. along with support documents	Yes/No	Pg.___to Pg.__
8.	Power of Attorney of the signatory / Authorized signatory nominated by the company for the tender, if signed by other than proprietor.	Yes/No	Pg.___to Pg.__
9.	Annexure-VIII regarding details of present / concurrent commitments and information of the tenderer	Yes/No	Pg.___to Pg.__
10.	Forwarding Letter and Undertaking as Per Annexure-V	Yes/No	Pg.___to Pg.__
11.	Mandatory Information of the Bidder as per Annexure-II	Yes/No	Pg.___to Pg.__
12.	Exception / Deviation Statement to the Tender Terms & Conditions as per Annexure-IV	Yes/No	Pg.___to Pg.__
13.	Declaration by the Bidder as per Annexure-VI	Yes/No	Pg.___to Pg.__
14.	Social Accountability Policy as per Annexure-XVI	Yes/No	Pg.___to Pg.__
15.	Bank Mandate Form for E-Payment as per Annexure-XXIII	Yes/No	Pg.___to Pg.__

16.	Declaration regarding relatives in NALCO as per Annexure-XX & Annexure-XXI	Yes/No	Pg.___to Pg.__
17.	Preference to Make in India (Annexure-XVII)	Yes/No	Pg.___to Pg.__
18.	Compliance of Public order on Restrictions under Rule 144 (xi) of the General Financial Rules (Annexure-XVIII)	Yes/No	Pg.___to Pg.__
19.	Solvency Certificate from a Bank	Yes/No	Pg.___to Pg.__
20.	Proof of ownership/partnership of the firm/ Article of association of company, etc..	Yes/No	Pg.___to Pg.__
21.	Anti-Profiteering Declaration as per Annexure-XIX	Yes/No	Pg.___to Pg.__
22	Statement of compliance with General Environment requirement as per Annexure-XV	Yes/No	Pg.___to Pg.__
23	Litigation History & Criminal Background as per Annexure-VII	Yes/No	Pg.___to Pg.__

1. Bidders are requested to submit all the requisite documents in 1st instance itself. If any of the information is not furnished, the offer of the party shall be evaluated based on the documents available.
2. Bidder's are requested to mention the page number of the documents submitted.

SIGNATURE OF BIDDER WITH SEAL

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Annexure-A2

TENDER SPECIFICATION

FOR

ALUMINA UNLOADING

AND

TRANSPORTATION SYSTEM



NATIONAL ALUMINIUM COMPANY LTD.

(A Govt. of India Enterprise)

Nalco Bhavan, P/1, Nayapalli
Bhubaneswar-751013, Orissa
Phone: 91-674- 2301988 to 2301999
Fax: 91-674-2300550/2300470/2300521/2300640

Tender Ref. No.:
NALCO/CORP/P&T/CONT/2025/052 Dated: 23.10.2025

DOC. NO.14L08-000-SPC-M-TD01

SEPTEMBER, 2021

TECHNICALSPECIFICATION

DEVELOPMENT CONSULTANTS PRIVATE LIMITED
CONSULTING ENGINEERS
BLOCK DG-4, SECTOR II, SALT LAKE CITY ,KOLKATA – 700091, West Bengal, India

DOCUMENT CONTROL SHEET

PROJECT	:	ALUMINA UNLOADING AND TRANSPORTATION SYSTEM
CLIENT	:	NATIONAL ALUMINIUM COMPANY LIMITED
DOCUMENT TITLE	:	TENDER SPECIFICATION FOR DESIGN, MANUFACTURE, SUPPLY, ERECTION & COMMISSIONING OF THE PROJECT FOR AUGMENTATION OF ALUMINA UNLOADING AND TRANSPORTATION SYSTEM
DOCUMENT NO.	:	14L08-000-SPC-M-TD01
REV. NO.	:	10
DCPL JOB NO.	:	14L08

REV. NO.	DATE	DESCRIPTION	PREPD. BY	REVWD. BY	APPRVD BY
9	30.09.21	TENTH ISSUE	AC	SC	ARG
8	05.07.21	NINTH ISSUE	MM/SB/DD	KN	ARG
7	26.05.21	EIGHTH ISSUE	MM/SB/DD	KN	ARG
6	01.03.21	SEVENTH ISSUE	GK	SKG	ARG
5	24.11.20	SIXTH ISSUE	GK	SKG	ARG
4	27.07.15	FIFTH ISSUE	SM	DN	DKG.
3	22.07.15	FOURTH ISSUE	SM	DN	DKG
2	29.04.15	THIRD ISSUE	SM	DN	DKG
1	14.01.15	SECOND ISSUE	SM/SBK	DN	AKM/DKG
10	18.10.21	ELEVENTH ISSUE	AC	SC	ARG

DEVELOPMENT CONSULTANTS PRIVATE LIMITED
CONSULTING ENGINEERS
DEVELOPMENT CONSULTANTS HOUSE, BLOCK DG-4, SECTOR-II, SALT LAKE CITY,
KOLKATA - 700091, INDIA

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TECHNICAL SPECIFICATION

PART A: PROJECT DESCRIPTION, SCOPE & SPECIFICATION

SECTION – I :GENERAL

SECTION – I

GENERAL SPECIFICATION

CLAUSE NO.	DESCRIPTION
1.00.00	INTENT OF SPECIFICATION
2.00.00	SCOPE, BATTERY LIMITS AND EXCLUSIONS
3.00.00	REGULATIONS, STANDARDS AND STANDARDISATION
4.00.00	LIST OF PREFERRED MAKES OF EQUIPMENT
5.00.00	QUALITY CONTROL & SURVEILLANCE
6.00.00	MANUFACTURING & INSPECTION HISTORY DOCKET
7.00.00	WORK SCHEDULE
8.00.00	PROJECT PROCEDURE
9.00.00	DEVIATION

1.00.0 INTENT OF SPECIFICATION

This specification is intended to cover the scope of work of the LSTK vendor for setting up of, as a part of the aforesaid project, the various systems/plants grouped under this subject titled the **"ALUMINA UNLOADING AND TRANSPORTATION SYSTEM"**.The Systems/facilities, which constitute the above subject, has been enumerated in the following clause no. 2.00.00 of this section.

It is not the intent of this specification to specify completely all the minute details of design, construction, installation or scope. Since the subject work is to be executed on a total EPC/Turnkey basis, any equipment material or services not specifically mentioned in this specification but are necessary for completion of the plant in all respects pertaining to its safe, efficient and trouble free operation on sustained basis shall also be deemed to have been included, without any prejudice whatsoever, under this specification.

2.00.00 SCOPE, BATTERY LIMITS AND EXCLUSIONS

2.01.00 SCOPE

2.01.01 Asmentioned in clause no. 1.00.00 of this Section, followings are the systems/plants, which constitute the total scope and define the battery limits for the subject namely **"ALUMINA UNLOADING AND TRANSPORTATION SYSTEM"**:

- Pneumatic Conveying system for unloading of Alumina from BTAP wagons and gravity discharge to the air slides..
- Wagon Hauling, placement & movement of wagons by Rope-Winch System with reversible rope.
- All Air Slides and Air Blowers / Fans for fluidization system complete, as required.
- Ventilation and pressurization system for Blower Room and Substation, MCC, Switchgear and VVVF panel & auxiliaries
- All staircase, ladder, platforms as required.
- All transfer points and galleries of pipe conveyors shall be covered.
- Air conditioning of Control room, VVVFD room, Operators Cabin at watch Tower and Battery Room. For watch tower High wall split type A/C unit to be provided and also sufficient number of ceiling fans with electronic regulator and wall mounted type. Self-contained automatic electronic air cleaning unit to be provided.
- Tunnel, Pent House, and Winch Drive Room, as required
- Two nos gates at rail crossing the road near the tail of the rail siding.
- Pipe conveyors including belt scale at pipe conveyor PC-100 complete withdedusting systems/ bag filters, technological structure, drive system, safety equipment/instruments, take-up arrangement, docking system at tail and head side, transfer towers & supporting structures including & safety barriers.

- Compressed air & water supply system located within the plant with compressors, pumps and all accessories including pipes & piping/support.
- Power Receiving and Distribution System
- Control & Instrumentation System including Control Room
- Contour survey of the wagon unloading area, spot level fixing of the support location and support structures, Soil Investigation, Area Grading, Roads, Drainage etc as required.
- Firefighting system connection with the existing firefighting network.
- Fire detection, protection, alarm and fireextinguisher as required .
- Passenger-cum-goods elevator near transfer point (TP3) of silo 5 & 6.
- Electric and manual hoists including monorail as required.
- All civil & structural, architectural, process/mechanical, environmental, electrical and control & instrumentation works pertaining to Alumina Unloading & Transportation System shall be under the scope of bidder.
- Approach road for smooth & uninterrupted movement of traffic shall be provided from main approach road of the plant to the proposed wagon unloading area keeping in view the traffic and personal movement a road of width 7.5 m shall be considered.
- Placement of rails with clamps on concrete pavement at wagon unloading area. Relocation of DOL starter, electrical panel and cable tray routing and also modification of supporting structure and side sheeting for interfacing with existing system (at silo 5 & 1).
- Design, supply and construction of outdoor paving and roads of the proposed installation.
- Design, manufacture, planning, fabrication, assembly, shop testing and shop painting including procurement and supply of all materials, labor, supervision and necessary quality assurance testing.
- Receiving/unloading, storage at site, handling at site including insurance tilltake over.
- Site fabrication, construction and final assembly.
- Layout and Civil & Structural construction
- Erection and Final painting.
- Mechanical and Electrical No Load Tests, Interlock Tests
- Pre-commissioning, Checkup, No Load run, Trial Run and Commissioning.
- To provide training at site to O&M personnels before commissioning. The no of participants and duration will be mutualy discussed and agreed upon.
- Performance Guarantee Tests.
- Maintenance till handing over.
- All the software loaded on the hardwares installed for the project shall be procured in the name of NALCO. The license key of the softwares shall be handed over to NALCO after commissioning for any modification in future.

- The supplier of the hardware and software shall extend their service support atleast for a period of six years from date of commissioning at site. The LSTK vendor shall arrange the agreement for the same from the supplier and submit to NALCO.
- Apart from the desired PC/Laptops for the project ,LSTK vendor shall supply two nos. of PC (i7/latest 10th Gen or higher,8 GB DDR4 RAM, 1TB HDD, DVD writer, Graphics Card, 24" LED monitor etc) with two nos. of A4 size laser color printers before the start of engineering. The same shall be on non returnable basis.

All such relevant work and services as are necessary for successful commissioning and handing over to the total satisfaction of the Owner, of the subject complete with all systems, sub-systems equipment, accessories, auxiliaries and ancillaries materials and facilities, buildings, foundations and all other related civil and structural work as required on EPC basis within the battery limits as broadly described in the following clause no. 2.02.00: Battery Limits.

The scope of work shall also stand supplemented by other relevant stipulations in this Section: General, Technical specifications for Process/Mechanical, Environmental, Electrical, Instrumentation, Civil & Structural, respectively and by such details as furnished in drawings and various other parts of this Tender document.

In case, there is any contradiction or omission in thetechnical specification, design basis report attached with this specification shall be referred and binding to this specification.

Proposed unloading area of aluminna from railway wagon and pipe conveyor routes, transfer points location and pipe conveyor supports are tentative only.

LSTK Vendor has to finalise exact location of wagon unloading area after joint surveyth railway contractor. Pipe conveyuor routes, transfer points location and pipe conveyor supports shall be fixed after field survey by the LSTK Vendor.

Any change in the proposed system design, drawings and documents on account of above shall be at the cost of the LSTK Vendor and not to the cost of owner.

Technical documents/Data sheets:

The LSTK vendor shall provide completely filled in data sheets, first for "As Purchased" and then for "As Built".This shall be done by the LSTK vendor correctingand filling out the data sheets and submitting copies to the Owner. Preparationand submission of design calculations and all technical documents (vizEquipment data sheet etc.)

Technical Data/ Manual / Mechanical Catalogues.

- Technical Data /Manual / Mechanical Catalogue is a compilation of "as built" drawings and data, manufacturing and test records, installation, operating and maintenance instructions.
- 10 copies of installation, operation and maintenance instruction manuals along with soft copies of the manual shall also be submitted before the start of

erection. And any auxiliaries and instruments that the LSTK vendor is providing shall be included.The Technical Data/ Manual / Mechanical Catalogue shall include the following documents as a minimum.

i) All drawings and data as listed in the LSTK vendor data index & schedule.(For drawings, where Owner's approval is required, the final certified drawings shall be attached).

Sections shall be organized in a manner that data & drawings related to one subject are grouped together such as Mechanical, Electrical, and Instrumentation etc.

ii) All manufacturing, instruction and test data and records.

iii) Installation and Instruction Manual

iv) Operation and Maintenance Manual

This manual shall provide sufficient written instructions and data to enable Owner to correctly operate and maintain the equipment ordered. It shall include a section to cover special instructions for operation at extreme environmental and / or extreme operating conditions. The following shall be included in this manual.

a) Instructions covering start-up, normal shutdown, emergency shutdown, operating limits and routine operational procedures.

b) A description of equipment construction features and the functioning of component parts or systems (such as control, lubrication, sealing systems etc).

c) Outline and sectional drawings, schematics and illustrative sketches in sufficient details to identify all parts and clearly show the operation of all equipment and components and the methods of inspection and repair.Standardized sectional drawings are acceptable only if they represent the actual construction of the equipment.

d) The following maintenance information:

- Maximum and minimum bearing, labyrinth and seal clearances including any other clearance between moving and stationary parts ofthe equipment affecting proper running and maintenance of the equipment.
- Instructions for measuring and adjusting cold clearances, shaft run out, concentricity etc.
- Rotor floats allowance.
- Interference fits on parts that are required to be removed or replaced for maintenance of normally consumable spares.
- Balancing data with permissible unbalance.
- Lubricating schedules indicating recommended grades of oil, their properties, replacement period etc.
- Normal maintenance procedure.

- Preventive maintenance schedules and criterion for replacement of parts.
- Trouble – shooting procedures.

v) Following information shall also be included in the Technical Data Manual / Mechanical Catalogue.

a. Storage instructions for storing and preserving the equipment (including driver and all the auxiliary units) at the plant site before installation of the same.

b. Instructions for preserving the equipment after it has been installed.This is particularly required in cases where a long time gap is expected between equipment installations and commissioning.

c. Field performance test procedures andacceptance criterion.

vi) Drawings

The number of prints and soft copies (both in format of DWG & Pdf)required and the times within which these are to be submitted by LSTK vendor are specified in Owner's inquiry / order.

2.01.02. The Owner's review of the LSTK vendor's drawings shall not constitute permission to deviate from any requirements in the purchase order / specifications unless specifically agreed upon in writing. After the drawings have been reviewed, the LSTK vendor shall furnish certified copies in the quantity specified. All drawings must be clearly legible and shall be folded to 216 mm x 279 mm size. In all of submission soft copies (both in format of DWG & Pdf) of all drawings & documents must be accompanied by hard copies.The LSTK vendor shall submit a schedule of drawings and documents list within 15 days from the placement of LOI on LSTK vendor.

2.01.02.01 Drawings / documents with following titles shall contain as a minimum the following information:

a) Equipment General Arrangement Drawing

An equipment general arrangement drawing shall indicate:

i) Outline dimensions (minimum three views) (All principal dimensions).

ii) Allowable forces and moments on foundations and on suction and discharge nozzles.

iii) Location (in all three planes), size, type, rating and identification of all Owner's interface connections.

iv) Direction of rotation viewing from the driving end.

v) Weight of each assembly/components.

vi) Weight& location of center of gravity of the heaviest assembly / components that must be handled for erection.

vii) Identification and weight, dimensions of the heaviest assembly / subassembly / component required to be handled for maintenance.

viii) Maintenance clearances and dismantling clearances.

ix) Speeds of Driven Equipment and Driver with Driver rating. Location of driver terminal box (in case of Electric Motor Driver).

x) Layout of auxiliary equipment and operating platform as applicable.

xi) Make, Type and Size of couplings and the location of guards and their coverage.

xii) A list of reference drawings, if any.

xiii) A list of any special weather-protection and climatic features.

xiv) Line diagram of sealing piping indicating direction of flow of fluid by arrow and inlet and outlet.

xv) Tag numbering of all equipment.

xvi) Successful bidder shall Submit BOTH HARD AND soft copies of As Built drawings for all drawings.

b) Foundation Drawings

A foundation drawing shall indicate complete information required for foundation design by purchase including the following:

i) Foundation bolt sizes, pipe sleeve details, pocket sizes &locations.

ii) Grounding thickness and other necessary technical details.

iii) Static weight of each equipment independently grouted item and location of center of gravity of each of such equipment / items in all three planes.

iv) Weight distribution for each bolt /sub-sole plate location and total static weight.

v) Dynamic loading caused due to various items grouted independently.

vi) The direction and magnitude of unbalance forces and moments generated by motor, drivers/generators.

vii) GD^2 value of each item resolved to driver speed.

viii) Maximum permissible amplitude of vibration on the foundation at base level.

ix) Total mass of rotating parts.

x) Suggested dynamic factor and ration of foundation weight to weight of equipment as per LSTK vendor experience.

xi) All load data drawings shall contain all load points & fixing details on floor / wall / roof of the building.

c) Layout Drawing

This drawing shall include at least the following:

i) Layout of all equipment and their auxiliaries, vessels, control panels, exchangers etc. LSTK vendor shall furnish an optimized layout (considering the space allocated, site wind conditions, area

classification, the type of equipment located in the vicinity etc.) indicating elevation and dimensions of equipment.

ii) Minimum spacing required between the various equipment and between the equipment and the walls / columns / roof for an easy accessibility and maintenance.

iii) Layout for water & compressed air piping, cable tray/trenches layout etc.

iv) Piping arrangement and piping support arrangement/ location for piping in LSTK vendor's scope.

v) Layout for auxiliary equipment and operating platform details.

vi) Specification for crane/monorail (including suggested monorail layout) recommended for maintenance and height of the lifting hook from the centerline of equipment.

vii) Building Sizes, column location, column markings, no bracing zones.

viii) Building Frames.

ix) No bracing Zones.

x) Stair details and approach to platforms.

xi) Building cladding, roof type, floor types.

xii) Extent of floors

xiii) Isolated footings.

xiv) DE/DS/VENT – Requirement of space.

xv) Electrical Panels etc. – Requirement of space.

xvi) Space allocation for any water tank on roof / floor.

xvii) Hatch/opening with sites.

xviii) Maintenance platform for Electrical Hoist & EOT Cranes with access stairs / ladders.

xix) Monorail extension with radius.

xx) Mesh guards against moving parts hand railings around openings & gratings on sump pits & drains.

xxi) Equipment / Part opening / removal dimension.

xxii) I beam, hook for lifting equipments.

xxiii) Co-ordinates of all major structures and equipment shall be shown in the lay out drawings with respect to co-ordinates of 'S' point of Smelter Plant.

2.01.02.02 P&I Diagrams (with Bill of Materials)

LSTK vendor shall submit P&I Diagrams along with Bill of Materials of each system in the LSTK vendor's scope of supply or specified in the order. P&I Diagram shall indicate the system details, location of various auxiliaries, instruments, controls and safety devices as required. Line sizes, piping class, valve

sizes and class shall be clearly marked on the P&ID. LSTK vendor's scope and Owner's scope shall be clearly demarcated. Each item shall be identified by an items No. / Item tag no., which shall correspond to the item no. shown on the bill of materials. The bill of materials shall include items number, normal value, set value, range, quantity per unit, make and other specifications as applicable.

Legends adopted shall be indicated either at the bottom of drawing or on a separate drawing.The legends shall be as per ISA.

2.01.02.03 Cross-sectional Drawing (with Bill of Materials)

The LSTK vendor shall submit cross-sectional or assembly type drawings for all equipment furnished showing all parts, design assembly and running clearances, and balancing data required for erection and maintenance. Each part shall be numbered which shall correspond to the part number on the bill of materials. The bill of material shall include the part no., name of component, materials quantity installed per unit & sizes where applicable (say for bolts, nuts, rings, gaskets etc.). All bought out items shall also be indicated with make and brief specifications.

A separate cross-sectional drawing showing installation and setting dimensions for the seals shall be furnished.

2.01.02.04 Performance Characteristic Curves

- The LSTK vendor shall provide complete performance curves to encompass the map of operations, with any limitations indicated thereon.
- All curves submitted prior to final performance testing shall be marked "PREDICTED". Any set of curves resulting from a test shall be marked "TESTED".

2.01.02.05 Drawings required by Stautory Authorities:

Drawings as required by Statutory Authorites shall have to be prepared and submitted by LSTK Vendor for their review and approval.

2.01.02.06 After finalization of lay out drawing , the same shall be superimposed on overall plot plan of Smelter Plant by LSTK Vendor and submitted to NALCO.

2.01.02.07 All the desired drawings by NALCO shall be submitted by the by LSTK Vendor in hard copies & soft copies in Pdf and editable DWG formats compatible to AutoCad. Drawings are to be developed using different colored layers avoiding light colours (like yellow etc) so that color print of the drawing shall be clearly visible.

2.01.02.08 LSTK vendor shall not develop drawing using any pirated or educational product software. LSTK vendor shall have to develop the drawings using licensed version of the software (version 2013 or updated version) only. LSTK vendor has to produce the proof of valid license of the software within one month of the effective date of contract.

2.01.02.09 Instrument grade compressed air requirement for various control equipment & other places as required for the entire plant will be supplied from the compressor with all accessories including moisture trap, air receivers, oil filters and dryers etc. by the LSTK vendor. The supply pressure from the compressors shall be 7.50 kg / cm^2 g and shall be distributed suitably through air piping within the supply point.

2.01.02.10 The service grade compressed air supply required for pulse jet dust extraction systems, air blaster, line flushing as required etc. The LSTK vendor shall install suitable independent compressed air systems with oil filter and dryer (if necessary) of adequate capacity at the locations as specified in relevant technical specifications. The individual capacities of each unit shall be suitably and individually selected to cater to the needs of the respective area for which it is specifically meant.

2.01.02.11 The scope of work with regard to `Environmental systems under this package may broadly be summarized as:

Design, supply, installation, commissioning and testing of necessary environmental control systems consisting of Dust Extraction (DE) for all the plants/ buildings as detailed in this specification.

In addition to all the regular items of plant and equipment within the battery limits of the plant the LSTK Vendor shall also include in the scope of his supplies and installations all the auxiliaries to make the plant complete in all respect such as the following:

All equipment supports, hangers, platforms, walkways, access ways, access ladders, load beams, monorails, hoist, foundation bolts and sleeve pipes, base plates, pipe supports and pipe trestles, cable racks, hand railings protective guards or all such similar items, within the battery limits. All operating controls and points of process observation shall be well accessible by stairs and walkways. For other points requiring occasional attendance ladder may be provided.

The scope of supply also includes all consumables, first fill of lubricants, spares and special tools and tackles as detailed elsewhere in this specification.

The conveyor lengths and lifts shown in tender drawings are indicative only. Any change in conveyor length and lift during detail engineering including corresponding changes in associated systems viz. ventilation, illumination etc. shall be at no extra cost to the Owner.

2.03.01 Spares

For spares refer Section-XX.

2.04.0 Tools and Tackle – For tools and tackles refer Section XIX.

2.05.0 Transporation of equipment and material shall be defined like overall height, width at maximum heght, overall height from rail level and overall width etc.

2.06.0 Energy efficiency norms of the proposed system shall be as per ISO 50001:2011 guidelines. For details please refer Section-VII.

2.07.0 Commissioning /Hook-up of the new system with existing one shall bedone in a phased manner during the planned monthly maintenance schedule of existing alumina handling system.

2.08.0 2.02.00 The battery limits for the subject system: "Alumina Unloading & Transportation" and Compressed Air & Allied Systems shall be as described hereunder and as shown in the relevant Process & Instrumentation Diagrams mentioned in reference to respective system in Section III of this specification.

2.08.01 Mechanical battery limit:

From Alumina wagon discharge to one (1) pipe conveyor (PC-100) through 3 nos. air slides(AS-100, As-200 & AS-300) and then feed to silos 2 & 1 and 6 & 5 through another two (2) pipe conveyors (PC-200 & PC-300) and 4 nos. air slides (AS-400, 401 & As-500 & 501) to inlet of silo-5, Silo-6, Silo-2 & Silo-1.

Compressed air supply system along with required piping with auxiliaries and accessories etc.upto the inlet flanges of the BTAP wagons and then from the discharge flanges (unloaded alumina) of the wagon at the wagon unloading site to the inlet of silo-5, Silo-6, Silo-2 & Silo-1. Afterwards alumina transportation facility has been connected to existing belt conveyor TR2 & BL012 (both conveyors having 1400mm belt width) for filling of silos 3, 4 & 7, 8 respectively.

Compressors to be installed to meet Compressed air requirement at the wagon unloading area

For details please refer PID and PFD drawing no. 14L08-DWG-PR-PFD-001(2 Sheet) & 14L08-DWG-PR-PID-001(2Sheet) attached with this technical specification.

2.08.02 Utility battery limit:

Water amounting 5 to 10m^3/hr shall be made available near north east corner (Line 200 WT-35-2305-A34,E=2344.420M, N=1153.280M) of the new compressor house building. All necessary pipework for distribution from battery limit to individual consumers is in Vendor's scope.

The fire water (8" Fire Hydrant Under ground existing, E=2343.605M, N=939.874M) shall be available from weigh bridge area of rolling plant. Necessary taping shall be made by Vendor as per requirement. All necessary piping from taping point to individual consumers is in Vendor's scope. Pressure at battery limit will be available between 4 to 7 kg/sq.cm.

The compressed air line for stand by arrangement shall be tapped from the nearest point at south side of ABF-2 (E=2581.830M, N=1258.680M). All necessary piping from taping point to individual consumers is in Vendor's scope. Available pressure at battery limit for compressed air is 4.5 kg/cm2 (g). If more pressure is required necessary arrangement is to be done by Vendor. The compressed air line for bag filters near silo-6 and silo-2 shall be tapped from the nearest existing compressed air line. Necessary pipework up to the consuming point is in Vendor's scope.

The compressed air line for bag filters near silo-6 and silo-2 shall be tapped from the nearest existing compressed air line available at that area.

Drinking water supply line shall be tapped from RP area. All necessary pipework for distribution from battery limit to individual consumers is in Vendor's scope.

2.08.03 Electrical, Instrumentation and Civil battery limit:

Please refer relevant specification of electrical, instrumentation and civil.

2.09.00 Performing the works under this NIT is under the scope of successful bidder.

3.00.00 REGULATIONS, STANDARDS AND STANDARDISATION

3.01.00 Regulations:

The LSTK vendor shall design the system, equipment, layout, facilities etc. and shall execute the manufacture and all other related works conforming to the provisions of all relevant statutory regulations in force such as Indian Factories Act.

This specification also makes it obligatory for the LSTK vendor to arrange necessary clearance from relevant statutory authorities, if so required, for importation, supply and installation of the plant and machinery covered under this subject package and also to render all assistance and services required in this regard.

The system shall be designed to conform to the prevailing safety and statutory requirements, as applicable. LSTK vendor shall arrange for the inspection and approvals from the Statutory Authorities as required. The statutory fee for the inspection and approval shall be borne by the owner. Statutory approval in original shall be submitted to the Owner for records.

3.02.00 Standards:

The technicalities of this specification shall generally be governed by the latest applicable Indian standards (IS)/IEC standards except where specifically modified and /or supplemented by the specification. In cases, where suitable Indian Standards are not available, generally accepted and recognized standards, codes and practices as approved by the Owner shall be followed. In that case, the LSTK vendor shall furnish details of all applicable test procedures along with complete equipment list for factory tests of components, site tests and commissioning etc. to obtain prior approval of the Owner.

Equipment and materials conforming to any other standard which ensures at least equal or better quality may also be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the Tender.

The electrical installation shall meet the requirements of Indian Electricity Rule as amended up to date and relevant IS Codes of Practice. In addition, other rules or regulations applicable to the work shall also be followed. In case of any discrepancy, the more restrictive rule shall be binding.

The pollution control equipment and system shall be so selected and designed that the emission level of pollutants(SPM) at different dust generating points and at the outlet of the stacks shall be kept below the present statutory regulations of State and Central Pollution Control Boards.

3.03.00 STANDARDIZATION

The LSTK vendor shall take into consideration the requirement of standardization of plant, equipment and auxiliaries in order to maximize interchangeability and to minimize inventory level supplemented by ease of maintenance.

4.00.00 LIST OF PREFERRED MAKES OF EQUIPMENT

For list of preferred list of makes of equipment refer Section V.

5.00.00 QUALITY CONTROL & SURVEILLANCE

The plant /equipment to be supplied under this specification shall have assured quality and workmanship. The LSTK Vendor in his proposal shall submit his Quality Assurance Plan containing quality assurance programme for all types of equipment and works offered and quality assurance documents for Owner's approval. The LSTK vendor shall be bound to conduct all stage inspection on various equipment materials during manufacturing, construction and /or erection process in accordance with the approved copy of this document. Owner shall have the right to carry out Quality Audit and Quality surveillance by witnessing any or all such tests to be carried out at LSTK vendor's/Sub-contractor's works as well as at site as and when desired. The procedure applicable to LSTK vendor's works will also apply to the works of his sub-contractors. For items coming under the purview of any Indian Statutory Regulation during the course of manufacture, all stage inspections and tests shall be witnessed by an inspecting authority recognized under the statutory regulation. A list of all sub-contractors is to be forwarded to the Owner for approval prior to the placement of sub-contract. All unpriced copies of Owner orders of all major bought-out items giving technical details shall be sent to Owner for approval prior to placement of orders on sub-contractors. These audit/ surveillance/approvals, shall however, not relieve the manufacturer of their responsibility of the Quality Assurance of their product and overall guarantee and responsibility shall solely be confined to the LSTK vendor.

Tests/inspections shall be carried out during and after the completion of manufacture of different components and assembly as applicable in accordance with relevant cases and standards and /or as per procedure agreed or approved by Owner. Test certificates for all such tests / inspections shall be made available to the Owner for approval.

Owner or his authorized representative shall have full access to witness any or all tests/inspection to be carried out at manufacturer's shop. In case, the job is sub-contracted, it will be LSTK vendor's responsibility to make all arrangements so that Owner or his authorized representative can attend such tests at Sub-contractor's premises.

After installation, the equipment /system shall be tested and commissioned at site to Owner's full satisfaction.

6.00.00 MANUFACTURING & INSPECTION HISTORY DOCKET

6.01.00 A bound history docket shall be prepared by the LSTK Vendorfor all equipment duly signed by NALCO'S QA Engineer for completeness in four copies within two weeks from the issue of shipping release. The history docket shall consist of the following as minimum:

a) As built drawing

b) All non-destructive test reports

c) Material test certificates

d) Inspection and test procedure and reports

e) Guarantee Certificate from manufacturer

f) Copy of purchase order

g) Copy of technical specification

h) Welder qualification report and welding procedures

i) Quality Assurance Plan

j) Design Concession Request

k) Non-conformance Report

l) Shipping Release Note

m) Type and routine test certificate of motor

n) Construction Completion Certificate

In addition to the history docket, the supplier shall submit soft copies of file Drawings/Documents and equipment drawings in editable DWG format.

10 copies of installation, operation and maintenance instruction manuals along with soft copies of the manual shall also be submitted before the start of erection.

7.00.00 WORK SCHEDULE

The completion time for the entire work, as broadly stipulated in Clause No. 2.01.00 of this section, up to and including successful commissioning of all the system /plants shall strictly be Twenty Four (24) months from the date of issue of 'Letter of Intent' by the Owner.

8.00.00 PROJECT PROCEDURE

An initial kick-off meeting will be held with the successful bidder and during this meeting the successful bidder has to submit a project procedure document. The contents of all documents shall generally include but not limited to the following: -

List of Revisions

Project Summary/Scope

Customers Special Requirement

Project job no.& task

Design Interfaces, Responsibilities and Terminal Points.

Design Criteria

Administrative

Documentation Distribution

Project Report

Schedule/BOM

Component Delivery Schedule

Customer / Internal Distribution List.

The procedure document shall also include the items for design basis report, soil investigation report and formulation of other procedures with flow chart, detail working methodology, manpower deployment (office and site), contact persons and responsibility wise divisions, a methodology regarding project execution.

This will include: -

Project Schedule in the PERT/Network with inter-relationship.

Detail activity list

Project Deliverables

Project Co-ordination procedures.

Detail methodology to be followed for successful completion of work.

9.00.00 DEVIATION

Incase the proposal has deviations from the stipulations of this Tender Specification, or an alternative offer is made which the Bidder thinks to be superior to what has been asked for and price of which is comparable in terms of capital and operating costs, the Bidder, in his proposal shall indicate clearly each such deviation item wise as per the format furnish in this specification. The tabulation shall contain full particulars of these deviations and shall be signed underneath. Additional sheets may be added if necessary. Price implication of such deviations shall also be indicated item wise in the Deviation Sheet. Cross reference notes to any other statement regarding deviation made elsewhere in the proposal will not be accepted.

In absence of the duly filled-in Deviation Sheet, even if any such deviation/s has been mentioned elsewhere in the offer, it will be understood and agreed that the Bidder has taken no deviation whatsoever from the specification and the stipulation of the specification will be binding and final on the Bidder. Also in absence of any price implication/s against any item/s for which technical deviation/s has been taken by the Bidder, it will be understood and agreed that such technical deviation/s will have no reflection on the quoted price.

SECTION – II :PAINTS AND PROTECTION

SECTION – II

PAINTS AND PROTECTION

1.00.00 All process machinery, equipment, piping, steel structure etc. shall receive surface preparation viz. sand blasting etc. and painting. This specification does not relieve the LSTK vendor from supplying any other special paints or coatings where special local conditions require such.

1.01.00 Extent of Painting:

i) All steel surfaces shall be painted.

ii) Non-ferrous (like copper, bronze, chromium plated, nickel-plated, aluminum etc.), hot dipped galvanized, stainless steel surfaces shall not be normally painted.In case for some specific reason, painting is required on these surfaces, the procedure shall be developed by the LSTK vendor and got approved from the Engineer.

iii) Unless otherwise asked for, surfaces within 50 mm of any site weld location shall be free of paints, which may prevent proper weldingor produce objectionable fumes during welding.

1.02.00 Surface Preparation:

i) All steel surfaces shall be free from all mill scales, rust, oil, grease or any foreign matters.

ii) Only dry sand blasting procedure will be allowed.The abrasive shall be chloride free siliceous sand (marine sand excluded). The compressed air used for blasting shall be free from detrimental amount of water and oil. Suitable separator and traps shall be provided for the purpose.

iii) No acid/solvents/other cleaning solutions shall be used on surfaces after they have been sandblasted.

iv) All welded areas shall be given special attention for removal of welding flux in crevices.

v) The paint manufacturer's recommendation, if any, shall be strictly followed during surface preparation.

vi) Structural Steel work after inspection and approval and before leaving the shop shall be cleared by hand wire brushing or other suitable means.

1.03.00 General Requirements:

i) The paint manufacturer’s instructions covering thinning, mixing, method of application, handling and drying time shall be strictly followed and considered a part of this specification.

ii) All materials used shall be new and of first class quality from reputed manufacturers. The Brand, application procedure shall be subjected to the Owner's approval.

iii) The surface preparation and painting work shall not be carried out on damp surfaces or if the surface is expected to become wet before the primer/paint has dried up due to impending rain, fog or mist.

iv) The color scheme for the entire plant equipment, piping and steel structures shall be got approved by the LSTK vendor from the Owner before application of paint.

v) The manufacturer may follow his standard painting provided the same is suitable for the operating and environmental conditions where the equipment are to be installed. In such cases, the manufacturer's painting procedure and quality shall be subjected to Engineer's approval.

vi) General compatibility between Primer and finishing paint shall be certified by the paint manufacturers supplying these paints.

vii) Colour scheme of painting shall take into account national and international safety standards on accident prevention.

viii) Any other requirement, stipulated specifically elsewhere in this specification, shall supplement the general stipulation furnished in this Clause 1.00.00.

1.04.00 Primers and Finish Paints:

1.04.01 Primers:

Primers shall be selected based on the local conditions to which the painted objects are exposed:

Accordingly, the suitable/appropriate type shall be chosen from the following general categories:

-Red-oxide Zinc Chromate as per IS 2074.

-Aluminium Zinc Oxide as per IS 2931.

High build coal tar pitch yielding a dry film thickness of 0.30 mm shall be used where applicable.

1.04.02 Finish Paints:

The choice of finish paints shall be governed by the local conditions to which the painted object will be subjected. However, the general guideline for selection is furnished below:

- Ready mixed, quick drying type paints to be used.

- For general application, Synthetic Enamel Exterior type paint of approved brand conforming to IS 2931 shall be used.

1.05.00 Application of Paints:

i) Structures/equipment shall receive one coat of primer paint immediately after fabrication at shop after appropriate surface preparation followed by spot priming (if necessary) and second coat of primer after erection. Two coats of finish paint shall be applied thereafter.

ii) Surfaces not in contact, but inaccessible after assembly, shall receive two coats of shop primer paint positively of different tinge to prove application of two coats before assembly. This does not apply to the interior of sealed hollow sections.

iii) Shop primed objects shall be touched-up in areas where the paint has been damaged, loosened, cracked or rendered brittle. Touch-up shall be carried out in the same manner as the original application.

iv) The paints shall be applied by brushing, roller coating, spraying flow coating or dipping as per recommendation of the paint manufacturer and as may be approved by the Engineer.

v) Spray painting at site shall be carried out only at time and location approved by Engineer. The LSTK vendor shall provide adequate covers, drop cloths etc.to protect the surroundings from airborne materials and paint splatter to the satisfaction of the Engineer.

vi) Field painting shall only be done after the structure s erected, leveled, plumbed, aligned and grouted in its final position, tested and accepted by the Engineer.

vii) All field rivets, bolts, welds shall be spot primed as described in item no.(iii) above. Where specified, surfaces, which will be in contact after site assembly, shall receive a coat of paint (in addition to the shop coat) and shall be brought together while the paint is still wet.

viii) The quality of material and workmanship shall be best available and particular care shall be taken during application to prevent painting defects, such as, dripping, runs, waviness, thickness, poor adhesion, brush-marks or brushing defects etc. Edges of painting adjoining other materials or colors shall be sharp and clear without over lapping.

ix) Unless specifically requested, no drying agent shall be added to paints.

x) Any sub sequential coat, whether primer or finish paint shall not be applied till the previous coat is dry.

xi) The finish paints shall have slightly different tinge to enable the Engineer to distinguish the two coats.

xii) After successful commissioning, the finish shall be touched up, restored and left in good condition wherever damaged.

xiii) Newly painted surfaces shall be provided with “Wet Paint" boards.

xiv) It is preferable to use peel able paints, adhesive tapes, punched metal sheets on the equipment for identification.

xv) Paints shall be stored in well-ventilated rooms, away from heat sources, open flames, sparks and protected from direct Sun. Outdoors storages is not permitted. Shelf life shall be clearly indicated on each container. Paints, which have thickened or gelled or contained in non-original containers or unsealed containers shall not be used. The Engineer's decision in this regard shall be final and binding.

xvi) Electrical equipment like MCC and LPBS shall be given a phosphate coating after thorough cleaning to be followed by painting as described above with additional 'Stoving' after each coat.

xvii) The shades for various electrical equipment shall be as under

- Switchgears, MCCs and other panels: Light Grey Shade 631 of IS: 5.
- Motors : Battleship Grey Shade 632 of IS: 5.

1.06.00 Inspection and Tests:

The following inspection and testing shall be performed during and on completion of painting:

(i) Checking of Dry Film thickness by suitable non-destructive thickness Gauge. The painting will be rejected if any of the spot measurement shows thickness to be less than 80% of the specified thickness.

(ii) Visual inspection of appearance and uniformity of the surface painted.

(iii) Checking of time of drying and subsequent coating in accordance with the paint manufacturer's recommendation.

(iv) Checking cleared and prepared surface as per the paint manufacturer's recommendation or as per relevant IS.

(v) If during inspection, defects are observed, the LSTK vendor shall carryout rectification, at his own cost, to bring the faulty surface to the acceptable degree.

SECTION – III :TECHNICAL

SECTION – III

TECHNICAL

C O N T E N T S

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E-0009	BATTERY & BATTERY CHARGER
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SECTION – III/1 :PROCESS / MECHANICAL

SECTION – III/1 -PROCESS / MECHANICAL

1.00.0 INTRODUCTION

The plant has a yearly aluminium production capacity of 4, 60,000 T after phase-2 expansion, which approximately corresponds to a yearly requirement of 9,00,000 T of alumina. The purpose of this system is for installation of additional wagon unloading facility along with alumina conveying to all the silos independently.

Similar to the existing system, alumina will arrive at the plant in specially designed BTAP wagons. Each rake is grouped in 52 wagons corresponding to a service capacity of approx. 2880 -3120 tons.

The new installation comprises following major activities:

- Wagon placement system to save time
- Suitable rope winch systems (2nos.) for hauling 12 BTAP wagons.
- Unloading from wagons near straight portions of new proposed railway tracks located at east side of Rolling Plant (RP) and unloading of alumina from 8 wagons simultaneously at a time (4 nos. wagon from each track).
- Conveying of alumina to silo no. 6 & 5 and silo no.2 & 1 (separately) through unloading of wagons by pneumatic conveying system followed by, air slides and pipe conveyors.
- From silo1 & silo 5 the alumina can be diverted to silo 3 & 4 and silo 7 & 8 respectively through existing conveying path (conveyor / air slides).
- Compressor room / Blower room
- Drive winch house with automatic rope tensioning arrangement.
- Five nos. de-dusting units.
- Air Cooled Oil Free Screw Compressors (1W+1S) for supplying oil free compressed air to Dedusting unit (DE-1) at unloading area with all features provided in PLC.
- One dedicated Operator cabin on watch tower
- One rack and pinion type passenger cum goods lift of capacity 1Ton (16 passengers) with one side collapsible gate shall be provided near the transfer point (TP-3) of silo 5 & 6.

2.00.0 MATERIAL HANDLING PROPERTIES

2.01.0 CHARACTERISTICS OF ALUMINA

• Type	:	Sandy
• Bulk Density after Compression under four (4) bar (maximum)	:	1.1 t/m^3
• Angle of repose during reclaiming and during loading	:	35 degree & 23 degree respectively
• Internal angle of friction	:	27 degree to 36 degree

- Angle of friction on steel : 25 degree
- Granulometry : (+) 125 micron max. 15%
  : (-) 45 micron max. 12%
  : Typically 10%

2.02.0 SPECIFICATION OF ALUMINA

Item	Unit	Typical	Limit (max)
SiO_2	Wt %	0.01	0.025
Fe_2O_3	Wt %	0.01	0.015
TiO_2	Wt %	0.003	0.004
Na_2O	Wt %	0.39	0.5
P_2O_5	Wt %	0.001	0.002
V_2O_5	Wt %	0.0015	0.002
CaO	Wt %	0.025	0.06
Alpha	Wt %	<2.0	10.0
-45 micron	Wt %	8.0	20 (Max corresponds to CA 15 grade Alumina)
+125 micron	Wt %	10 - 12	15
LOI (300- 1000 ^{0}C	Wt %	0.6 - 0.7	1.0

- BET : 60-70 m^2/g (Typical)
  40 m^2/g (Min)& 80 m^2/g (max)
- Bulk Density : 0.95 to 1 t/m^3 (Typical)

3.00.0 UTILITIES AVAILABLE AT SITE

Plant air cum instrument air

Oil Content in gm/Nm^3 : Nil

Supply Pressure : 4.5 kg/cm^2 (g) min (line should be designed for 7.5 kg/cm^2 (g))

Temperature : 45^0 C max

Dew point : $+3^0$ C to + 5^0 C at 7 kg/cm^2(g)

Ambient Temperature : 51^0 C max. for design

Power:

Power LT : 415 V +/-10% 50 Cycles +/-3%

4.00.0 DESIGN BASIS

The alumina handling plant is designed to operate 365 days in a year without interruption. The proposed Alumina Unloading and transportation system shall be designed & installed in such a way so that any one stream can be operated and if required both streams can be operated simultaneously.

System requirement :

- ✓ No. of operation shift/week : 18 (max)
- ✓ Effective operating hours / day : 24
- ✓ Hours/shift : 8
- ✓ Capacity : 900000 T per annum
- ✓ Alumina unloading : 8 nos. wagons simultaneously from rake (4 nos. wagon from each track).
- ✓ Rake capacity : 2880-3120 T
- ✓ No. of wagons in a rake : 48 to 52
- ✓ No. of track : Track 1, track 2 and Engine escape line
- ✓ No. of wagon on each track : 26
- ✓ Rate of unloading from individual wagon : ≈ 2 t / min
- ✓ Wagon unloading and conveying capacity to silo : 1000 TPH

4.01.0 GENERAL

The following Design Criteria shall apply to all mechanical equipment. However, these guidelines supersede all other design guidelines.

4.01.01 The system shall be capable of operating continuously round the clock throughout the year. The installation must be designed so that it can always be serviced without having a complete shutdown.

4.01.02 Design of all facilities shall be in accordance with this specification and the respective specification enclosed with the Purchase requisition.

4.01.03 Alumina unloading and transportation system shall be laid out and constructed for convenience and safety of operation and maintenance. All equipment shall be oriented to permit servicing in such a way as to require a minimum of dismantling. The specification indicates a minimum standard of quality for the materials, fabrication and construction of the proposed plant.

4.01.04 All equipment and materials (mechanical, piping, electrical, instrumentation, controls, civil, architectural etc.) shall be sourced from manufacturers acceptable to DCPL & NALCO. The list of acceptable sub contractors is attached elsewhere in the purchase requisition. For the items not covered in the list, LSTK vendor shall submit the sub-contractor list along with the proven track record of the proposed sub-contractors for NALCO & DCPL review/approval before placing orders for those items.

4.01.05 All electrical installations including the hoists in open area shall be provided with rain protection hood.

4.01.06 Maintenance platforms/access walkways shall be provided at one end beam for each electric monorail hoist.

4.01.07 All the equipment shall be field proven for such an operation taking into consideration normal preventive and running maintenance of the unit and their auxiliaries. The spare part list along with the drawings and part numbers shall be provided.

4.01.08 All equipment, controls and structure shall be designed for installation in carbon and alumina dust charged atmosphere of aluminium smelter area and seismic condition of site.

4.01.09 All equipment shall be of proven design, prototypes or extensive modifications of the basic designs are unacceptable.

4.01.10 The installation shall be designed with adequate facilities for maintenance &operations.

4.01.11 The design, fabrication, painting, supplies and testing shall conform to relevant international codes and standards, Indian codes and standards, wherever applicable, shall take precedence over those of other nationalities. Only latest editions including addenda shall be referred to.

4.01.12 Design, fabrication & operation of the plant shall be based on the following:

A) Indian factory act

B) Indian explosive act

C) Petroleum & Carbide of calcium manual

D) Fire protection manual of fire sectional committee, Insurance association of India

E) Regulations laid down by explosive directorate and electrical inspectorate

F) Regulations of Director general of civil aviation for all stacks

G) NFPA code of practice

H) Regulation of electrical equipment of buildings insurance association of India

I) Regulation of both Central and state pollution control boards of overall pollution control for both surface and air

J) Indian electricity rules

4.01.13 An air cooled screw compressor (1w+1s) for pulse jet cleaning of de-dusting unit, cooling chamber, dampers and actuators at wagon unloading area shall be provided. LSTK vendor shall tap the compressed air from the existing Plant compressed air line

for pulse jet cleaning of three (3) nos.de-dusting units, located at three (3nos.) transfer houses area. Fluidization air for air slide shall be generated by blowers/ centrifugal fans which will be supplied by LSTK vendor.

4.01.14 Compressed air facilities supplied by the LSTK vendor as well as from the supply points of the owner shall include all compressed air piping, valves, regulators, pressure gauges and fittings, moisture traps with auto draining system as required.

4.01.15 All blowers and compressors generating process air supply for AUT shall be housed in a common blower/compressor house, which shall provide weather protection as well as act as noise enclosure common to all equipment inside the room. The noise level shall be maintained as per requirement of environmental norms.

4.01.16 All equipment to be supplied shall be of robust design and manufacture and shall correspond to state of the art of manufacturing technology. Selected equipment shall have a high degree of availability, require minimum maintenance and operate with high efficiency. Electrical and thermal energy consumption shall be low. Equipment shall be designed for heavy-duty industrial application, capable of handling very abrasive materials in dusty environments. The equipment shall be suitable for continuous operation at uniform maximum load without adverse effect on the life or maintenance of the equipment under prevailing conditions. Furthermore it shall be suited to all local climatic and operating conditions at the site.

4.01.17 The equipment shall be designed with sufficient safety margins from the mechanical design and the process performance point of view. It shall be capable of re-starting after stopping due to power failure or other process-related interruption (i.e. interlock).

5.00.0 PROCESS DESCRIPTION

(Please refer attached process flow diagram 14L08-DWG-PR-PFD-001, 2 sheets).

EXISTING SYSTEM DESCRIPTION

The requirement of fresh alumina for the smelter plant after expansion will be approximately 9,00,000TPY. The additional requirement of fresh alumina for the phase-2 expansion is approximately 2, 42,350 TPY.

In the existing NALCO Smelter Plant, requirement of alumina is being catered by transporting alumina from Damanjodi to Angul in specially designed pneumatically operated wagons. These wagons have a payload capacity of approx 60 T each. Total alumina payload in a rake comprising 48 to 52 wagons i.e. approximately 2880-3120T.

The residence time of rake is at present 8 hrs. as maximum. The unloading time of one rake is approximately 5 hrs. During unloading, a group of wagons are placed in position and each wagon is connected to compressed air inlet. Flexible hoses are connected with one end to wagon evacuation points and other end to the fixed pipes leading to air slides. The rate of unloading for individual wagon is 2 T/min. The extracted alumina is conveyed through air slide for feeding to intermediate bin (15 T capacity). From the intermediate bin (having fluidized bottom) alumina comes to belt conveyor TR1 that conveys alumina to existing silos 1, 2, 3, 4, 5, 6, 7 & 8 through number of belt conveyors/air slides at the rate of 1000 TPH.

The main conveyor TR1 is integrated with weigh scale of load cell type to meter the quantity of alumina to be conveyed to the silos. In the existing unloading system an outlet has been provided from the distribution box located over silo No. 1 to feed to air slide HA-AL-001. The air slide HA-AL-001 conveys alumina to the belt conveyor HC-BL-002.The belt conveyor transports alumina to pot line 3 areas for feeding to Silo No.5 (TI-AL-020) or to Silo No. 7 (TI-AL-021), through air slides and belt conveyor HC-BL-012.

PROPOSED SYSTEM DESCRIPTION

The plant will have a yearly aluminium production capacity of 4,60,000 T after phase-2 expansion, which approximately corresponds to a yearly requirement of 9,00,000 T of alumina. To achieve such alumina requirement a new system with wagon unloading facility by gravity and alumina conveying to the silo 5 & 6 and silo 1 & 2 (separately) have been envisaged.

From silo1 & silo 5 the alumina can be diverted to silo 3&4 and silo 7 &8 respectively through existing conveying path (conveyor / air slides). Similar to existing system, alumina will arrive at the plant in specially designed pneumatically operated wagons. Each rake is grouped in 48 to 52 wagons corresponding to a service capacity of approx. 2880-3120 ton. This new system has been envisaged to facilitate to convey alumina to each silo @1000 TPH through pipe conveyors (for silos 1, 2&5, 6) independently to all the silos during shut down of existing main conveyor TR1 & also conveyor (HC-BL-002) which is conveying alumina from silo1 to silo 5. Afterwards alumina transportation facility has been connected to existing belt conveyor TR2 & BL012 (both conveyors having 1400mm belt width) for filling of silos 3, 4 & 7, 8 respectively. There shall be a two way diverter and inter connecting chute at Transfer Tower -1 for future provision.

Unloading of alumina from wagon for this new system shall be done in between proposed expansion railway tracks1 & 2 (12m apart), located at east side of Rolling Plant (RP). Suitable rope winch systems (2nos.) for hauling 12 BTAP wagons has been envisaged. The unloading of 8 wagons shall be done at a time (4 nos. wagon from each track). The drive units and automatic rope tensioning arrangements of the winch systems shall be located in a common shed / house. 2 nos. Rope winch system (reversible type) have been provided for wagon hauling, positioning for unloading and also operate haulage winch to move the wagons from the unloading zone and again set for the position for next 8 wagons. By adopting the suitable connecting / removing of hitch ropes / round link chain sling to the near side rope / far side rope, the optimisation of unloading cycle are to be obtained.

A dedicated operator cabin shall be provided over the unloading area at the starting point to precisely control the placement of rake in the unloading stations.

Unloading of alumina from each BTAP wagon is to be connected to compressed air inlet and also flexible hoses to be connected with one end to wagon discharge points and other end to fixed pipes for gravity discharge (for quick unloading and lesser energy consumption) to the air slides placed in an underground pit (i.e. in between two railway tracks). Unloaded alumina shall be conveyed by air slides (3 nos.) to pipe conveyor. Additionally pneumatic shut off gate shall be provided for control of the

capacity of the pit outlet to feed material to AS-300. PC-100 partly underground and partly over ground which in turn feed alumina either to pipe conveyor PC-200 or another pipe conveyor PC-300 through 2-way chutes at transfer point TP-1 located above ground. Underground tunnel shall have the sump with pumping (1w +1s) facility to drain out water from the sump. The pipe conveyor (PC-100) shall be provided with integrated Belt weigh scale of load cell type for metering amount of Alumina conveyed to the silos. The pipe conveyors PC-200 & PC-300 shall carry same alumina from TP-1 to silo-1 & 2 and silo-5 & 6 respectively through air slides (4 nos.). Two nos. transfer points (TP-2 & TP-3) shall be provided, one near silo 1 & 2 and other transfer point near to silo 5 & 6 to convey alumina to silo1 & 2 and silo 5 & 6.

In order to feed alumina for the future expansion of smelter plant, provision to be kept in the transfer house TP-1 of Alumina Unloading and Transportation System. The scheme will be worked out in detailed engineering and only one more diverter shall be considered to be in the scope of supply at TP-1.

One rack and pinion type passenger cum goods lift of capacity 1Ton (16 passengers) with one side collapsible gate shall be provided near the transfer point (TP-3) of silo 5 & 6.

Five nos. de-dusting units with measurement system of DP, Inlet pressure, outlet pressure and pulsing pressure etc., one at unloading area, one at feeding area of pipe conveyor PC-100 from air slide (AS-300) and three nos. at different transfer houses shall be installed. The dust emission level from the de-dusting units shall be limited to 50 mg/Nm^3.

One new control room, MCC room, Blower room & VVVF room shall be suitably installed. No disturbance to the existing system while erection and commissioning will be allowed except during hook-up. During construction and erection, proper care shall be taken for existing equipment at the interface.

Please refer drawing documents 14L08-DWG-PR-PFD-001(2 Sheet) & 14L08-DWG-PR-PID-001(2 Sheet).

The Description & Scope of the Complete Facility:

Complete design, engineering, procurement of materials and bought out components, fabrication, assembly, testing, painting, packing, delivery, storage at site hook-up, erection and commissioning of wagon unloading and alumina conveying to silos including PG test.

Scope also includes:

- 2 nos. rope winch system with reversible rope for wagon hauling, placement, movement of BTAP wagons to facilitate unloading from wagons.
- Pneumatic Conveying system for unloading of Alumina from BTAP wagons and gravity discharge to the air slides placed in an underground pit.
- All Air Slides and Air Blowers / Fans for fluidization complete system with dampers, flexible pipes, flexible joints, couplers, expansion joints, dampers, pipes, valves, isolators, gates, junction boxes, flanges, etc., as required.

- Pipe conveyors complete with technological structure, drive system, safety equipment/instruments, take-up arrangement, docking system at tail and head side, transfer towers & supporting structures including & safety barriers.
- Belt weigh scale for pipe conveyor PC-100.
- Dedusting Systems/ Bag filters, as required.
- Ventilation and pressurization system for Blower Room and Substation Building along with MCC, Switchgear and VVVF panel & auxiliaries (Blowers/Fans, Suction, Filters, Louvers, Bird Screens, Pressure Relief Dampers, Ducting etc.)
- Drive units and automatic rope tensioning arrangement of rope winch systems located in a common house.
- Modification of existing system to feed alumina to existing silos as necessary.
- Compressors, air dryers, moisture traps, air receivers with auto drain, safety relief valves etc.
- Compressed Air, water supply system located within the plant with compressors, pumps and all accessories including pipes & piping /support.
- Air conditioning of Control room, VVVFD room and Battery Room.
- Tunnel, Pent House, Operator's Cabin at Watch Tower and also Winch Drive Room, as required
- Power Receiving and Distribution System
- Control & Instrumentation System including Control Room
- RCC foundations for structures and equipment's including all foundation bolts, (nuts, washers etc.)
- Contour survey of the wagon unloading area, spot level fixing of the support location and support structures, Soil Investigation, Area Grading, Roads, Drainage etc. as required. Successful bidder shall execute Geotechnical investigation including Soil Resistivity as per Owner / Consultants approved Technical specification. However, available Soil Test report adjacent to the site is given below for reference only.

Foundation Location	**Depth of Foundation below FGL,(M)**	**Soil Type**	**Net Allowable Bearing Capacity, t/sqm**	
			Strip/ Isolated	**Raft**
BH-01 to 09	2.00	Very stiff I Hard, silty clay	15	15
	2.50		20	20
	3.50	Hard silty clay I Weathered rock	35	35

Fire fighting system consisting of ringmain, fire hydrant, landing valves, hoses etc. as required for connection with the existing firefighting network of the Smelter Plant. Co-ordinate near unloading area for fire hydrant is already identified on layout drg, however tapping point near silos will be identified during detailed engineering.

- Fire detection, protection, alarm and fire extinguisher, as required, shall also be provided and shall be as per relevant norms. Fire Detection System will be given for entire buildings. Fire detection system will not be provided throughout the conveyor gallery.
- Passenger-cum-goods elevator near transfer point (TP3) of silo 5 & 6.
- Electric and manual hoists including monorail as required.
- All staircase, ladder, platforms as required.
- All transfer points and galleries of pipe conveyors shall be covered.
- Two no's gates at rail crossing the road near the tail of the rail siding.
- New substation building along with MCC, Switchgears and auxiliaries.
- RCC Foundations for structures including all foundation bolts, nuts, washers, etc. as required.
- Structure strengthening of existing system if required.
- Route survey. The route of pipe conveyors as shown in the drawing in MR is indicative only. However, if the bidder feels for the necessity of any kind of modification/rerouting of the layout to meet the site conditions after route survey and soil investigations, the same shall be done without any extra cost to the owner/purchaser.
- All civil & structural, architectural, process/mechanical, environmental, electrical and control & instrumentation works pertaining to Alumina Unloading & Transportation System.
- Approach road for smooth & uninterrupted movement of traffic shall be provided from main approach road of the plant to the proposed wagon unloading area keeping in view the traffic and personal movement a road of width 7.5 m shall be considered.
- Relocation of DOL starter, electrical panel and cable tray routing and also modification of supporting structure and side sheeting for interfacing with existing system (at silo 5 & 1).
- Site data collection and/ measurement if needed, of existing structures, conveyor galleries, pipe racks, cable racks, drains etc. coming on the way of the of the new system.
- Techno economic feasible if alternative system any.
- All mobile equipment and special handling equipment, such as fork lift truck etc. for normal operation of the plan shall be arranged by the successful bidder. The Owner shall provide the equipments, if available on chargeable basis as per the rate of NALCO.

Exclusions:

- Owner's cost of inspection
- Supply of consumables during the construction period (potable water, industrial water, firefighting water, electrical energy etc. up to the battery limits)
- Maintenance of access roads during the construction period as shown in the layout only. No new roads will be constructed for the project by the owner.
- Operational and maintenance staff during commissioning and start-up. LSTK vendors' personnel shall be deployed for commissioning. Owner shall extend technical support.
- The system shall be designed to conform to the prevailing safety and statutory requirements as applicable. LSTK vendor shall arrange for the inspections and approvals from the statutory authorities as required. The statutory fee for the inspection and approval shall be borne by the owner. Statutory approval in original shall be submitted to Owner for records.
- Utility lines beyond interface points.
- Compressed air for instruments @ 5 kg/cm2 , if it is designed to be drawn from utilities. If dedicated compressors are included in the design, the same shall be in LSTK vendor's scope.
- Supply of maintenance tools. But Special tools and tackles shall be in LSTK vendor's scope.
- Stack sampling and sample analysis
- Power factor improvement capacitor banks.
- Wagon Rail **track** (except placement of rails with clamps on concrete pavement at wagon unloading area. However, civil requirement below rail track adjacent to the unloading area shall be in the bidder's scope).

6.00.0 SYSTEM TERMINALS

Refer "Battery limit" in Section I of this tender part A.

7.00.0 LIST OF EQUIPMENT

Sl. No.	Eqpt. No	System / Item description	Qty	Brief specification	Drawing No.
1		Rope winch system for wagon hauling	2		14L08-DWG-PR-PID-001 (2 sheet)
2		Pneumatic Unloading System from wagons to Air slides (underground) through flexible Hose connections:			
2a	KA100 to 108	Oil Free Screw Compressors (Air Cooled) discharge pressure 3.0 kg/cm2 (g)	8w+1s		
2b	BL100 / 200& 300	Fan type Blower for air slides	3		
2c	FN 100 & 200	Fan in Blower Room	1w+1s		
2d	AS 100 & 200	Air Slide	2	500 tph for each	
2e	SG-001, SG-002	Manual Operated Slide Gate	2		
3	AS 300	Air Slide	1	1000 tph	
4	EH-1 & EH-2	Electric Hoist with motorized trolley greater than 10m lift and travel	2	Cap: 3 ton for Unloading Station & Compressor Room	
5	EL 01	Goods cum passenger lift (Rack and Pinion type) near transfer point (TP-2) of silo 5 &6	1	Capacity: 1000 kg	
6	DE-1 A/B	De-dusting system complete unit in unloading station	1+1		
6a	DC 100 A/B	Dust Collector	1+1		
6b	EF 100 A / B	Dust Extraction Fan with motor	1+1		
6c	RV 100 A / B	Rotary air lock valve	1+1		
6d		Oil Free Screw Compressors (Air Cooled) For supplying pulse air to Dedusting units 7.5 kg/cm2(g) discharge pressure.	1w+1s		
7	PC 100	Pipe Conveyor	1	Cap: 1000 tph	
8	EH-3, EH-4 & EH-5	Electric Hoist with motorized trolley for Pipe Conveyor drive unit	3	Cap: 4 tons each for TP-1, TP-2 & TP-3	
9	DG 01	Diverting gate (pneumatic Operated)	1	Cap: 1000 tph	
10	AS 400	Air Slide	1	Cap: 1000 tph	
11	AS 401	Air Slide	1	Cap: 1000 tph	

Sl. No.	Eqpt. No	System / Item description	Qty	Brief specification	Drawing No.
12	PC 200	Pipe Conveyor	1	Cap: 1000 tph	
13	DE-2	De-dusting system complete unit in Transfer Point (TP-1)	1		14L08-DWG-PR-PID-001 (2 sheet)
13a	DC 200	Dust Collector	1		
13b	EF 200	Dust Extraction Fan with motor	1		
13c	RV 200	Rotary air lock valve	1		
14	JB 001	Junction Box	1		
15	PG 001 & 002	Pneumatic operated cut off gate	2		
16	DE-3	De-dusting system complete unit in Transfer Point (TP-2)	1		
16a	DC 300	Dust Collector	1		
16b	EF 300	Dust Extraction Fan with motor	1		
16c	RV 300	Rotary air lock valve	1		
17	PC 300	Pipe Conveyor	1	Cap: 1000 tph	
18	AS 500	Air Slide	1	Cap: 1000 tph	
19	AS 501	Air Slide	1	Cap: 1000 tph	
20	DE-4	De-dusting system complete unit in Transfer Point (TP-3)	1		
20a	DC 400	Dust Collector	1		
20b	EF 400	Dust Extraction Fan with motor	1		
20c	RV 400	Rotary air lock valve	1		
21	BL 400	Fan type Blower for air slide	1		
22	BL 401	Fan type Blower for air slide	1		
23	BL 500	Fan type Blower for air slide	1		
24	BL 501	Fan type Blower for air slide	1		
25	BW-001	Belt Weigh Scale on Pipe Conveyor (PC-100)	1		
26	P-1 &2	Sump Pump capacity m^3/ hr	1w+1s	Cap: 20m^3/hr	
27		Elevator (Rack & Pinion Type)	1	1 Ton	

The above is a list of major equipment only. Any other equipment required to make the system complete in all respect for its successful and guaranteed operation which is acceptable to NALCO & DCPL is also deemed to be included under bidder's scope without any additional cost to Owner.

8.00.0 TECHNICAL SPECIFICATION
TECHNICAL FEATURES OF ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

The technical features of major equipment of alumina unloading and transportation system should address all functional, safety and environmental requirement. All equipment foundation bolts shall be high tensile (HT) bolts.

8.01 PIPE CONVEYORS

8.01.01 COMPONENTS OF THE PIPE CONVEYOR:

A. **Mechanical**

1. Conveyor Belt
2. Idler incl. Bracket
3. Pulleys
4. Plummer Block
5. Pulley Bearing
6. Discharge Hood
7. Discharge Chute & Liner
8. External Pre-Scrapper
9. External Main Scrapper
10. Int. V Plough Belt Cleaner
11. Drive Motors
12. Input Coupling
13. Gearbox
14. Output Coupling
15. Coupling Guards
16. Drive Base Frame
17. Pulley Frames
18. TU Arrangement
19. Disc Brake
20. Guide Frame
21. Take Up Cage
22. Stringer Frame & Post
23. Deck Plate
24. Skirt Board Assy.
25. Safety & Limit Switches.
26. Suitable no. of stairs, cross-over and platform from ground shall be provided wherever access is required for regular inspection, Lubrication or operation of machinery or equipment.
27. Clear walkway on one side of 1200 mm and other side of 600 mm minimum width shall be provided along the length of pipe conveyor gallery
28. In an underground tunnel, a clear walkway space of 1000 mm shall be provided along the length of the conveyor on either side
29. The pipe conveyor gallery structure shall be of box type with side sittings and also top covered to avoid rainwater entry
30. 1500 mm clearance shall be maintained all around drive system for maintenance purpose

31. Maintenance platform & walkway for pipe conveyors shall be of chequered plate construction

B. **Electrics & Controls**

Electrical drive motors for pipe conveyors shall be VVVF drive and for detail description of VVVF drive, please refer relevant electrical DBR.

C. **Structural Steelwork & Civil work**

Please refer relevant civil & structural DBR.

8.01.02 CONVEYOR PARAMETERS

A. Design

Code & Standard	-	As per manufacturer's standard
Capacity	-	1000 TPH
Utilisation Factor/ Filling Factor	-	0.7
Slope Factor	-	As applicable
Belt Speed	-	3.2 m/s
Belt Width	-	1800mm
Pipe Diameter	-	450mm
Bulk Density (After Fludisation)	-	0.85T/m^3

B. Belting (Grade M24 FR) : Fire Reiststance Type

Code & Standard	-	IS / DIN / BS / JIS
Duty	-	Continuous
Edge Construction	-	Moulded both edge capped.
Cover	-	Rubber

C. Pulley

Code & Standard	-	IS 8531
Shell	-	IS 2062
Disc	-	IS 2062

Hub	-	IS 2062		
Construction	-	Welded		
Shaft	-	50C8 (IS 1570) / EN-9 (BS 970)		
Connection	-	Keyed to Hub		
Machining Tolerance	-	IS 919		
Balancing	-	Statically Balanced		
Lagging	-	Neoprene Rubber		
Type	-	Drive Pulley	:	Grooved
	-	Non Drive Pulley	:	Plain
Shore Hardness	-	55-60 Scale A		
Plummer Blocks	-	Cast Iron Housing		
Bearing	-	Double Row Self Aligning Spherical Roller		

D. <u>Idler</u>

Code & Standard		IS 8598/Manufacturer's standard
Construction	-	Grease Packed & Sealed for Life
Roll Tubes		ERW Black conforming to IS 9295
Shaft		50C8 (IS 1570) / EN-9 (BS 970)
Machinging Tolerance	-	IS 919
Bearing	-	Deep Groove Ball Bearing
Bearing Housing		Press Formed out of 3 mm DD Steel Sheet
Housing Connection		Welded to Roll Tubes
Inner Seals		FRP
Labyrinth Seals	-	FRP
Inner Dust Seals		FRP
Outer Dust Seals		Press Formed out of 1 mm DD Steel Sheet

Out of Roundness		+/- 0.5 mm
Mounting		Drop in Bracket Slot
Brackets		IS 2062 Fabricated
Carrying Idler	-	3 Equal Roll – In Line/PSK Rollers
Return Idler		2 Equal Roll – In Line/PSK Rollers
Impact Idler		3 Roll with Rubber Disc. – In Line
Pipe Forming Idler		12 (6+6) / 9 (6+3) Equal Roll – In Line

E. Skirt Board

Body		IS 2062 / 10 mm Plate
Liner		HARDOX 400 / 12 mm Plate
Sealing	-	Segmented Modular Rubber Blade
Cover		IS 2062 / 2 mm Sheet
Mounting		From Stringer Frame

F. Deck Plate

Material	-	IS 2062
Thickness	-	3.15 mm

G. Chute Work

Discharge Hood-	IS 2062 / 4 mm Sheet
Discharge Chutes	IS 2062 / 10 mm Plate
Liner	HARDOX 400 / 10 mm Plate

H. Technological Structure

Stringer & Short Post		IS 2062 / Rolled Section
Size		ISMC 150
Construction	-	Bolted

I. Gear Box

Type		Helical / Bevel Helical
Housing		Fabricated
Lubrication		Splash.
Mechanical Rating	-	Should be greater than equal to at least 1.25 times on Motor Rating Or 1.5 times on Drive Pulley Shaft Power.
Thermal Rating	-	shall be at least equal to the motor rating.
Cooling Type	-	Natural Cooling.
Holdback		Integral with Gear Box

J. High Speed Input Coupling

Type		Resilient
Service Factor	-	1.5 times on Motor Rating for Resilient Type

K. Low Speed Output Coupling

Type		Geared
Service Factor	-	1.5 times on Motor Rating

L. Pull Cord Switch

Location		30 m C/C (Walkway side)
Enclosure		Cast Aluminium
Protection		IP 65
Contact	-	2 NO + 2 NC
Operating Positions	-	1-0-1
Reset		Manual

M. Belt Sway Switch (Both Side)

Location		50 m C/C at both sides of the pipe conveyor in the transition zone of receiving & discharge area.
Enclosure		Cast Aluminium
Protection		IP 65
Contact	-	2 NO + 2 NC

	Reset	Manual

N. Speed Monitor

Function	Zero Speed Switch
Type	Inductive Proximity Switch
Location	Conveyor Pulley
Quantity	One (1)
Operating Distance-	15 mm
Probe Enclosure	Brass
Protection	IP 67
Accessories	Monitoring Unit
Type	Rotational Speed Controller
Contact Rating -	5 A

O. Pull Cord Rope & Eye Hook

Cord Material -	GI Rope
Diameter	3 mm
Construction -	30 swg / 6x7
Protection	PVC Sheath
Eye Hook Diameter	35 mm
Construction -	6 mm Rod

P. Belt Rip Switch

Type	Cable Type Switch for Pipe Coveyor to be provided.

Q. Misc.

Hood Cover for the conveyor as shown in the MR document shall not be required. Bidder is requested to go through the drawing (refer Drg No -14L08-DWG-M-PL-004 REV.-D.) where inclination at feeding zone is 5.32 deg & Conveyor inclination is 15 deg.

8.02 AIR SLIDE

8.02.01 TECHNICAL REQUIREMENT

Air slides unit shall be complete with:

a) Bottom casing, complete with flanged air inlet manifolds with dampers, stiffeners and support brackets.

b) Top cover, complete with weather proof fixing arrangement, flanged feed spouts, bolted inspection hatches and flanged air vent connection with damper.

c) Flanged discharge boxes and distribution boxes.

d) Air slide maintenance is limited to the replacement of fluidization cloth.

e) Total length of air slides shall be divided into suitable no of segments. Fabric, of required size, preferably in single pieces for each air slide. Application of Silastic is must for installation of air slide fabric. Fabric supporting wire mesh at feeding zones. The fluidization cloth of air slides shall be of imported quality from reputed vendor.

f) Provision of balancing air in the air slide shall be kept. The control philosophy of balancing and methodology shall be clearly mentioned.

g) Provision must be kept in the air slide chamber for fixing manometer and pressure gauge with plug.

h) Flushing points shall be provided in all air chambers of air slides and vent pipe joints.

i) Additional pneumatic shut off gate and motorized gate to control the capacity of the pit outlet to feed the material to AS 300.

j) All air control valves of the air slides to be provided with butterfly valves only and suitable platform shall be provided for maintenance of valves in all areas.

k) Air permeability of the fabric shall be approximately1.15 m3/m2/min at 600 mmWC. Depending on bulk material characteristics, the air quantity may deviate from this figure.

l) Fan-Type Blowers

Guide values for air pressure (including reserve) are:

- Conveyor width ≤ 500 mm 60 mbar
- Conveyor width > 500 mm 80 mbar

Guide values for specific air volume are:

- Fine material 2 m3/m2 per minute
- Coarse material 3.5 m3/m2 per minute

m) Maximum speed: 3000 rpm for 50 Hz electrical supply.

n) Air filters shall be provided at fan inlet at man height.

o) Fans installed outdoors shall be protected against taking in of rain through the suction inlet.

p) Casing mounted fans are as well accepted.

q) All bolts, nuts, washers and loose fittings, as would be necessary for erection.

8.03 SCREW TYPE AIR COMPRESSOR

Nine (9) nos. (8 working and 1 standby) oil free air cooled Screw type air compressors, each having suitable capacity free air delivery at 3.0 bar for unloading of wagon and two (1 working and 1 standby) Oil Free Screw Compressors (Air Cooled) for supplying pulse air to Dedusting units 7.5 kg/cm2(g) with suction filters fitted with electrical & instrumentation, interconnecting cables etc. These compressors shall be controlled both from local control panel view and from level 2 SCADA system. The piping design has to be done in such a way that the stand by compressor shall be capable of substituting any blower as per requirement.

Compressed air will be passed through air dryer and air receiver and quality of air shall be such that instrument air receiver shall receive compressed air having aerosol of 1ppm and particle size down to 1 micron.

8.04 FAN

The fans shall be capable of withstanding the stresses which may be experienced during normal operation and during over speed testing. All fans shall be suitable for outdoor installation.

All the fan units shall be reasonably noise and vibration free in operation and hence of reasonably low speed. The noise level shall be limited to 80 db at 1.5 M radius.

Operating pressure of fan shall not exceed 93% of Peak pressure of fan performance curve.

Fan static efficiency – min. 80%

Drive – Directly coupled and motor

Fan performance testing shall be as per BS: 848, Class ‘A’ latest revision.

Anti-vibration pads to be provided for fan installed above ground level

Inspection doors with fly nuts and gasket of suitable size shall be provided on the scroll for easy access to fan internals for inspection, cleaning and for in-situ rotor balancing.

Fan casing shall be provided with clean out doors and drain plugs, as required

Inlet Boxes are to be provided as required and casing shall be stiffened to resist vibrations and distortions.

Motorised inlet damper has to be provided for fans with motor rating above 11 kW.

The fan and the drive motor shall be rated for continuous operation.

The starting torque characteristic of the motor shall be suitable for the duty desired.

All centrifugal fans may have adequate arrangement for vibration isolation of minimum 70% efficiency as the case may be.

The centrifugal fans shall have flat backward inclined / backward curved blades. They shall be single inlet and shall be of single width type. For design purpose outdoor temp. shall be taken as 51 deg.C.

The fans shall be of robust construction. The thickness of the casing and impeller shall be as given below:

Casing – 8 mm.

Inlet box – 6 mm.

Blades – 8 mm (min.).

Fan should be designed for adequate duty keeping a margin in approximately 15% on pressure ratings. Operating speed of the centrifugal fan shall not preferably be more than 1500 rpm and velocity of outlet shall not exceed 15 m/sec.

8.04.01 MATERIAL OF CONSTRUCTION

The following materials shall be used for the construction of various parts:

a)	Fan scrawl	:	MS (IS 2062).
b)	Supports, frames & structures	:	MS (IS 2062).
c)	Cone inlet for wall exhausters / supply fans	:	CI or MS.
d)	Dampers – louver type and butterfly type	:	MS (IS 2062).
e)	Flexible connections for fan inlet & outlet	:	Rubber impregnated canvas with MS Flanges & Cleats. Split draw band type made of spring steel for DE System.
f)	'V' Pulleys	:	CI Multi-grooves (IS 210, Gr. 20).
g)	'V' Belt	:	Reinforced rubber of appropriate section.
h)	Slide Rails	:	CI or MS.
i)	Connection Pieces	:	Galvanized iron according to supplier's design.
j)	Bolts and Nuts	:	All foundation bolts and nuts shall be HT and Others shall be MS unless otherwise specified.
k)	Rain protection cowls, hoods and casing for roof exhausters	:	Casing & exhaust hoods will be hot dipped galvanized after fabrication from MS IS 2062.
l)	Vibration isolating pad, washers & bushes, if any	:	Hard synthetic rubber of hardness 40 degree shore.
m)	Chute thickness	:	10mm

8.05 BEARING AND BEARING HOUSING

- Anti friction bearings, suitable for specified duty conditions shall be used for the fans, conveyors, elevators, etc. The bearings shall have a minimum life of 100,000 hours.
- The bearing make shall be of SKF / FAG / TIMKEN. The supplier shall provide authenticity certificate for genuineness of bearings. Spurious bearings shall be rejected.
- Bearings shall be provided with suitable lubrication system with adequate cooling arrangement to maintain the bearing & lubricant temperature within permissible limits. Grease lubrication system shall be preferred. For oil lubrication system, maximum permissible oil temperature during operating condition shall be limited to 90 deg. C / 40 deg. C above ambient temperature. Drain plug shall be provided in bearing housing.

8.06 DE-DUSTING UNITS/ BAG FILTERS (JET PULSE TYPE)

8.06.01 GENERAL

- Not more than 8 dust sources shall be connected to a single dust filter.
- The maximum air to cloth ratio shall be 1.15:1 / air permeability shall be 1.15 m3/m2/min for general dedusting.
- Pulse jet type bag filter shall be provided with suitably reinforced bag/man-catcher screens.

8.06.02 BAGS

- Filter cloth for dry gas application up to 135 °C: Needle felt made of high quality Polyester fibres (for air and alumina dust).
- For standardization of bags (e.g., diameter of 140/160 mm) most filters shall be matched in such a way that only one size (i.e. diameter, length) and filter bag type is used for similar applications.
- Maximum number of bags per row: 16 bags
- Bag cages shall be provided with longitudinal wires:
  - To 12 for filter cloth diameter < 160 mm.
  - Bag cages shall be of single piece design and shall be corrosion-resistant (galvanized, stainless steel or epoxy coated), depending on application.

8.06.03 BAG MONITORING AND PROTECTION EQUIPMENT

- Bag cleaning shall be controlled by timer and differential pressure measurement across the bag filter by DP gauge or transmitter.
- Manual condensate drain, pressure gauge and regulator at the inlet of compressed air receiver/manifold shall be provided.

8.06.04 DEDUSTING AIR VOLUME

- Air Slide : 125% of Air Blower capacity.
- Pneumatic Transport :1.5 times of the expanded compressed air volume
- Small Bin(< 50 m3) : 1000 m3/h

8.06.05 VENTING DUCTS

- Inclined vent ducts for up and downwards dust-laden air flow shall have an inclination of at least 60 degrees measured from horizontal.
- A conveying velocity of 18-25 m/Sec shall be maintained at all points in the ductwork between dust collection hood and dust collection plant to ensure flow of air without settling of dust. Hinged cleaning hatches shall be provided on the ducting near the bends & interconnection of ducts. Measuring ports shall be provided on the ducting near each suction point and on ducting before & after the centrifugal fan to measure the flow rate and pressure. Platform with ladder shall be provided for approach to cleaning hatches & measuring ports.
- Horizontal ducts may be avoided.
- Minimum venting duct diameter shall be 133 mm (outside).
- Air velocity at venting hood entries shall not exceed 1.5 m/s
- Minimum duct and hood wall thickness shall be 3 mm
- All expansion / flexible joints shall have bolted flange-to-flange type connections on both sides of expansion joint for removal of complete unit. Minimum flange thickness shall be 6 mm.

Orifice plates with wear protection shall be used for balancing the de-dusting air volumes from the various de-dusting points of a single filter if wear is predicted.

8.06.06 HOPPER CONSTRUCTION

Hopper valley angles shall not be less than 55 degrees (measured from horizontal) for dust from general applications. For filters with the risk of operation below the water dew point, the casing insulation shall be minimum 50 mm of rock wool.

8.07 AIRLOCKS

- RAL casing should be casting of IS 4896 Grade II.
- Spring loaded tips to be provided on rotor vanes for continuous sealing.
- Tip blade shall be of replaceable and adjustable type.
- RAL size : min. 300 x 300 mm
- RAL speed not more than 20 rpm.
- Motor shall be suitable for 100% filling of RAL at compact density. Minimum 1.1 kW / 1500 rpm motor to be considered.

8.08 VENTILATION & AIR CONDITIONING

- Ventilation system shall be provided for all the working areas/locations/ buildings of proposed alumina unloading and transportation system which are frequented/manned by operating & maintenance personnel. Ventilation system shall be designed and installed conforming to "Industrial Ventilation" (American Conference of Governmental Industrial Hygienists/Committee on Industrial Ventilation).

- Type of ventilation system required are outlined below:-

	Location	**Type of Ventilation System**
A	Wagon Unloading Area (proposed)	
1)	Tunnels for conveyor # PC-100 & associated Air slides of underground pit.	Exhaust air fans and dry HDPE filter type with supply air fans etc.
		Air changes per hour = 20
2)	Control room building for proposed AUT system:-	
i)	VFD Panel / PLC bldg./.control room building of proposed AUT System.	Minimum 2.0 TR capacity of Duct able split type Air Conditioning unit of adequate number shall be provided.
ii)	Switchgear room/other electrical area	Dry type pressure ventilation system.
iii)	Battery room	2.0 TR capacity of Ductable Split A/C of adequate number shall be provided.
B	All transfer points & Drive winch House.	Natural ventilation. The structural design/cladding etc. shall be designed to ensure well, natural ventilated building.
C	All toilet areas	Standard exhaust fans (propeller type) to ensure minimum 20 air changes per hour.
D	Dedicated Operator's cabin in watch tower	High wall split type A/C unit to be provided and also sufficient number of ceiling fans with electronic regulator and wall mounted type. Self-contained automatic electronic air cleaning unit to be provided.

8.09 ROPE WINCH SYSTEM

Rope winch system for wagon hauling shall be as per vendor's standards.

8.10 EQUIPMENT PARAMETERS AND OTHER SALIENT FEATURES:

- Stack height for Dust collector system shall be as per latest pollution control norms.
- Motor name plate rating at 50ºC shall have at least 15% margin over the input power requirement of the driven equipment at duty point except for package type screw compressor where service factor motor are used as per manufacturers standard.
- The equipment shall be designed with sufficient safety margins from the mechanical design and the process performance point of view. It shall be capable of re-starting after stopping due to power failure or other process-related interruption (i.e. interlock).
- The open space between the walkways on both sides of the air slides, conveyors to be covered with plates for safety purpose.
- The pipe conveyor gallery shall be suitably designed to prevent ingress of rain water.
- Pipe conveyor belt shall be selected properly for smooth operation (namely pipe formation, flexibility etc.). Pipe conveyor belt grade shall be fire resistance type.
- One Maintenance cum Sub-Store to be constructed near Blower room.
- All the alumina unloading area shall be under shed to protect Sun & Rain.
- Platforms (full length of the shed for both tracks) shall be constructed for two side access to roof of BTAP wagons inside the shed for alumina unloading area.
- Flushing points to be provided in all air chambers of air slides and vent pipe joints.
- All air control valves of the air slides to be provided with butterfly valves only.
- Suitable platforms to be provided for maintenance of valves in all areas.
- All de-dusting chamber shall be protected from rainwater and in case of necessary, sheds/canopy to be provided.
- In the control room, all the screens must be TFT to avoid heavy magnetic field.
- The outdoor electrical /Instrumentation installations like local cabinet of motors and other instruments shall be provided with rain protection shed.
- Total system lighting arrangement shall be preferably 70 Watts HPSV (High Pressure Sodium Vapor) with glass fitting.
- Pull chord/Belt sway switches and other switches as mentioned in P&ID shall be provided considering system tripping.
- In the control room there shall be Audible buzzer and Indication light during Alarm/Trip of the any equipment /system.

- Elbow installed on alumina pipes must be designed to resist abrasion. The inside pipe shall be lined with an abrasion proof medium. Elbow radius must not be less than 1 meter.
- The fluidization cloth for air slide shall be of fabric quality from reputed vendor.
- Pressurized ventilation system shall be provided in the blower room.

9. PERFORMANCE REQUIREMENT OF MAJOR EQUIPMENTS

Pipe conveyor

Equipment Number	:	PC-100/200/300
Capacity	:	1000 TPH
Accuracy	:	± 5%

Air slides

Equipment Number	:	AS-100/200
Average Capacity	:	480 TPH
Design Capacity	:	500 TPH

Air slides

Equipment Number	:	AS-300/400/401/500/501
Design Capacity	:	1000 TPH

Dust Emission

Equipment Number	:	DC-100-A/B/200/300/400
Type	:	Bag Filter type
Location	:	As per site condition
Function	:	Filter the air loaded with alumina dust before venting it to the atmosphere.
Dust Load	:	Approx. 25 gms/Nm^3
Dust Emission to atmosphere	:	50 mg / Nm^3 (desirable)

10. UTILITY FOR ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

One make up water line (existing 200-WT-35-2305-A34) will be tapped from existing line at the Co-ordinate N= (-) 1153.28M, E = (-) 2581.83M
8" Fire Hydrant (U /G Line) shall be available from existing line at the co-ordinate N= (-) 939.874M, E = (-) 2343.605M

8" / 12" compressed air line shall be tapped from the existing line at the co-ordinate N= (-) 1258.68M, E = (-) 2581.83M

The compressed air line for bag filters near silo-6 and silo-2 shall be tapped from the nearest existing compressed air line.

Drinking water supply line for proposed shall be tapped from existing system near RP area.

SECTION – III/2 :ELECTRICAL

SECTION: III/2- ELECTRICAL SPECIFICATION

SUB-SECTION: E-0100

GENERAL ELECTRICAL SPECIFICATION

C O N T E N T S

CLAUSE NO.	DESCRIPTION
1.00.00	INTENT OF SPECIFICATION
2.00.00	SCOPE OF WORK
3.00.00	CODES AND STANDARDS
4.00.00	GENERAL REQUIREMENTS
5.00.00	CO-ORDINATION WITH STATUTORY BODIES AND OUTSIDE AGENCIES
6.00.00	FACILITIES
7.00.00	SYSTEM DESCRIPTION
8.00.00	CONTROL PHILOSOPHY
9.00.00	DESIGN CRITERIA FOR EQUIPMENTS
10.00.00	CABLING, EARTHING & LIGHTNING PROTECTION
11.00.00	FAULT LEVEL
12.00.00	SYSTEM STUDY
13.00.00	DEGREE OF PROTECTION FOR ENCLOSURE
14.00.00	PAINTING & PAINT SHADE
15.00.00	TYPE, ROUTINE & ACCEPTANCE TESTS
16.00.00	DRAWINGS, DATA & MANUALS
ANNEXURE-A	DESIGN DATA
ANNEXURE-B	LIST OF ELECTRICAL DRAWINGS/DOCUMENTS TO BE SUBMITTED WITH TENDER
ANNEXURE-C	FORMAT FOR ELECTRICAL LOAD DATA

1.00.00 INTENT OF SPECIFICATION

1.01.00 The specification is intended to cover complete electrical work for the Alumina unloading and transportation system including 11/0.433kV transformers, 11& 0.415 kV Switchgears along with control, protection and metering, HT & LT Motors, VVVF Drives including 11/0.690kV transformers, HT&LT Power and control cables, LT NPS BUS DUCT, Overhead Cable Tray/trestle including support structures, Complete Indoor/Outdoor electrification of Control room, Office, Substation buildings, Conveyor, Transfer house ,Compressor house, indoor/outdoor illumination within the boundary limit and all auxiliary AC/DC systems as required for the proposed package of National Alumina Company Limited at Angul, Odisha.

2.00.00 SCOPE OF WORK

2.01.00 The scope of these specifications shall include design, engineering, manufacture, assembly, shop fabrication, testing at works, transportation to site, unloading and storing at site, erection, testing, commissioning, trial operation and putting into successful commercial operation including supply of erection consumables, supply of spares, hardwares, labour, tools & tackle, obtaining all statutory clearances etc. The scope of work also includes all civil, structural and architectural works associated with installation of the electrical system and equipment at site.

2.02.00 This specification shall be applicable to all equipment to be supplied and erected under this package in accordance with detailed scope of work and accompanying electrical and mechanical sub-sections. Ratings of equipment / system mentioned in these specifications are indicative only, and Bidder shall finalize the same based on their system requirement, and establish by calculation.

2.03.00 It is the responsibility of Bidder to have thorough understanding of reference document, site condition and specifications. The intending bidder shall be deemed to have visited the site and studied the condition collected relevant and required data before submitting the tender to make the tender in all respect. Non- familiarity with the site condition will not be considered a reason either for extra claim or for not carrying out the work in strict conformity with the specifications/acts/code of practices/ rules and regulations of local Electrical inspectorate. Bidder is requested to carefully examine and understand the specifications and seek clarifications, if required, to ensure that they have understood the specifications.

2.04.00 Hazardous areas / location in the plant shall be clearly defined and marked on the layout drawings by the Bidder. Where fire hazard is present increased safety, non-sparking, flame-proof or explosion proof type equipment shall be used in line with relevant standards. All such equipment supplied shall be certified, by a recognized authority, as fit for use in that particular location.

2.05.00 In case of any conflict/contradiction among various electrical sub-sections, generally Sub-Section: E-0100 (General Electrical Specification) shall govern unless otherwise clarified by the Owner/Owner's Engineer.

2.06.00 Broad scope of electrical works under this package is outlined below. Items that are not specifically mentioned but are required to make the system complete in all respect shall be deemed to be included in the scope without any extra cost implication.

2.06.01 **Scope of Supply**

Alumina Unloading and Conveying System	
a)	HV Switchgear
(i)	Vacuum Type 11 kV Switchgear (Double Bus bar system) complete with Control, Metering (Multifunction meters), transducers and Protection including numerical relays with protocol IEC 61850 or Proprietary protocol – 1 Set.
(ii)	Augmentation of 11kV Cellular Switchgear at Swgr-3 near 220kV Substation (Double Bus bar): Extension of One no. 11kV VCB feeder along with all bus work and interfacing with the existing system complete with Control, Metering (Multifunction meters), transducers and Protection including numerical relays with protocol IEC 61850 or Proprietary protocol – 1 Set. *Note: In 11kV cellular switchgear, space available for feeder 3C10 shall be used for proposed augmentation. Two nos. isolators are installed in feeder 3C10. Bus work also exists upto the isolators. Necessary bus work after the isolators, breaker, CT etc. shall be provided by LSTK vendor.*
(iii)	Augmentation of Substation : 710.37(Double Bus bar): Extension of One no. 11kV VCB feeder along with all bus work and interfacing with the existing system complete with Control, Metering (Multifunction meters), transducers and Protection including numerical relays with protocol IEC 61850 or Proprietary protocol – 1 Set.
Note: All system / equipment / items for HV Switchboard shall be located in the switch board itself.	
b)	415 V Switchgear
(i)	0.415 kV Switchgear complete with Control, Metering (Multifunction meters), transducers and Protection including numerical relays with protocol IEC 61850 or Proprietary protocol – 1 Set
Note: All system / equipment / items for Main substation 415 volt Switch Gear shall be located in the switch board itself.	
c)	11/0.415 kV Power Cable and Control cables for the entire system-Lot
(i)	11kV XLPE power cables with FRLS grade HR PVC outer sheath and Aluminium conductor of H4 Grade : Lots
(ii)	1.1kV XLPE power cables FRLS grade PVC outer sheath: Lots
(iii)	PVC control cables FRLS grade PVC outer sheath: Lots
d)	Transformers
(i)	1600kVA, 11/0.433 kV Transformers with Off Circuit Tap Changer-2 Set.
e)	Motors
(i)	HT/LT Motors-Lots.
	Note : above 200 kW - 11 kV Upto 200 kW - 415 Volts VFD Driven Motors- 690V

Alumina Unloading and Conveying System	
f)	Battery & Battery Charger
(i)	Lead Acid PLANTE type Battery with dual Float cum boost charger- 2 Sets
(ii)	110V DCDB– As required.
g)	VVVF Drives
	VVVF Drives-3 sets.
h)	Aux AC Distribution Board
(i)	Ventilation DB, Aux DB -As reqd.
(ii)	Complete cabling, earthing and lightning protection system.
(iii)	Complete earthing and lightning protection of equipment, cable tray/trestle, buildings and structures including interconnection amongst bidder's earth grid around different buildings / structures and of the bidder's earth grid with that of the Owner.
i)	Cabling and Cable tray/trestle/trenches
(i)	Cable trenches (Inside substation), Outdoor Overhead Cable tray/trestle – Lot.
(ii)	Cabling viz. cable laying along with cabling accessories, RCC cable trenches, trays with supporting structures, termination and jointing kits, etc. as required for LSTK vendor scope cables.
(iii)	Inside substation Bidder to provide adequately sized cable trenches/trays/risers to accommodate all cables under the Bidder scope.
(iv)	In addition to above bidder to keep 20% free space in each cable tray.
(v)	All LT cable glands shall be brass double compression type.
(vi)	In / Out cable from S/S building/PMCC/other building shall be sealed properly and fire resistance compound to be provided around the sealing.
(vii)	Inside the industrial building/shed/plant, cable tray shall run above the man height along the wall/structure and cable drops shall be at the nearest wall/column. From wall/column to motor/PB station, cable shall run through U/G pipe/cable tunnel. Cable tunnel/pipe shall be below the floor. Protective GI pipe shall be provided for all cable at the ground level.
(viii)	a) For areas' other than inside substation building Overhead cable trestle will be provided up to the conveyer from the respective S/S. The bottom of the steel supporting structure shall be generally at 4.0 m above the grade level except for road crossing where it shall be 9.0 m above grade level. System with single structure and trays shall be employed suitably. b) The cables in areas where the conveyor is running, the cabling shall be done along the conveyor support structure with suitable supporting arrangement.
j)	Illumination
(i)	Complete Indoor/Outdoor area Illumination including approach road illumination.

Alumina Unloading and Conveying System	
(ii)	Illumination systems as required for complete internal and external Area lighting of substation under the scope of this package. This should include illumination of stairways, ladders, approach roads, and vicinity of substation : Lots
(iii)	Entire Indoor/Outdoor illumination in the vicinity of transfer house, Conveyor gallery and other plant and non-plant buildings related to alumina unloading and transportation shall also be considered.
(iv)	Miscellaneous items as specified in illumination specification: Lots
k)	Normal/Emergency supply Lighting Panels – Lots.
l)	Feeder pillar boxes for area lighting – Lots
m)	METERING
(i)	Audit metering in LV side of the each distribution transformer.
(ii)	Built-in energy meter of numerical relays will be provided for other feeders.
n)	Each Substation/ switchgear rooms shall be provided with rubber mats in front of every panel (both side), shock treatment chart, CO_2 fire extinguisher (min 2), first aid box, rubber gloves, discharge rods, sand filled buckets, fuse pullers, caution boards, special and general purpose tool box of sufficient nos.
o)	Local Pushbutton Stations in various locations with metering and start/ stop facility for the drives -Lots
p)	Local control board for controlling the drive and local/remote selection-Lots
q)	Local Isolating Switch Units for local isolation of drives-Lots **The following additional Tools and Tackles for maintenance work shall be other than normal tools & tackles** **- Breaker lifting winch/trolley** **- ACB handles and keys** **- Programming cables / laptop and software for relay and energy meter programming.**
r)	Multiplication of field contacts for process safety interlocks shall not be realized in HV/ LV PMCC. Hardwired interfacing with PMCC / Switchgear and PLC system are under the scope of this package.

2.06.01.01

a) Proposed VFD system can be located in the Sub-Stations near the Silo 1 & 2 and Silo 5 & 6. But there is no building available for installation of transformers near the Silo 1 & 2 and Silo 5 & 6 . The successful bidder has to construct necessary building for the transformers supplied by them adjacent to the Sub-Stations in the

space provided by NALCO near the Silo 1&2 and Silo 5&6. The nearest S/S area at a distance of 50 m approximately from the Silos.

b) Existing System Power factor improvement capacitor bank is not required. Bidder has to ensure the Power factor at 11 KV BUS of the new Sub Station should be at least 0.85 or more.

c) For illumination, LED lights with suitable ratings shall be provided. Conventional HPSV, fluorescent lights will not be considered.

d) Equipment handling facilities of installed motors, VFD, Air circuit breaker shall be provided.

e) Pull cord switches shall be indicative type of 220V control supply.

f) Spare motor shall be supplied above 75KW.

g) The power socket cabinet for welding works shall make of stainless steel with ELCB and provided with 63A, 3 phase& 20A single phase plug and socket arrangement system.

h) Lighting transformer for emergency lighting system.

i) Spare Cable Tray shall be provided of same size of main cable tray.

j) Cable distance from Substation 710.37 to New Electrical Room To be obtained from Layout Drg (approximately 450 meters).

k) Cable distance from New Switchgear 3 (Existing) to New Electrical Building (upcoming) will be approximately 1700 meters. However, exact cable distance to be ensured by the bidder from site.

l) Location of New Electrical Room Approximate location is tentatively coordinate (N750 , E2350), Exact location will be finalized during detailed engineering.

m) Distance from 220 kV SCADA location to New substation (upcoming) is approximately 2000 meters, kindly note, 220 kV SCADA system building is adjacent to new switchgear -3 (existing) area. However, exact cable distance to be ensured by the bidder from site.

n) Tentative Electrical Load List Near Silos:

Supply of power to the drives near Silo 1&2 and Silo 5&6

A) Tentative Electrical Drive Load near Silo-1 & 2 is as below-

1. Pipe Conveyor Drive (PC 200 at TP-2) – 315 kW or 2 X 160 kW
2. Blower for Air Slide 500 – 22 kW
3. Blower for Air Slide 501 -22 kW
4. DE-3 system (fan with motor) at TP-2 – 45 kW (Qty 1.)
5. Rotary air lock valve-0.5 Kw (Qty 1.)

6. Electric Hoist Capacity 4 Ton Power 7.5 kW

B) Tentative Electrical Drive Load near Silo-5 & 6 are as below-

1. Pipe Conveyor Drive (PC 300 at TP-3) – 275 kW
2. Blower for Air Slide 400 – 22 kW
3. Blower for Air Slide 401 -22 kW
4. DE-4 (fan with motor) at TP-3 – 45 kW (Qty 1.)
5. Rotary air locks valve-0.5 kW (Qty 1.)
6. Electric Hoist Capacity 4 Ton Power 7.5 kW
7. Goods cum Passenger Lift 2 x 9.2kW

o) The following additional Tools and Tackles for maintenance work shall be other than normal tools & tackles

- Breaker lifting winch/trolley
- ACB handles and keys
- Programming cables / laptop and software for relay and energy meter programming.

2.06.02 Scope of Services

- Site visit and collection of data for correct and complete quotation. Bidder shall visit the site to acquaint himself with the detailed technical requirement, terminal points, facilities available, specific requirement of owner before submitting the offer. It is the responsibility of bidder to assess correctly and quote accordingly. Failure to do so by bidder will not be a reason for the Owner to accept any additional price claim on such ground.
- Design, engineering, manufacture, assembly, shop fabrication, testing at works, transportation to site, unloading and storing at site, erection, testing, commissioning, trial operation including supply of erection consumables, hardwares, labour, tools & tackles etc. for the electrical system & equipment required for proposed plant. The scope of work also includes all civil, structural and architectural works associated with installation of the electrical system and equipment at site.
- Sizing calculation of equipment's. All equipment ratings mentioned in this specification are indicative minimum, and shall be finalized by bidder by calculation. In case calculated approved rating comes out to be higher than the specified tentative rating, Bidder shall have to supply the calculated rating at no additional cost to owner.

2.06.03 General Design Requirement

For the purpose of design of electrical equipment/systems, an ambient temperature of 51°C and relative humidity of 100% shall be considered.

The equipment shall be designed to operate in a highly polluted and corrosive environment.

For equipment installed in air-conditioned areas, design ambient temperature can be less than 51°C, only if 2x100% air-conditioning system is specified and provided.

The electrical system parameters as envisaged are given below. It is responsibility of Bidder to verify HT/LT system data.

Voltage Level	**Description**	**Utilization**
11 kV	11 kV, 3 ph., 3 wire, 50 Hz, 40kA *for 1 sec. Bidder shall collect data and verify system earthing and fault level.	Power Source from existing system. Power feeding to HT motor and LV transformer.
690V	690V, 3 ph, 4 wire, 50 Hz, effectively earthed; Fault level : 50 kA* for 1 Sec	Power distribution to VFD driven motor.
415V	415V, 3 ph, 4 wire, 50 Hz, effectively earthed; Fault level : 50 kA* for 1 Sec	Power distribution to LT motors, other LT auxiliaries, and any other system pertaining to the package.
DC	110V DC, 2 wire, ungrounded, 25 kA* for 1 Sec	Switchgear control, indication, protective relay circuits etc.
240V/110V AC	240V/110V AC, 2 Wire supply to UPS	PLC & 4 Wire field instrumentation.

*Minimum and indicative. Actual value shall be calculated by Bidder with back up calculation.

Any other AC or DC voltage level if required for the system shall be arranged by the bidder.

All electrical equipment shall be suitable for a supply voltage variation of ± 10%, supply frequency variation of ± 3% and a combined absolute variation of 10%.

DC equipment / components if any, fed from the bidder's battery, shall be suitable for a voltage variation of + 10% to – 15% of the nominal voltage.

2.06.04 Scope of Design Work

The scope of design work shall include detail design for supply, erection construction and installation, commissioning of entire electrical system of alumina unloading and transportation package.

2.06.05 Design Work - Electrical

- Design Memorandum for various Equipment & Systems
- Electrical system study.
- Design Calculation, Bill of Material, sizing calculation of electrical equipments.

- o Electrical Single Line Diagrams.
- o Electrical layouts, showing equipment location, cable trays, cable trenches in transformer yard, overhead cable routes (cable bridge ,cable trestle) etc. cable trenches is acceptable only in Transformer yard.
- o Control, metering, protection and signaling scheme of each equipment and the system.
- o Cable sizing calculations.
- o Cable schedule and interconnection charts including route charts.
- o List of equipment and respective ratings.
- o Cabling and cable tray system including routing.
- o Grounding and lightning protection system including underground grounding mat, over ground grounding grid, air terminal network, lightning mast.
- o Lighting system including receptacles and power socket outlets. Illumination layouts show dispositions of fixtures, conduit routing.
- o Relay co-ordination and recommended settings, insulation co- ordination, relay setting calculations.
- o Preparation of installation, commissioning, operation and maintenance manuals.

2.06.00 Bidder shall quote for complete scope of work, with itemized price break-up.

2.09.00 System Study of the in view of system stability, harmonics, steady state/transient voltage drop, short circuit study along with protective relay setting and coordination, earthing and lightning protection, power factor improvement etc.

2.10.00 Terminal Point

2.10.01 Electrical battery limit for this package shall start from existing 11kV switchboards of substation 710.37 and 11kV cellular switchgear at switchgear room-3 near 220kV switchyard.

11kV switchboard at substation 710.37 shall be extended by adding one no. VCB feeder. The supply of the extension panel along with the bus work, metering. Control and protection for interfacing with the existing system shall be included under the scope of LSTK vendor.

For 11kV cellular switchgear, space available for feeder 3C10 shall be used for proposed augmentation. Two nos. isolators are installed in feeder 3C10. Bus work also exists upto the isolators. Necessary bus work after the isolators, breaker, Ct etc. shall be provided by LSTK vendor.

Further distribution shall be under the scope of this package. Please refer attached Key Single Line Diagram.

2.10.02 Emergency power for lighting shall be arranged by contactor from existing substation 710.37. Supply, laying, termination of the above cable shall be under the scope of this package.

2.10.03 For cable routing from substation-37 to proposed 11kV new switchgear cable tray shall be provided by LSTK vendor for laying their cables from existing substation. However, Cable bridge supporting structure is available up to Weigh Bridge of rolling plant. LSTK vendor has to provide and install Cable Bridge thereafter for laying the cable up to new proposed switchgear.

For cable routing from 11kV cellular switchgear at swgr-3 to proposed 11kV new switchboard, cable tray is available up to the pot line 4 south west end. Cable tray for laying their cable from pot line 4 southwest end to new proposed switchgear shall be provided by LSTK vendor. However, Cable Bridge supporting structure is available up to Weigh Bridge of rolling plant. LSTK vendor has to provide and install Cable Bridge thereafter for laying the cable up to new proposed switchgear.

2.10.04 For grounding, nearest risers of the existing grounding system is available near to new compressor and rolling plant area. LSTK vendor shall connect his grounding system to the above mentioned existing grid/risers.

3.00.00 **CODES AND STANDARDS**

3.01.00 Equipment

3.01.01 All electrical equipment and materials shall conform to latest applicable standard publications of International Electro-technical Commission (IEC) or equivalent standards published by the Bureau of Indian Standards (BIS) and other standards mentioned in the various volumes of sections of this specification. In case of a conflict between IEC and other standards, the requirement of IEC shall govern. The provisions of tender specifications (except the clauses of codes and standards of individual specifications) shall however have precedence over all other standards.

3.01.02 Equipment and material conforming to any other standard, which ensures equal or better quality, may be accepted. In such cases, copies of the English Version of the standard adopted shall be submitted along with the tender.

3.02.00 Installation

3.02.01 All electrical installation work shall comply with the provisions of the Indian Electricity Act, the Indian Electricity Rules, DGMS / CEA guidelines as amended up-to-date, relevant IS Codes of Practice and recommendations of Tariff Advisory Committee (TAC). In addition, other rules and regulations applicable to the work shall be followed. In case of any discrepancy, the more restrictive rules shall be binding.

3.02.02 Nothing in this specification or in the accompanying specifications shall be construed to relieve the LSTK vendor of his responsibility.

4.00.00 GENERAL REQUIREMENTS

4.01.00 Drawing Approval

4.01.01 Before starting manufacture of any equipment, the LSTK vendor shall have to take approval of relevant drawings and data from the Owner/Consultant in writing.

4.01.02 Any manufacture done prior to the approval of drawings/data shall be rectified in accordance with the approved drawings/data by the LSTK vendor at his own cost and the equipment shall be supplied within the stipulated period.

4.02.00 Drawings & Annexure

4.02.01 All drawings and annexure appended to the specification shall form part of this specification and supplement the requirements specified herein.

4.02.02 This specification shall be read and construed in conjunction with the drawings and annexure to determine the scope of work and terminal points.

4.02.03 The quantities shown on drawings and annexure are tentative for tendering purpose only. Any variation arising during detailed engineering stage shall be taken into account by bidder without any price adjustment.

4.03.00 Completeness of Supply

4.03.01 It is not the intent to specify completely herein all details of the equipment. Nevertheless, the equipment shall be complete and operative in all aspects and shall conform to highest standard of engineering, design and workmanship.

4.03.02 Any material or accessory which may not have been specifically mentioned but which is necessary or usual for satisfactory and trouble-free operation and maintenance of the equipment shall be furnished without any extra charge.

4.03.03 The LSTK vendor shall supply all brand new equipment and accessories as specified herein with such modification and alteration as agreed upon in writing after mutual discussion.

4.03.04 'Make' of brought-out items are subject to Owner's approval. The LSTK vendor shall furnish relevant details to the Owner for his concurrence before procurement.

4.04.00 Proposal Data

The proposal data sheets annexed to this specification shall be filled in without any ambiguity by typing in appropriate place on each page. These pages must be properly signed by authorized representative of the Bidder as verification of the data and submitted along with the tender to form part of the Bidder's formal proposal.

4.05.00 Guaranteed Performance

The performance figures quoted in Technical Particular sheets shall be guaranteed within the tolerance permitted by relevant standards. In case of failure of the equipment to meet the guarantee, the equipment may be liable for rejection.

4.06.00 Deviation

4.06.01 Should the Bidder wish to deviate from this specification in any way, he shall draw specific attention to such deviation.

4.06.02 All such deviations shall be clearly mentioned on the Deviation sheet enclosed, with reference to the respective clause of the specification.

4.06.03 Unless such deviations are recorded in the Deviation sheets and submitted with the offer, it shall be taken for granted that the offer is made in conformity with this specification in all respects.

4.06.04 Bidder to write "No Deviation" in the deviation sheet if there is no deviation from technical specification.

4.07.00 Experience & Qualifying Requirement

4.07.01 Necessary information about the financial and technical resources, organization and experience to undertake the manufacturing and supply of such equipment shall be supplied by the Bidder as an evidence of his capability for satisfaction of the Owner.

4.07.02 The Bidder shall submit along with his tender a list of major contracts for supply of similar equipment executed/being executed by him during last 5 years giving detailed particulars such as quantity, equipment rating, contract value, name of the Owner, year of commissioning etc.

4.07.03 The bidder shall submit the documentary evidence that equipment of similar rating has been manufactured by him and are in successful operation for more than two (2) years in two or more projects of similar nature on the date set for opening of the tender.

4.07.04 Not withstanding anything stated above, the Owner reserves the right to assess bidder's financial and other capabilities to execute the contract.

4.08.00 Quality Assurance

4.08.01 The LSTK vendor shall follow his standard procedures for quality assurance and control. A copy of the said standard procedures shall be submitted to the Owner for his reference. However, Owner reserves the right to review the same and give his observations, if any, for compliance.

4.08.02 The procedures shall be in such a form as to clearly delineate the manufacturing sequence, inspection points, tests and test procedures, acceptable ranges / values, reference drawings etc.

4.08.03 The Owner shall inform the LSTK vendor as to which of the inspection points and tests shall be witnessed. As a minimum, inspection and testing of the finished equipment shall be made prior to shipment, unless specifically waived by the Owner. The LSTK vendor shall give at least fifteen (15) days advance notice regarding readiness of the equipment.

4.08.04 Manufacturing and quality control procedures shall be available for audit to the Owner and/or its representative at the place of manufacture.

4.08.05 The Owner reserves the right to inspect the equipment at the point of manufacture and witness factory and other such tests as may be necessary to ensure conformance to the specification.

4.08.06 The Owner may inspect the LSTK vendor's facilities prior to award of contract.

4.08.07 The Owner may witness any or all of the tests stipulated in the relevant standards and this specification.

4.08.08 The Owner may conduct surveillance of the LSTK vendor's facilities for compliance to his standard procedures of Quality Assurance and Quality Control while work on the specified equipment is in progress.

4.09.00 Packing for Shipment

4.09.01 The equipment complete with its accessories, spares, special tools and tackles shall be suitably protected by respective packing for shipment considering handling during transit, distance and weather conditions involved. The LSTK vendor shall submit the packaging method for shipment to be adopted by him, if so desired by the Owner.

4.09.02 Each consignment shall be marked with Equipment name, Owner's name & address, Project details, handling instruction etc. It shall be complete with part list and identification details. The copies of the part list of each consignment shall also be furnished to the Owner after dispatch.

4.09.03 Equipment shall be packaged for transportation so as to meet the space and weight limitation of transport facilities. The LSTK vendor shall obtain approval from concerned authorities for transportation of over dimensioned consignment/package, if any, before starting manufacture of such equipment. Insurance cost for transportation shall be in bidder's scope.

5.00.00 CO-ORDINATION WITH STATUTORY BODIES AND OUTSIDE AGENCIES

The LSTK vendor shall be fully responsible for carrying out all co- ordination and liaison works with Electrical Inspectors, Factory Inspector, and other statutory bodies for implementation of the work.

Applications on behalf of the Owner, for submission to the Electrical Inspector and other statutory bodies along with necessary drawings complete in all respects shall be prepared by the LSTK vendor. Approved drawings and certificates shall be submitted to the Owner/Consultant well ahead of schedule so that the actual commissioning of equipment does not get delayed for want of inspection and approval by the Inspector and other statutory bodies. The actual inspection work by the Electrical Inspector shall be arranged by the LSTK vendor and necessary coordination and liaison work in this regard shall be the responsibility of the LSTK vendor.

6.00.00 FACILITIES

All site facilities shall be arranged by Bidder unless specifically excluded. NALCO will be giving construction water at one point free of charge and also provide construction power from nearest power source at one point at chargeable basis. Further distribution shall be done by LSTK vendor at his own expenses. No own DG will be allowed to take inside the plant.

Nalco shall provide commissioning power for the equipment/system under the scope of the package LSTK vendor through the permanent installed system of package bidder.

Temporary illumination during construction stage in the working area and its surroundings including approach roads shall be under the scope of work of LSTK vendor.

7.00.00 SYSTEM DESCRIPTION

For Electrical Power Distribution system, please refer Key Single Line Diagram, Dwg. No. 14L08-DWG-E-0101, Rev.5.

7.01.00 Proposed new substation:

The power supply for this package shall be received at 11kV level through two no. HT cable at 11kV switchgear of new substation. This 11kV switchgear shall be used to receive power from existing substations 710.37 and 11kV switchgear at switchgear room-3 near 220kV switchyard and to feed HT motors of the proposed system & LT transformers. 11kV shall be further stepped down to 415V by two no (2X100% capacity) 1.6MVA, 11/0.433kV oil filled transformer to feed LT auxiliary loads of the new system. The transformer capacity shall be selected in such a way that in case of outage of one transformer, the other transformer will take care of total loads. In order to meet the requirement of emergency power for emergency lighting power shall be received from existing substation 710.37 through Al. XLPE cable. Supply, laying, termination etc. of the above cable shall be included in Bidder's scope.

8.00.00 CONTROL PHILOSOPHY.

8.01.00 There shall be one main control room for complete Process Plant located at new substation. Control Philosophy of the Plant Equipment shall be such that each equipment shall have three modes of operation selectively through respective Local-Remote selector switch preferably at control room. Plant on operation shall have only emergency stop facility.

Auto mode
In this mode the equipment shall be operated from the Central Control Room with DCS/PLC fulfilling all sequence and process interlocks.
Manual mode
In this mode the equipment shall be operated manually from the Central Control

Room by individual start/stop device after fulfilling all sequence and process interlocks.
Local mode
In this mode individual drive shall be started and stopped from the local push button station in de-interlock mode. However safety interlock, if any, for the drive shall be fulfilled. Incomer & Bus coupler shall be controlled from existing 220kV SCADA as well as proposed SCADA at new substation. Interfacing hardware and software with the existing system shall be included in Bidder's scope.

9.00.00 DESIGN CRITERIA FOR EQUIPMENTS

This section outlines basic sizing/design criteria of major electrical equipment. Bidder shall also refer to detailed specification of equipment being issued with this specification.

All Switchgears/PMCC shall be suitable for extensions at either end.

9.01.00 HT Switchgear

9.01.01 The switchgear shall be indoor, metal-clad, floor-mounted, with horizontal isolation and horizontal draw-out type vacuum circuit breaker. No wiring, TTB, Instrument shall be fixed on the side walls of VCB panels.

9.01.02 Each switchgear shall be provided with 20% spare feeders with minimum one no of each type and rating.

9.01.03 All Switchgear shall be provided with double bus bar and isolators as per SLD and shall have bottom cable entry.

9.01.04 All HT drive shall be vacuum breaker operated.

9.01.05 11kV switchgear extension panels of the existing substation 710.37 and 11kV cellular switchgear shall be of same make as existing make. Details of existing switchgear are given below. All other information shall be collected by Bidder from the site.

Details of 11kV Cellular Switchgear

Make: SIEMENS
Bus-bar: 12kV, 3Ph, 3W, 50Hz, Double Busbar, 2500A, 25kAfor 1Sec
Type of Switchboard: Cellular switchboard with 3AH VCB

Details of 11kV Switchgear at Substation 710.37

Make: SIEMENS
Bus-bar: 12kV, 3Ph, 3W, 50Hz, Double Busbar, 800A, 25kAfor 1Sec
Type of Switchboard: 8BM 80 with 3AH VCB

9.02.00 SWITCHGEAR / MCC / DB.

9.02.01 PMCC/MCC/DB shall be sized for maximum 100% connected load plus 20% margin. All the starters, Breaker feeders, MCCB feeders shall have ELR protection. Each MPCB, power contactor shall have minimum 2 no+2 NC contacts. No wiring, TTB, Instrument shall be fixed on the side walls of Switchgear, MCC, PMCC, MCC panels.

9.02.02 Each switchgear shall be provided with 20% spare feeders with minimum one no of each type and rating.

9.03.00 Step-down Transformer

9.03.01 Transformers shall be sized to cater 100% maximum continuous running load + 10% design margin.

9.03.02 Starting current of motor (with IS tolerance), starting power factor and Starting method shall be given due consideration to ensure starting of the largest motor while all other loads are running.

9.03.03 Impedance of the Transformer shall be as per relevant IS code. While finalizing Impedance value, contribution of large motors shall be given due consideration while checking fault level of connected switchgear.

9.03.04 The transformer capacity shall be selected in such a way that in case of outage of one transformer, the other transformer will take care of total LT loads.

9.04.00 Busduct

9.04.01 Busduct shall be sized according to the selected rating of connected transformer.

9.05.00 Cables

Power cables shall be sized based on following considerations:

A. Rated current of the equipment plus 20% spare capacity. All the cables shall be FRLS XLPE type.

B. Short circuit withstands capability.

i) For fuse-protected feeders, cables shall be capable of withstanding the let through short circuit current.

ii) For HV breaker operated incomer feeders the cables should be capable of withstanding the system fault level for 1 second.

iii) For LV/HV breaker controlled motor feeders, cable shall be capable of withstanding the system fault level for main protection fault clearing time with 0.5 seconds maximum

iv) For LV breaker controlled outgoing feeders for power feed to PMCC having incomer breaker with SC & O/C release and having no breaker operated outgoing feeder, cable shall be capable of withstanding the system fault level for main protection fault clearing time with 0.5 seconds maximum

v) For LV breaker controlled outgoing feeders for power feed to PMCC having incomer breaker with shunt trip coil and over current and short circuit protection and having breaker operated outgoing motor feeder, cable shall be capable of withstanding the system fault level for main protection fault clearing time with 1 seconds maximum.

vi) For Incomers from Transformers and Tie feeders between switchgears the Cables shall be rated for fault clearing time of 1 sec.

C. Maximum allowable voltage drop in cable between PMCC/MCC and individual motor terminal during normal running condition shall not exceed 3% under full load conditions and 15% during motor starting conditions. In any case, voltage at motor terminal must be above 80% of nominal voltage rating during starting.

D. HV cables shall be of unearthed (UE) grade for unearthed/non-effectively earthed HV system (to be verified by Bidder).

9.05.01 Cables shall be derated for site ambient and ground temperatures, grouping, Method of laying and soil resistivity. LSTK vendor shall furnish detailed cable selection / sizing criteria for approval. Voltage grade of cables shall be of earth grade when used in solidly earthed system and unearthed grade when used in non-effectively earthed system.

9.05.02 Bidder shall generally use the following cable sizes.

A	H.T. XLPE	:	120, 150, 185, 240, 300 sq.mm.
B.	LT XLPE insulated power cables	:	2.5sq.mm (Cu conductor) and 6, 10, 16, 25, 35, 70, 120, 185, 300 &630 sq.mm.
C.	LT PVC-insulated control cables 2.5 sq.mm	:	2C, 3C, 5C, 7C, 10C, 14C & 19C

9.05.03 The power cable sizes indicated in clause no. 9.05.02 are indicative only. It is the bidder's responsibility to validate the cable sizes by design calculation. Cable sizes higher than those indicated, if required, shall be used.

9.05.04 All cable shall be of 3.5 core (red, yellow, blue, black). Black core will be used for neutral.

9.06.00 110 V Battery & Battery Charger

9.06.01 Each Substation shall be furnished with a set of DC battery, battery charger and DCDB primarily to cater to the following DC loads:

a) Closing and tripping of breakers, relays, meters and indicating lamps of 11kV and 415V system as applicable.

b) Twenty percent reserve capacity shall be provided in each battery/charger set.

9.06.02 The Bidder shall enhance the AH capacity of each battery determined by the above criteria, by another 20AH to cater to Owner's DC load.

9.06.03 Lead Acid PLANTE type battery shall be used.

9.06.04 The batteries shall be so sized as to meet emergency load duty cycle requirements for one (1) hour. While estimating battery capacities, a design margin of 15% shall be kept. An ageing compensation factor of 1.25 shall be applied.

9.06.05 The procedure for estimating battery capacities shall be as per guidelines stipulated in IEEE-485.

9.06.06 Capacity of battery shall be as per the size calculated on the basis of clause 9.06.01 a), b),c) above.

9.06.07 Battery charging equipment shall consist of dual float cum boost charger.

9.06.08 The battery charging equipment will be static type and will be designed to supply the continuous DC load in addition to float/trickle/boost charging of the battery.

9.06.09 Rating of float charger and boost charger shall have to be validated by the Bidder by design calculation.

9.06.10 Built-in AVR will be provided to maintain the float charger DC output voltage to within 1% from 'No load' to 'Full load' and for AC line voltage variation of ±10%. Boost charger shall be capable of quick charging the battery to 2.75 V per cell. Charger shall have sufficient capacity to restore a fully discharged battery to a state of full charge in 8 hours.

9.07.00 Illumination System

9.07.01 All the lighting fixture shall be energy efficient fixture.

9.07.02 Lighting fixtures shall generally be group controlled from lighting panel itself. However, for office areas, control rooms, stores etc. control shall be provided through switch boxes. Each switch may control maximum 3 fluorescent fixtures.

9.07.03 For areas illuminated by more than one circuit the adjacent circuits shall be fed from different phases.

9.07.04 415V TPN 63A welding sockets with switch shall be provided in the following areas.

(a) 2 No. each in all rooms like Switchgear room, Cable celler, Transformer area, Conveyor, Maintenance bays etc.

(b) Two No. on gangway.

(c) Any other area as required.

9.07.05 No cabling or wiring in control room shall be exposed type. For all small power wiring and lighting, concealed conduit wiring shall be used.

9.07.06 Each lighting distribution board shall be provided with duplicate 3 phase, 4 wire, 415 V supply from the separate MLDB with changeover switch.

9.08.00 Layout Criteria

9.08.01 Layout of switchgear room shall be liberally designed with adequate clearances. Switchgear/ control room shall have clear head room of 3.5 M (minimum) and cable cellar room clear head room 3.00M (Minimum)

9.08.02 Switchgear room shall be located in the first floor of the substation building and ground floor of the same building shall be used for cable cellar. Separate battery room shall be provided in substation building.

9.08.03 All electrical equipment shall be located above the highest flood level.

9.08.04 For finalizing room size, following points shall be considered:

a. Minimum clearance between two switchgear panels, facing each other shall be maintained as 3000 mm. These distances shall be maintained for all other panels located inside the room.

b. Clearance from any obstruction like column, wall, and vertical raceway on back side of switchgears shall be maintained as 1000mm (minimum) and shall also comply with manufacture’s standard.

c. Minimum Space between the sides of two switchgears, between any two panels or between switchgear and the wall shall be 1000 mm. Where access is not envisaged, clearance shall be 200 mm.

d. Clearance between front face of SWGR and any obstruction like column, wall, vertical raceway, etc. shall be maintained as 1500 mm (minimum) and shall also comply with manufacture’s standard.

e. Clearance between switchgear panels and any other panels, facing each other shall be maintained as 3000 mm.

f. Minimum Clearance from top of bus duct to nearest obstruction shall be at least 1000 mm.

g. Access to Rooms, Doors, etc. to be provided in various floors shall consider movement of the panels during erection and later during maintenance.

h. Switchgear shall be arranged to minimize interference with floor beams. Where interference is unavoidable dummy panel shall be provided.

i. Switchgear room/MCC / Control room and cable spreader room (if applicable) shall be pressurized above the atmospheric pressure to prevent ingress of dust.

j. Adequate space and provision for handling of equipment shall be provided.

9.08.05 Control room, VVVFD room and battery room shall be Air conditioned.

9.08.06 Layout shall have due provision for maintenance area, shift room and all equipment (e.g. Crane, Hoist etc.) for handling of heavy equipments shall be provided.

9.08.07 More than one ton installed capacity equipment are to be facilitated with EOT care/JIB crane/suitable lifting arrangement as required for maintenance purpose.

9.08.08 Suitable lifting arrangement shall be provided for lifting/handling switchgears from ground floor to MCC room and vice-versa for maintenance.

9.09.00 Criteria of Oil Pit for HT Transformers (If applicable)

For oil filled transformer containing 2000litre or more, oil soak pit under the transformer and a common oil pit (unitized) outside the building at a distance not less than 2.5 meter from the fencing shall be provided.

9.09.01 Oil Pit under Transformer and its Cooler Bank

a) Gravel filled open oil pit will be provided under each transformer and its cooler bank. The pit shall be such that it can take oil /water surge of 1/3 of the volume of the transformer oil when filled with gravel of size 60 mm.

b) Each pit will be connected to the drain line of at least 150mm diameter stoneware pipe with a minimum slope of 1:96 leading to common oil pit. Level of the pit under the transformer shall be such that there will not be permanent accumulation of oil/water.

9.10.00 Interplant Cable Routing

9.10.01 Interplant cable routing will be on overhead cable trays on pipe cum cable trestle or only cable trestle except where approved by Owner/consultant. The cables in areas where the conveyor is running, the cabling shall be done along the conveyor support structure with suitable supporting arrangement.

Major overhead outdoor interplant cable routes are:

a) From substation 710.37 to New Substation

b) From substation cellular switchgear at swgr room-3 to New Substation

Space for accommodating additional trays, which may come in future shall be provided in present cable route. Some trays may be required for use by the LSTK

vendors of other packages which will be finalized during detail engineering stage. The successful bidder of the plant package shall provide such trays without any extra cost to Owner.

9.11.00 Energy Management System

9.11.01 LSTK vendor shall abide by energy management and energy saving guideline of NALCO attached elsewhere in the specification.

9.11.01 Apart from the incomers and transformer feeder, motor feeder rating 30kW and above shall be provided with the energy meter and same shall be monitored at proposed SCADA.

9.11.02 The power requirement of this new 11kV substation from both the incoming sources shall be monitored at existing 220kV substation energy management system. EPC LSTK vendor shall provide energy meters, associated hardware and software require for the proposed energy management system interfacing. Energy meters shall be of class 0.5 and shall interface with the existing SCADA system.

10.00.00 CABLING, EARTHING & LIGHTNING PROTECTION

10.01.00 All buildings shall be provided with an earth mat ring which shall be inter-connected together by minimum two parallel conductors below ground. The interconnected earth ring shall be connected with Owner's earth mat/ring at two points in each direction when such owner's grid is available such as inside Plant boundary. Connection to owner's grid is to be made in all directions depending on existence of adjacent owner's building/structure. All buildings shall also be provided with lightning protection system. Separate earth pit shall be provided for electronic equipment grounding. Each electronic equipment/panel ground terminals shall be connected (by insulated copper conductor cable) to electronic equipment earth bus which in turn shall be connected (by insulated copper conductor cable) to separate earth pit. Soil resistivity measurement for designing grounding system is included in scope of this package.

10.02.00 All cable routes shall be provided overhead inside the various buildings excluding the Switchgear /PMCC / Control Room. Interplant cabling amongst various buildings shall be through overhead steel trays in cable trestles. Suitable walkway with steel floor shall be provided along all overhead cable tray routes. The cables in areas where the conveyor is running, the cabling shall be done along the conveyor support structure with suitable supporting arrangement.

10.03.00 Cable Vault/spreader room shall be provided below the Switchgear room.

10.04.00 All cable entry/exit from any plant /electrical building / rooms shall be adequately sealed with fire resistant barriers and compounds.

10.04.00 Cable trays shall be laid out horizontally in sub-station buildings whereas the same shall be installed vertically inside transfer points, conveyor gallery/ etc. Further, cable trays shall be installed stream-wise on either side of conveyor gallery.

10.05.00 Details Cabling, grounding and lightning protection are describes in Specification E-0111 and attached drawing.

11.00.00 FAULT LEVEL

Equipment through fault withstand capabilities under worst operating conditions duly taking negative tolerances on transformers and maximum fault levels of source etc. shall be as follows.

i)	Switchgear	:	1 second
ii)	Transformer	:	2 seconds
iii)	HT cable screen	:	2 seconds for the adopted ground fault current

12.00.00 SYSTEM STUDY

On the basis of the transformer capacity and impedance chosen, voltage regulation and short circuit levels are to be calculated to determine the followings.

a) Voltage dip on starting auxiliaries

b) Symmetrical breaking current

c) Maximum momentary current.

Successful bidder to determine voltage regulation and short circuit levels to ensure that these are within permissible value will do system study. Various conditions to be considered in Study are as follows.

12.01.00 Voltage Regulation

Condition		Permissible voltage at motor terminal in percent of rated voltage
a)	HT Motor Starting	80
b)	LT Motor Starting	85

13.00.00 DEGREE OF PROTECTION FOR ENCLOSURE

Degree of protection for various enclosures as per IS: 13947 shall be as follows.

13.01.00 HT Switchgear:

a) VT/ relay compartment : IP 52

b) Other compartments : IP 42

13.02.00 Busduct Enclosure

a)	Indoor portion	:	IP 52
b)	Outdoor portion	:	IP 65

13.03.00 Transformers

a)	Transformer tank	:	IP 43
b)	Cable box	:	IP 55
c)	Kiosks and marshalling box	:	IP 55

13.04.00 415V Switchgear/DBs (Indoor) : IP 52

13.05.00 Motor : IP 55

13.06.00 Kiosk/Box/Panel/Enclosure

a)	Indoor / outdoor.	:	IP 55
b)	In dusty areas.	:	IP 65

13.07.00 Junction boxes for cables / wires : IP 55

13.08.00 Outdoor lighting fixtures : IP 55

13.09.00 Battery charger panel : IP 42

13.10.00 VVVF Drives : IP 54

14.00.00 PAINTING & PAINT SHADE

14.01.00 All sheet metal panels such as control / protection / desk, PMCC / AC distribution boards, LPs etc. shall be painted with epoxy-based paint. Paint shade shall be as specified elsewhere or shall be intimated to successful Bidder.

15.00.00 TYPE, ROUTINE & ACCEPTANCE TESTS

15.01.00 General

15.01.01 All equipment / systems to be supplied shall conform to type tests as per relevant standards and shall be of proven type.

15.01.02 The bidder / LSTK vendor shall furnish the reports of all the type tests carried out within five years preceding the date of tender opening as per specification and relevant standards for all components / equipment's / systems. These reports should be for the tests conducted on identical / similar components / equipment's / systems to those offered / proposed to be supplied under this contract.

15.01.03 In case LSTK vendor is not able to submit report of type test(s) conducted in last five years, or in case type test report(s) are not found to be meeting the specification / relevant standard requirements, then all such tests shall be conducted under this contract by the LSTK vendor free of cost to Owner, and reports shall be submitted for approval.

15.01.04 Even if the LSTK vendor furnishes valid test report as indicated above, Owner may get some type test conducted under this contract as specified in subsequent clause below in this section for which bidder shall include in his total tender price the cost of carrying out all such type tests. The charges for each of these type tests shall be given separately in the relevant schedule for price adjustment purpose, in case of waival of any test at a later date.

15.01.05 All acceptance and routine tests as per relevant standards and specification shall be carried out. Charges for these shall be deemed to be included in the tender price.

15.01.06 Bidder / LSTK vendor shall furnish the test reports of all type tests (irrespective of conducting / repeating the test under this contract) as per relevant standards and codes as well as other specific tests required under this specification. An indicative list of such tests is given below. Please note that this list of tests is not exhaustive, and Owner may ask for submission of test report of any other test as per standards. Further, Bidder shall refer to various Sub-Sections of specification of electrical equipment's for requirement of tests.

15.02.00 H.T. Switchgear

(a) Short circuit duty test on circuit breaker, mounted inside the panel offered along with CTs, bushings and separators.

(b) Short time withstand test on circuit breaker, mounted inside the panel offered together with CTs, bushings and separators.

(c) Lightning impulse withstand test on breaker and panel.

(d) Temperature rise test on breaker and panel together. For this test, the test set-up shall include three panels with breakers, the test breaker and panel being placed in the center. The adjacent panel shall also be loaded to their rated current capacity.

(e) Measurement of resistance of main circuit.

15.03.00 415V Switchgear

(a) Short time withstand test on main circuit and earth circuit.

(b) Temperature rise test.

(c) Verification of making and breaking capacity.

(d) Degree of protection test.

(e) Mechanical endurance test.

(f) Electrical endurance test

15.04.00 LV Busduct

(a) Heat run test on a representative section of the busduct.

(b) Short time current test for a duration and current as covered in the specification on an assembly of representative section

(c) One minute high potential power frequency voltage withstand test on a typical section

(d) Air and water tightness test on a typical section

15.05.00 Transformer

(a) Capacitance and tan delta of windings

(b) Short circuit test

(c) Temperature rise test

(d) Tank pressure test

(e) Tank vacuum test

(f) Noise level

15.06.00 Motors

Only type test reports for the tests as per IS shall be submitted.

15.08.00 Power and Control Cables

All type tests as per IS.

15.09.00 Battery

Following type tests on two cells of the Battery to be conducted, even if type test certificates of these tests are submitted by the Bidder for Owner's approval:

Test for capacity - test for voltage during discharge

Ampere hour & watt hour efficiency test

Endurance test.

15.10.00 VVVF Drives

Type Test reports as per relevant standards and as described in the VVVF specification shall be submitted.

16.00.00 DRAWINGS, DATA & MANUALS

16.01.00 Documents to be submitted for approval (A)/information (I) after award of contract.

	Layout		
	i)	Electrical layout of each Substation/ Electrical Room showing all equipment and cable raceway	A
	ii)	Cable Tray Layouts in all Plant areas under scope of this package	A
	iii)	Earthing and Lightning Layout	A
B.	Motor		
	i)	Dimensional G.A. drawing	I
	ii)	Foundation Plan & Loading	I
	iii)	Cable end box details	I
	iv)	Thermal withstand curves – hot & cold	A
	v)	Starting & speed torque characteristics at 80% & 100% voltage	A
	vi)	Complete motor data	A
	vii)	Erection & maintenance manual	I
	viii)	Space required for rotor removal	I
	ix)	Test report	A
C.	Valve Actuator		
	i)	Technical catalogue of manufacturer	I
	ii)	Schematic and wiring diagram	I
	iii)	Routine test report	A
D.	HT/LT Switchgear		
	i)	Single line diagram	A
	ii)	GTP	A
	iii)	QAP	I
	iv)	Bill Of Material	I
	v)	Overall GA drawing with dimensions	I
	vi)	Control schematics	I

	vii)	Wiring diagram	I
	viii)	Relay setting calculation	I
	ix)	CT Calculation	I
	x)	Manufacturer's technical catalogue for VCB, relays and other switchgear components	I
	xi)	Inspection manual	I
	xii)	Test report	A
E.	PMCC, DB		
	i)	Single line diagram	A
	ii)	Overall GA drawing with dimensions	**I**
	iii)	Control schematics	I
	iv)	Wiring diagram	I
	v)	Relay setting calculation	**I**
	vi)	Manufacturer's technical catalogue for ACB	I
	vii)	Inspection manual	I
	viii)	Manufacturer's technical catalogue for PMCC components	I
	ix)	Test report	A
F.	Cables		
	i)	Confirmed cable data	I
	ii)	Shop test report	A
G	Transformer		
	i)	General arrangement drawing , Foundation data, List of accessories, Data sheet	A
	ii)	Wiring diagram of Marshalling Box	A
	iii)	General Arrangement of HV & LV Terminal Box	I
	iv)	Manufacturer's technical catalogue	I
	v)	Instruction manual	I
	vi)	Test report	A
H.	Cable Raceway System		
	i)	Outdoor (Interplant) cable layout with trench sections of each route	A

	ii)	Indoor cable layout with tray sections of each route	A
	iii)	Tray conduit loading data	**I**
	iv)	Dimensional details of cable trays and supporting arrangement	**I**
	v)	Cable/ conduit schedule	I
	vi)	Interconnection diagram	I
I.	Grounding & Lightning Protection		
	i)	Grounding layout (overall) with interconnection with Owner's system	A
	ii)	Grounding layout and arrangement for each plant/building	A
	iii)	Details of earth electrode, riser, conductor, air termination, test points	A
J.	Battery & Battery Charger		
	i)	Battery & battery charger layout	A
	ii)	GA of charger panel	I
	iii)	Schematic diagram of charger	A
	iv)	Wiring diagram of charger	I
	v)	Battery cell voltage characteristic and data	I
	vi)	Duty cycle diagram	A
	vii)	Battery sizing calculation in IEEE-485 format	A
	viii)	Sizing calculation of charger main equipment	A
	ix)	Instruction manual	I
K.	VVVF Drive		
	i)	General arrangement drawing	**I**
	ii)	Control schematic & Operational Write-up	I
	iii)	Wiring diagram	I
	iv)	Instruction manual	I
	v)	Functional and routine test reports	A
	vi)	Manufacturer's technical catalogue	I
L.	Illumination System		
	i)	General arrangement drawing of lighting DB, lighting panel and junction box	**I**
	ii)	Single line diagram for lighting power distribution	A
	iii)	Lighting layout of all areas under this package	A

iv)	Manufacturer's technical catalogue for all boards, panels, JBs, fixture, receptacles and other accessories used	I
v)	Routine test report for all procured/manufactured items	A

M. General (Enabling documents for review of all other documents pertinent to the system/ equipment)

i)	Detailed load list in format given (Ref. Annexure-C)	I
ii)	Load Calculation (normal and emergency) - overall and board wise	I
iii)	Board wise single line diagrams and Key interconnection diagram	A
iv)	Adequacy check for owner's provided transformer sizing and feeder rating.	A
v)	Busbar sizing calculation for PMCC, DB and panels	A
vi)	Duty cycle diagram and battery sizing	A
vii)	Cable sizing calculation based on Short circuit, voltage drop (running and motor starting) and continuous current carrying capability. .	A
viii)	Typical control schemes with block interface and block cabling diagram fir incomers, bus coupler, motor feeders, (both HT & LT)	**I**
ix)	Control logic diagram	I
x)	Electrical Equipment IO list (both analogue and digital)	**I**
xi)	Equipment Data sheet	A
xii)	Grounding calculation	A
xiii)	Lighting design calculation for determining fixture quantity for each indoor area	A
xiv)	Lighting power calculation	A

16.02.00 The above list and the category of approval of documents is not exhaustive. Owner may ask for any other drawings/data sheet/manual etc. as deemed necessary for completing the review of engineering documents and the successful bidder shall submit such documents.

16.03.00 The successful bidder shall ensure that submission of design/sizing calculation precedes submission of other engineering documents of that system/equipment. This is an essential pre-requisite for review work.

16.04.00 The drawings and documents marked with (A) above are of 'Approval' category and are subject to review by Owner. Those marked (I) are for 'Information' category.

The Owner may review the documents marked (I) if thought necessary. The LSTK vendor shall note that the approval of drawings & documents by the Owner does not relieve him of his contractual obligation.

16.05.00 All drawings shall be prepared by using AutoCAD and documents shall be generated using Electronic version. The paper copy of the drawings & document shall be submitted for approval & reference. All final drawings and documents shall be submitted in CD in AutoCAD 2010 and MS Office format as applicable for Owner's future reference.

ANNEXURE A

DESIGN DATA

1.0 AUXILIARY POWER SUPPLY FOR MOTORS

Supply	Description	Consumer
H.T. Supply	11kV, 3-phase, 3W, 50Hz, Non-effectively earthed, 40kA	Motors above 200kW
M.V. Supply	690V, 3-phase, 4W, 50Hz, Effectively earthed, 50kA	VFD Driven Motors
L.T. Supply	240V, 1-phase, 2W, 50Hz, Effectively earthed	Motors 200W and below
L.T. Supply	415V, 3-phase, 4W, 50Hz, Effectively earthed, 50kA	Motors above 200W and up to 200kW
D.C. Supply	110V, 2W, unearthed, 25kA	

2.0 RANGE OF VARIATION

A.C. Supply

Voltage	:	± 10%
Frequency	:	± 3%
Combined voltage & frequency	:	10% (absolute sum)

D.C. Supply

Voltage	:	(+) 10% to (-) 15%

3.0 Design Ambient Temperature : 51°C

ANNEXURE B

LIST OF ELECTRICAL DRAWINGS/DOCUMENTS TO BE SUBMITTED WITH TENDER

Note: DATA sheet for all major items shall be furnished along with tender.

A. Motor

i) Motor data sheet

ii) Type test report

B. Valve actuator

i) Technical catalogue of manufacturer

ii) Type test report

iii) Data Sheet

C. HV/ LV Switchgear

i) Single line diagram

ii) Manufacturer's technical catalogue for VCB/ACB

iii) Manufacturer's technical catalogue for Relays

iv) Type test report

v) Data Sheet

D. 11/0.433kV, 11/0.690kV Transformer

i) Type test report

ii) Data Sheets

E. 415V Bus duct

i) Basic bus duct layout

ii) Sectional view of each rating of bus duct

iii) Type test report

iv) Data Sheets

F. PMCC/ DB

i) Single line diagram

ii) Manufacturer's technical catalogue

iii) Manufacturer's technical catalogue for PMCC components

iv) Type test report

v) Data Sheets

G. Cables

i) Cable data

ii) Type test report

H. Battery & Battery charger

i) Manufacturer's technical catalogue

ii) Data Sheets

I. VVVF Drive

i) Data sheet

ii) Control schematic

iii) Manufacturer's technical catalogue

J. Illumination system

i) Single line diagram for lighting power distribution.

ii) Manufacturer's technical catalogue for all boards, panels, JBs, fixture, receptacles and other accessories used.

iii) Type test report for all procured/manufactured items.

K. General

i) Key Single Line Diagram

ii) Metering and Protection Drawing

iii) Switchgear Room Layout

iv) Load List as per Annexure-C

NOTE: The above of list documents is not exhaustive. Owner may ask for any other drawings/data sheet/manual etc. as deemed necessary for completing the review of tender.

ANNEXURE C

FORMAT FOR ELECTRICAL LOAD DATA
Package: Alumina Unloading and Transportation

(IMPORTANT NOTE: The required data duly filled in this format is to be submitted by the successful Bidder; Bidder to add more sheets as required)

Sl. No	Process Section	Switch Gear/ PMCC Name	Drive		Motor Name plate rating (kW)	Absorbed kW	Absorbed kVA	Voltage, Phase & Frequency	Power Factor	Total Nos. of drives	No. running	No. stand - by	Power supply fed from
			Name	Tag									

SUB SECTION: E-0101

ELECTRIC MOTOR

C O N T E N T S

CLAUSE NO.	DESCRIPTION
1.00.00	GENERAL
2.00.00	STANDARDS
3.00.00	SERVICE CONDITIONS
4.00.00	TYPE AND RATING
5.00.00	PERFORMANCE
6.00.00	SPECIFIC REQUIREMENTS
7.00.00	ACCESSORIES
8.00.00	TESTS
9.00.00	SPECIAL TOOLS & TACKLES
10.00.00	SPARES

1.00.00 GENERAL

1.01.00 Motors shall be furnished in accordance with both this general specification and the accompanying driven equipment specification.

1.02.00 In case of any discrepancy, the driven equipment specification shall govern.

2.00.00 STANDARDS

2.01.01 All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) and IEC except where modified and/or supplemented by this specification.

2.01.02 Equipment and material conforming to any other standards, which ensure equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the tender.

2.01.03 The electrical installation shall meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

3.00.00 SERVICE CONDITIONS

3.01.00 The motors will be installed in hot, humid and tropical atmosphere, highly polluted and corrosive.

3.02.00 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in specification E-0100.

3.03.00 For motor installed outdoor and exposed to direct sun rays, the effect of solar heat shall be considered in the determination of the design ambient temperature.

4.00.00 TYPE AND RATING

4.01.00 A.C. Motors

4.01.01 Motors shall be general purpose, constant speed, squirrel cage, three/single phase, induction type.

4.01.02 All motors shall be either totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or closed air circuit air cooled (CACA).Temperature rise shall be limited to 70 deg C by resistance method for both class B and F insulation.

4.01.03 All motors shall be rated for continuous duty. They shall also be suitable for long period of inactivity.

4.01.04 LT motors up to 200kW output rating at 50 ºC and of continuous duty shall be energy efficient type – efficiency class Eff**3** conforming to IS: 12615-**2018 / IEC:60034-30.**

4.01.04 The motor name-plate rating at 51°C shall have at least 15% margin for LT system and 10% margin for HT system, over the input power requirement of the driven equipment at rated duty point and also covering the maximum load demand of the driven equipment under entire operating range, including voltage and frequency variations, unless stated otherwise in driven equipment specification or in general electrical specification.

4.01.05 The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating, pull up, break down and full load torques are available for the intended service. The direction of rotation of motor and its cooling fan should be properly matched with the driven equipment.

4.02.00 AC motor for VFD application

4.02.01 Inverter duty motors are designed according to the requirements of IEC/TS- 60034 -18-41 or NEMA MG-1, Part-30, Part 31 and have performance characteristics match with the driven equipment and variable speed requirement.

4.02.02 Induction motors to be operated in adjustable-speed drive applications should be de-rated as per NEMA/IEC standard due to the reduction in cooling resulting from any reduction in operating speed and the effect of additional losses introduced by harmonics generated by the control.

4.02.03 Inverter duty motors shall have VPI/improved insulation systems that do not degrade readily due to transient voltage spikes and have an adequate thermal margin.

4.02.04 Inverter duty motors shall be self-ventilated without any auxiliary blower. Force ventilation shall be subject to Owner approval.

4.02.05 Inverter motor shall be suitable for scalar (open loop) control, without any speed feedback signal, where fast response is not required. Vector (closed loop) control will be used with encoder if specified.

4.02.06 The breakdown torque at any frequency within the defined frequency range shall be not less than 150% of the rated torque at that frequency when rated voltage for that frequency is applied.

4.02.07 The motor should be capable of producing a breakaway torque of at least 140% of rated torque requiring not more than 150% rated current when the voltage boost is adjusted to develop rated flux in the motor and when the inverter is able to produce the required minimum fundamental frequencies

4.02.08 The motor shall be provided with insulated bearing on one side.

4.02.09 Normally the maximum safe speed shall be as per IEC/NEMA, however it should be co-ordinated with VFD requirement.

4.02.10 In case of a conflict, the requirement mentioned under clause no. 4.02.00 for motors for VFD application shall supersede the corresponding requirement for standard motors.

5.00.00 PERFORMANCE

5.01.00 Running Requirements

5.01.01 Motor shall run continuously at rated output over the entire range of voltage and frequency variations as given in the annexure.

5.01.02 The motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals. The mill motors shall be suitable for operating at 75% of rated voltage for one (1) minute.

5.02.00 Starting Requirements

5.02.01 Motor shall be designed for direct on line starting at full voltage. Starting current shall not exceed 6 times full load current for all auxiliaries.

5.02.02 The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage.

5.02.03 All motors shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminals.

5.02.04 Motor shall be capable of three equally spread starts per hour, two starts in quick succession from cold condition and one restart from hot condition.

5.02.05 Pump motor subject to reverse rotation shall be designed to withstand the stresses encountered when starting with non-energized shaft rotating at 125% rated speed in reverse direction.

5.03.00 NA

5.04.00 Locked Rotor Withstand Time

5.04.01 For motors with starting time up to 20 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 secs. more than starting time .

For motors with starting time more than 20 secs. and upto 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 secs. more than starting time.

For motors with starting time more than 45 secs. at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time.

5.04.02 To prevent unwanted tripping of a high inertia load at start-up, there may be need to shunt out the motor's overload trip device. Speed switches mounted on the motor shaft may be provided in such case. Heating experienced during start-up must still be considered when sizing the motor.

5.04.03 Hot thermal withstand curve shall have a margin of at least 10% over the full load current of the motor to permit relay setting utilising motor rated capacity.

5.05.00 Torque Requirements

5.05.01 Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque.

5.05.02 Pull out torque at rated voltage shall not be less than 205% of full load torque.

6.00.00 SPECIFIC REQUIREMENTS

6.01.00 Enclosure

6.01.01 Enclosures for the motor and the cable box shall conform to the degree of protection IP-55 unless otherwise specified.

6.01.02 Motors like circulating water pumps of large output ratings, located inside a building and not directly exposed to coal dust or fly ash, could have screen protected drip proof enclosure conforming to IP-23.

6.01.03 Motor located in hazardous area shall have flameproof enclosure conforming to IS: 2148 /Equiv.

6.02.00 Cooling

6.02.01 The motor shall be self-ventilated type, either totally enclosed fan cooled (TEFC) or closed air circuit air cooled (CACA).

6.02.02 For large capacity motors, totally enclosed tube ventilated (TETV) may be considered for acceptance.

6.03.00 Winding and Insulation

6.03.01 All insulated winding shall be of copper.

6.03.02 HT motors shall have Class F insulation with winding temperature rise limited to 120^0C. Windings shall be impregnated to make them non-hygroscopic and oil resistant. The lightning impulse and coil inter-turn insulation surge withstand level shall be as per IEC-60034 – Part 15.

6.03.03 LT motors shall have Class F insulation with temperature rise limited to 120^0C.

6.04.00 Tropical Protection

6.04.01 All motors shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.

6.04.02 All fittings and hardware's shall be corrosion resistant.

6.05.00 Bearings

6.05.01 Vertical shaft motors shall be provided with thrust and guide bearings.

6.06.00 Noise & Vibration

6.06.01 Noise level shall not exceed 85 dB (A) except for BFP motor for which the maximum limit shall be 90 dB (A).

6.06.02 Peak amplitude of vibration shall be limited within the values prescribed in IS:12075 / IEC 60034-14.

6.07.00 Motor Terminal Box

6.07.01 Motor terminal box shall be detachable type, made of cast iron or pressed steel and located in accordance with Indian Standards clearing the motor base- plate/ foundation.

6.07.02 Terminal box shall be capable of being turned 360^0 in steps of 90^0, unless otherwise approved.

6.07.03 Terminal box for all LT motors shall be diagonally split type and shall have the same degree of protection as motor.

6.07.04 The terminal box shall have sufficient space inside for termination /connection of suitable sized HT cables. Where the specified main cable size demands, adopter/extension box of suitable size shall be provided as a part integral to the motor, for easy termination of the cable.

6.07.05 Terminals shall be stud or lead wire type, substantially constructed and thoroughly insulated from the frame.

6.07.06 The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor.

6.07.07 The terminal box shall be capable of withstanding maximum system fault current for a duration of 0.25 sec.

6.07.08 For HT motor, the terminal box shall be phase segregated type. The neutral leads shall be brought out in a separate terminal box (not necessarily phase segregated type) with shorting links for star connection.

6.07.09 Motor terminal box shall be furnished with suitable cable lugs and double compression brass glands to match Owner's cable. All threads shall be ISO metric thread only.

6.07.10 The gland plate for single core cable shall be non-magnetic type.

6.08.00 Grounding

6.08.01 The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GI bolts and washer.

6.08.02 The grounding connection shall be suitable for accommodation of ground conductors as follows:

Motor above 90 kW	50 x 6 mm GI Flat
Motor above 30 kW up to 90 kW	35 x 6 mm GI Flat
Motor above 5 kW up to 30 kW	25 x 3 mm GI Flat
Motor up to 5 kW	8 SWG GI Wire

The above sizes shall be superseded by different sizes if so indicated in the relevant clause of the General Electrical Specification.

6.08.03 The cable terminal box shall have a separate grounding pad.

6.09.00 Rating Plate

In addition to the minimum information required by IS, the following information shall be shown on motor rating plate :

a. Temperature rise in ^{o}C under rated condition and method of measurement.

b. Degree of protection.

c. Bearing identification no. and recommended lubricant.

d. Location of insulated bearings.

7.00.00 ACCESSORIES

7.01.00 General

Accessories shall be furnished, as listed below, or if otherwise required by driven equipment specification or application.

7.02.00 Space Heater

7.02.01 Motor of rating 30 kW and above shall be provided with space heaters, suitably located for easy removal or replacement.

7.02.02 The space heater shall be rated 240 V, 1 phase 50 Hz and sized to maintain the motor internal temperature above dew point when the motor is idle.

7.03.00 Temperature Detectors

7.03.01 All HT motors shall be provided with minimum four (4) numbers simplex or two (2) numbers duplex platinum resistance type winding temperature detectors per phase.

7.03.02 Each bearing of HT shall be provided with one (1) duplex or two (2) simplex type temperature detectors.

7.03.03 The temperature detector mentioned above shall be resistance type, 3 wire, platinum wound, 100 Ohms at 0oC.

7.04.00 Indicator/Switch

7.04.01 Dial type local indicator with alarm contacts shall be provided for the following : -

a) HT motor bearing temperature.

b) Hot and cold air temperature of the closed air circuit for CACA and CACW motor.

7.04.02 Flow switches shall be provided for monitoring cooling water flow of CACW motor and oil flow of forced lubrication bearing, if used.

7.04.03 Alarm switch contact rating shall be minimum 0.5 A at 110V D.C. and 5A at 240V A.C.

7.05.00 Not Applicable

7.06.00 Accessory Terminal Box

7.06.01 All accessory equipment such as space heater, temperature detector, etc., shall be wired to and terminated in terminal boxes, separate from motor (power) terminal box.

7.06.02 Accessory terminal box shall be complete with double compression brass glands and pressure type terminals to suit owner's cable connections.

7.07.00 Drain Plug

Motor shall have drain plugs so located that they will drain the water, resulting from the condensation or other causes from all pockets of the motor casing.

7.08.00 Lifting Provisions

Motor weighing 25 kg. or more shall be provided with eye bolt or other adequate provision of lifting.

7.09.00 Dowel Pins

The motor shall be designed to permit easy access for drilling holes through motor feet or mounting flange for installation of dowel pins after assembling the motor and driven equipment.

7.06.00 Painting

Motor including fan shall be painted with corrosion proof paints.

8.00.00 TESTS

8.01.00 Upon completion, each motor shall be subject to standard routine tests as per I S. In addition, any special test called for in the driven equipment specification shall be performed.

8.02.00 Type test requirement shall be as given in Sub-Section E-0100.

9.00.00 SPECIAL TOOLS & TACKLES

9.01.00 A set of special tools & tackle which are necessary or convenient for erection, commissioning, maintenance and overhauling of the equipment shall be supplied.

9.02.00 The tools shall be shipped in separate containers, clearly marked with the name of the equipment for which they are intended.

10.00.00 SPARES

10.01.00 The Bidder shall submit a list of recommended spare parts for three (3) years satisfactory and trouble-free operation, indicating the itemized price of each item of the spares. The final quantity shall be decided during placement of order.

10.02.00 Each list shall be complete with specification, make, identification number, unit rate, quantity etc.

SUB SECTION: E-0002

HV SWITCHGEAR

C O N T E N T S

CLAUSE NO.	DESCRIPTION
1.00.00	CODES AND STANDARDS
2.00.00	DESIGN CRITERIA
3.00.00	SPECIFIC REQUIREMENTS
4.00.00	TESTS
5.00.00	SPECIAL TOOLS & TACKLES
6.00.00	SPARES
ANNEXURE-A	RATINGS AND REQUIREMENTS
ANNEXURE-B	PROTECTIONS
ANNEXURE-C	TYPICAL LIST OF DIGITAL I/O AND ANALOG SIGNALS

1.00.00 CODES AND STANDARDS

1.01.01 All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) and IEC except where modified and/or supplemented by this specification.

1.01.02 Equipment and material conforming to any other standards, which ensure equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the tender.

1.01.03 The electrical installation shall meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

2.00.00 DESIGN CRITERIA

2.01.00 The11kV switchgear shall be used to receive power from other 11kV HT switchgear and feed power feed power to HT drives and LT transformers for further distribution for Alumina unloading and transportation system.

2.02.00 The switchgear shall be located in a clean but hot, humid and tropical atmosphere.

2.03.00 Switchgear ratings and quantity shown in the enclosed drawings and annexure are minimum and indicative. LSTK vendor shall derive the actual requirement with back up calculation and furnish the same.

2.04.00 For continuous operation at specified ratings, temperature rise of the various switchgear components shall be limited to the permissible values stipulated in the relevant standards and/or this specification.

2.05.00 The Switchgear and components thereof shall be capable of withstanding the mechanical forces and thermal stresses of the short circuit current listed in the annexure without any damage or deterioration of material.

2.06.00 Circuit breaker shall not produce any harmful over-voltage during switching off induction motors, unloaded lines and unloaded transformers. If required, surge protective device shall be provided in the scope of supply to limit over-voltage. to 2.2 times the peak value of rated phase to neutral voltage.

2.06.00 Besides the standard interlocks all the necessary safety interlocks as decided during detailed engineering as per the operational requirements of the Owner shall be provided by LSTK vendor.

3.00.00 SPECIFIC REQUIREMENTS

3.01.00 Construction

3.01.01 The switchgear shall be indoor, metal-clad, floor mounted, self-standing, dust proof construction, draw out type. Design and construction shall be such as to allow extension at either end.

The double bus bar switchgear shall be provided with two off-load isolators (front and rear) per cubicle.

The Switchgear, where specified in the annexure, shall be internal arc tested and shall conform to partition guideline as per latest edition of relevant IEC.

3.01.02 The switchgear enclosure shall conform to the degree of protection IP-4X. The minimum thickness of CRCA sheet steel used shall be 2 mm.

3.01.03 The switchgear assembly shall comprise a continuous, dead-front, line-up of free standing, vertical cubicles. Each cubicle shall have a front hinged door with latches and a removable back cover. All covers and doors shall be provided with neoprene gaskets.

3.01.04 Switchgear cubicle shall be so sized as to permit closing of the front access door when the breaker is pulled out to TEST position. The working zone shall be restricted within 750 mm to 1950 mm from floor level.

3.01.05 Circuit breakers, instrument transformers, bus-bars, cable compartment etc., shall be housed in separate compartments within the cubicle. The design shall be such that failure of one equipment shall not affect the adjacent units and the design should conform to the stipulation of Loss of Service Continuity and Partition guideline as per the latest edition of relevant IEC.

The sides of the Switchgear & Control gear, which are accessible according to the testing arrangement, shall be specially designed to withstand internal explosions to prevent personnel injury.

3.01.06 Pressure relief device (at the option of Owner/Owner) shall be provided in each panel and shall prevent the possibility of spreading the fault to other compartments and panels. The pressure relief device shall not be deterrent to achieving the degree of protection of Switchgear Panel.

3.01.07 All panels shall come fitted with infrared inspection windows along with the removable plate for measuring the temperature of joints/hotspots during charged condition. The plate shall be removable from outside the panel, exposing the termination joint for scanning by Infra-red Camera.

3.01.08 All relays, multifunctional meter (at the option of Owner/Owner), breaker control switches, selector switches and indicating lamps shall be flush mounted on the respective cubicle door or on control cabinet built on the front of the cubicle. AC/DC auxiliary supply switches / isolation switches for cubicle space heater, cubicle lamp, spring charging motor circuit shall be located inside metering compartment

3.01.09 Dummy panel shall be provided in the switchgear line up, if required, for easy termination access of power and control cables. Dummy panel / bus trunking panel shall be of full cubicle with closed roof and rear door similar to enclosures for active cubicles.

3.01.10 Mechanical and electrical interlock shall be provided to ensure that it is not possible to operate the isolators unless the breaker is in open position.

3.01.11 Switchboard design shall be such that the isolator's contacts are easily visible from the outside.

3.02.00 Bus and Bus Taps

3.02.01 The main buses (front and rear bus) and connections shall be of high conductivity copper or aluminum alloy and may be bare or coated and sized for specified current ratings with maximum temperature at the connection point limited to the following :

a.	For bolted joints (Bare)	:	90°C
b,	For bolted joints (Tin coated)	:	105°C
c.	For bolted joints (Silver coated)	:	115°C

3.02.02 Bus bars shall be of same size for the entire length of the switchgear. Continuous current rating of bus connections / dropper shall be same as that of continuous "in panel" current rating of associated breaker.

3.02.03 Adequate contact pressure shall be ensured by means of two bolts connection with plain and spring washers and locknuts. Bimetallic connectors shall be furnished for connections between dissimilar metals.

3.02.04 Bus bars and connection shall be fully insulated for maximum system voltage with adequate phase/ground clearances. Insulating sleeves for bus bars and cast-resin shrouds for joints shall be provided, suitable for maximum temperature rise of bus bars corresponding to maximum system voltage.

3.02.05 Bus support insulator shall be flame-retardant, track resistant type with creepage distance suitable for heavily polluted atmosphere.

3.02.06 All buses and connections shall be supported and braced to withstand stresses due to maximum short circuit current and also to take care of any thermal expansion.

3.02.07 Double Bus bars shall be color coded for easy identification and so located that the sequence R-Y-B shall be from left to right, top to bottom or front to rear, when viewed from front of the switch-gear assembly.

3.03.00 Circuit Breaker

3.03.01 Circuit breaker shall be triple pole, single throw Vacuum type. Ratings of circuit breakers shall be as per enclosed single line diagram / Annexure. The continuous ratings specified shall be achieved under installation conditions i.e. specified ambient temperature when installed within the breaker cubicle and without use of cooling fans.

3.03.02 Circuit breakers shall be horizontal isolation and horizontal draw out type, having SERVICE, TEST and DISCONNECTED positions with positive indication for each position.

3.03.03 Circuit breakers of identical rating shall be physically and electrically interchangeable.

3.03.04 Circuit breaker shall have motor wound spring charged trip free mechanism with anti pumping-feature and shunt trip. In addition facility for manual charging of spring shall be provided.

3.03.05 For motor wound mechanism, spring charging shall take place automatically after each breaker closing operation. One open-close-open operation of the circuit breaker shall be possible after failure of power supply to the motor.

3.03.06 Mechanical safety interlock shall be provided to prevent :

a. The circuit breaker from being racked in or out of the service position when the breaker is closed.

b. Racking in the circuit breaker unless the control plug is fully engaged.

c. Rack In/Out of the CB from Test to Service and vice versa with cubicle door open.

d. The enclosure cannot be open and the low voltage circuits cannot be disconnected when the withdrawable part is in the service or intermediate position.

3.03.07 Automatic safety shutters shall be provided to fully cover the female primary disconnects when the breaker is withdrawn.

3.03.08 Each breaker shall be provided with an emergency manual trip, mechanical ON-OFF, indication, an operation counter and mechanism charge/discharge indicator.

3.03.09 Each breaker shall be provided with following :

a. Auxiliary switch, with 6 NO + 6 NC contacts, mounted on the draw out portion of the switchgear.

b. Position/cell switch with 3 NO + 1 NC contacts, one each for TEST and SERVICE position.

c. Auxiliary switch, with 4 NO + 4 NC contacts, mounted on the stationary portion of the switchgear and operated mechanically by a sliding lever from the breaker in SERVICE position.

3.03.10 Switch contact shall be rated 10 A AC. and 2A DC at their respective operating voltage.

3.04.00 Control & Indication

The circuit breaker shall be wired up for local & remote operation. Each breaker cubicle shall be equipped with following:-

3.04.01 One (1) TEST-NORMAL-TRIAL selector switch stay put type with pistol grip handle and key interlock.

3.04.02 Two (2) heavy-duty oil tight, push buttons for TRIP & CLOSE.

3.04.03 Four (4) indicating lights on front of compartments:-

GREEN : Breaker Open and Spring Charged

RED : Breaker Closed

AMBER : Trip/Trip circuit trouble

3.04.04 Lamps shall be clustered type LED module pilot lights in thermoplastic enclosure with polycarbonate lens and diffuser. LED shall be protected by in-built fuse with surge suppressor and leakage voltage glow protection. Lamp and lens shall be replaceable from front.

The general scheme of connection for control, interlock and protection is shown in the enclosed drawings. Detailed requirements shall be developed by successful Bidder and furnish the schemes accordingly.

3.05.00 Current Transformer

3.05.01 Current transformers shall be cast resin type. All secondary connections shall be brought out to terminal blocks where wye or delta connection shall be made.

3.05.02 The Current Transformers shall be capable of withstanding the stresses arising out of making, breaking and symmetrical short circuit currents for the specified durations as mentioned in the annexure.

For Switchgear of 3 Sec. short circuit rating, CT s for outgoing motor feeders and transformer feeders may be provided with 1 Sec. rating.

3.05.03 Accuracy class of the Current Transformers shall be:-

a. Class PS for differential relaying (or as required depending on the type of relay selected).

b. Class 5P20 (or 5P10, if specified in the drawing) for other relaying.

c. Class 1.0 and ISF <=10 for metering.

d. Class 0.5 or better and ISF <=2 for performance / precision metering.

3.05.04 Current transformer secondary shall be rated for 1 A, depending on requirement.

3.05.05 CT ratio, accuracy, VA burden, knee point voltage, magnetizing current, saturation factor, etc. of the CTs to be provided shall be compatible with the requirement.

3.06.00 Voltage Transformer

3.06.01 Voltage Transformer (VT) shall be cast-resin, draw out type and shall have an accuracy class of 1.0. Voltage transformer shall be mounted in a separate vertical panel. However, for cassette mounted type breaker arrangement, line VTs mounted below circuit breaker compartment is also acceptable.

3.06.02 High voltage windings of voltage transformer shall be protected by current limiting fuses. The voltage transformer and fuses shall be completely disconnected and visibly grounded in fully draw-out position.

3.06.03 Low voltage winding of voltage transformer shall have MCB, installed in all ungrounded secondary leads. MCBs shall be suitably located to permit easy replacement while the switchgear is energized.

3.07.00 RELAYS (NUMERICAL)

3.07.01 Relays shall be of draw out design with built-in testing facilities and flush mounted at the front of panel. Small auxiliary relays may be in non-draw out execution and mounted within the cubicle.

3.07.02 Relays shall be rated for operation on 110V secondary voltage and 1A secondary current as shown on drawings. Number and rating of relay contacts shall suit the job requirements.

3.07.03 Unless mentioned otherwise in the specification, protective relays shall be multifunction type numerical relays.

3.07.04 Multifunction numerical relays shall be selected to provide an integrated protection, and monitoring functions. Features such as self-diagnosis and external testing, disturbance recording, sequence of event recording, time stampings shall be available with the relay. Relevant data shall be possible to be stored in non-volatile memory backed up by battery. The relay shall have multiple setting groups, optically isolated input / output, front LCD display and menus, fixed function and programmable LEDs, keypad and password protection. All functions including protection, automation, communication, LEDs, input / output shall be programmable and can be modified, if required, using the front panel user interface. Communication port for local and remote (with suitable protocol) communication shall be located in the front and rear part of the relay. A laptop loaded with support software (complete version) shall be supplied for local off line programming, measurements, extracting and viewing of events, disturbance etc. Protection relay communication protocol shall be compliant with IEC 61850. The relay shall be housed in dust tight enclosure, suitable for IP 52 degree of protection.

In addition to achieving the functions as described above, continuous measurement of various electrical parameters shall also be possible with an accuracy class of either 0.5 or 1.0 subject to Owner's requirement. Separate multifunction meter shall be provided in the event of said accuracy class cannot be met by the numerical protection relay. Multifunction meter shall be communicable type and be compliant with IEC 61850.

3.07.05 The LSTK vendor shall furnish, install & co-ordinate all relays to suit the requirements of protection, interlock schemes as broadly indicated in the annexure and drawings.

3.07.06 **Interface with DCS/PMS**

Modules are to be interlinked by serial communications to data concentrator unit which in turn will provide serial communication facilities to DCS/PMS.

3.07.07 Numerical relays shall be used for protection and monitoring only. No logic or control functionalities shall be incorporated in it.

3.08.00 METERS

3.08.01 Indicating instruments (96 x 96 mm) shall be switchboard type, with 240 degree scale, anti-glare glass and accuracy class of ± 2% full scale. Each meter shall have zero adjuster on the front.

3.08.02 Motor ammeter shall have extended suppressed end-scale range to indicate starting current (6-8 times full load).

3.08.03 Energy meter shall be three phase multifunction, digital type with communication port for DCS interface.

3.08.04 Energy accounting and audit meters

3.08.04.01 The energy accounting and audit meters shall be suitable for measurement, recording and display of cumulative active energy with date and time. The meter shall have accuracy class of 0.2S

3.08.04.02 The energy accounting and audit meters shall have the facility to measure, record and display one or more of the following parameters depending upon the energy accounting and audit requirement. All parameters excluding instantaneous electrical parameters shall also be stored in memory.

- Apparent power
- Phase wise kilowatt at peak KVA
- Phase wise KVA (reactive) at peak KVA
- Phase wise voltage at peak KVA
- Power down time
- Average power factor
- Line currents
- Phase voltages
- Date and time
- Tamper events

3.08.04.03 The energy accounting and audit meter shall have data storage capacity for at least 35 days in a non-volatile memory.

3.08.04.04 Energy accounting and audit meters shall have facility to download the parameters through meter reading instruments as well as remote transmission of data over communication network.

3.08.05 **Multi-Function Meter**

The multifunction power meter shall be digital type with communication port and suitable for display the following parameters on selection basis. The meter shall have accuracy class of 0.5S. Bidder shall get approved the make of MFM from Owner before providing the MFM.

- Voltage L-L
- Voltage L-N per phase
- Current per phase
- Neutral Current
- Frequency
- Power Factor
- Active Power
- Reactive Power

3.08.06 **Transducer**

Transducers shall be provided for conversion of AC electrical quantities such as voltage, current and power. Transducers shall be of low burden type having 4 – 20 mA DC linear galvanically isolated output compatible with secondary indicating instrument. Transducer shall be dual channel type.

3.09.00 ISOLATORS

3.09.01 The 11kV double bus bar switchgear shall be provided with two off-load isolators (front and rear) per cubicle and shall be rated as per the requirement .

3.09.02 Mechanical and electrical interlocks shall be provided to ensure that it is not possible to operate the isolators unless the breaker is in open condition. Castle key interlock to be provided as follows

i) For operating VCB
ii) For first isolator
iii) For second isolator

The key cannot be removed from the VCB if the VCB is in closed position. After the VCB is opened, key can be removed and one of the isolator can be closed. The key can then be removed and the VCB can be closed by inserting the key in the lock. The isolators are mechanically interlocked so that second isolator now can't be closed. If now the second isolator has to be closed, then similar sequence has to be followed.

3.09.03 The 11kV isolator shall have the following features:-

i) Contacts and blades shall be designed to prevent self-opening of the switch under short circuit condition.
ii) On/OFF mechanical indication shall be provided.
iii) Provision of padlocking the isolators in off position shall be provided
iv) Isolators contacts shall be silver plated.

3.09.04 The isolators auxiliary switch and solenoid shall be located in such a manner that it can be maintained without main bus shutdown.

3.10.00 SWITCH

3.10.01 Switches shall be dust protected, heavy duty, switchboard type complete with escutcheon plate. Contacts shall be silver surfaced, rated 10A at operating voltage.

3.10.02 Lockable stay-put type switchgear / field / remote selector switch shall be provided as per requirement and mounted on switchgear cubicle.

3.10.03 Meter selector switches shall be maintained contact, stay put type with knob handle. Ammeter & voltmeter selector switches shall be four position type. Ammeter selector switches shall have make before break feature to prevent open circuiting of CT secondary.

3.10.04 Breaker control switch shall be multistage, spring return to normal, with lost motion device and pistol grip handle.

3.11.00 FUSE & MCB

3.11.01 Fuses shall be HRC, link type, with minimum interrupting capacity equal to the listed short circuit current. Fuses shall be furnished complete with fuse bases and fittings. Visible indication shall be provided on blowing of the fuse.

3.11.02 MCBs, if used, shall be three/four pole, trip free, with manual close / open mechanism. Automatic tripping provision for over load and short circuit shall also be provided. MCBs shall be rated for full fault level of the system. MCB shall be provided with required number of auxiliary contacts as per circuit requirement.

3.12.00 MCCB (OPTIONAL)

3.12.01 MCCB shall be triple pole, air break, single throw type having trip free mechanism with quick make, quick break contacts. The MCCB shall have current limiting feature.

Motors duty MCCB shall be capable of safely making and breaking the locked rotor current of the associated motor circuit including number of starts.

3.12.02 Molded case circuit breakers of identical rating shall be physically and electrically interchangeable.

3.12.03 The compartment door shall be interlocked mechanically with the MCCB such that the door cannot be opened unless the MCCB is in OFF position. Further, the compartment door can only be closed when the MCCB is in service position.

3.12.04 Short circuit protection shall be provided with the MCCB.

3.12.05 All incoming and outgoing feeders shall be provided with bolted disconnect link for isolation of neutral, if necessary.

3.12.06 Molded case circuit breaker shall be provided with 1 NO and 1 NC electrically separate auxiliary contact.

3.13.00 PUSH BUTTON

Push button shall be heavy duty, shrouded, push to actuate type with colored button and inscription plate. Each push button shall have 2 NO + 2 NC contacts, rated 10A and 0.5A at their respective AC and DC operating voltage.

3.14.00 SECONDARY WIRING

3.14.01 The switchgear shall be fully wired at the factory to ensure proper functioning of control, protection, transfer and interlocking schemes.

3.14.02 Fuse, links and MCB shall be provided to permit individual circuit isolation from bus wires without disturbing other circuits. All spare contacts of relays, switches and other devices shall be wired up to terminal blocks.

3.14.03 Wiring shall be done with flexible, 1100V grade, PVC insulated, FRLS type switchboard wires with stranded copper conductors of 2.5 mm^2 for current circuits and 1.5 mm^2 for control and voltage circuits.

3.14.04 Each wire shall be identified, at both ends, with interlocking type permanent markers bearing wire numbers as per LSTK vendor's Wiring Diagrams. AC / DC wiring shall have separate color-coding.

3.14.05 Wire termination shall be made with crimping type connectors with insulating sleeves. Wires shall not be spliced between terminals.

3.14.06 All spare contacts of relays, timers, auxiliary switches shall be wired up to the terminal block.

3.15.00 TERMINAL BLOCK

3.15.01 1100V grade, multi way terminal block complete with mounting channel, binding screws and washers for wire connections and marking strip for circuit identification shall be provided for terminating the panel wiring. Terminals shall be stud type, suitable for terminating 2 nos. 2.5 mm^2 stranded copper conductor and provided with acrylic insulating cover. Terminals for C.T. secondary leads shall have provision for shorting and grounding.

3.15.02 Not more than two wires shall be connected to any terminal. Spare terminals equal in number to 20% active terminals shall be furnished. Separate terminal blocks shall be used for AC/ DC wiring termination.

3.15.03 Terminal blocks shall be located to allow easy access. Wiring shall be so arranged that individual wires of an external cable can be connected to consecutive terminals.

3.15.04 Terminal blocks used for interface with DCS / PMS / PLC via termination cabinet shall be suitably sized to facilitate proper termination of interconnecting cables.

3.16.00 CABLE TERMINATION

3.16.01 Switchgear shall be designed for cable entry from side / top / bottom, as specified. Sufficient space shall be provided for ease of termination and connection.

3.16.02 All provisions and accessories shall be furnished for termination and connection of cables, including removable gland plates, cables supports, crimp type tinned copper/ aluminum lugs, brass compression glands with tapered washer (Power cables only) and terminal blocks.

3.16.03 Gland plates shall be minimum 3 mm thick. The gland plate and supporting arrangement for 1/C power cables shall be of aluminum.

3.16.04 Sufficient space shall be provided between the power cable termination and gland plate. Core balance CTs wherever specified, shall be accommodated within this space, inside the cubicle.

3.17.00 GROUND BUS

3.17.01 A ground bus, rated to carry maximum fault current, shall extend for the full length of the switchgear.

3.17.02 The ground bus shall be provided with two-bolt drilling with G.I. bolts and nuts at each end to receive 75 x 10 mm G.I. flat.

3.17.03 Each stationary unit shall be connected directly to the ground bus. The frame of each circuit breaker and draw out VT unit shall be grounded through heavy multiple contacts at all times except when the primary disconnecting devices are separated by a safe distance.

3.17.04 Wherever, the schematic diagrams indicate a definite ground at the switchgear, a single wire for each circuit thus grounded shall be run independently to the ground bus and connected thereto.

3.17.05 CT and VT secondary neutrals shall be earthed through removable links so that earth of one circuit may be removed without disturbing other.

3.18.00 EARTHING TRUCK

Earthing trucks shall be provided for earthing the switchgear bus bars or outgoing cables. The trucks shall have a voltage transformer and an interlock to prevent earthing of any live connection. The trucks shall have audio-visual annunciation to warn the operator against earthing of live connections. It shall not be possible to use bus-earthing truck for cable earthing & vice versa. Earthing truck shall be non- fault making type. Circuit breakers provided with integral earth switch, as an alternative, is to be provided wherever specified.

3.19.00 NAME PLATE

3.19.01 Nameplates of approved design shall be furnished at each cubicle (one no. each at front as well as at backside of cubicle) and at each instruments & device mounted on or inside the cubicle.

3.19.02 The material shall be lamicoid or approved equal, 3 mm thick with white letter on black back ground.

3.19.03 The nameplate shall be held by self-tapping screws. Nameplate size shall be minimum 20 x 75mm for instrument/device and 40 x 150mm for panels.

3.19.04 Caution notice on suitable metal plate shall be affixed at the back of each vertical panel.

3.20.00 SPACE HEATERS AND PLUG SOCKET

3.20.01 Each cubicle shall be provided with thermostat controlled space heaters and 5A, 3 pin plug socket.

3.20.02 In addition, motor feeder cubicle shall be wired-up for feeding the motor space heater through suitable rated breaker auxiliary NC contact and/or contactor.

3.20.03 Cubicle heater, Motor heater, Plug/socket circuits shall have individual switch fuse units.

3.21.00 A.C/D.C POWER SUPPLY

3.21.01 The following power supplies shall be made available to each switchgear:

A.C. supply : Single Feeder

D.C. supply : Double Feeder

3.21.02 Isolating switch fuse units shall be provided at each switchgear for the incoming supplies, 4-pole, single throw for A.C. and 2-pole, double throw for D.C. Molded case circuit breaker (MCCB) shall also be accepted as an alternative.

3.21.03 Bus-wires of adequate capacity shall be provided to distribute the incoming supplies to different cubicles. Isolating switch fuse units / MCCB shall be provided at each cubicle for A.C/D.C. supplies.

3.21.04 A.C. load shall be so distributed as to present a balance loading on three-phase supply system.

3.21.05 Redundant DC control supply shall be designed for auto/manual changeover to alternate back up DC supply.

3.22.00 TROPICAL PROTECTION

3.22.01 All equipment, accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus, insects & corrosion.

3.22.02 Screens of corrosion resistant material shall be furnished on all ventilating louvers to prevent the entrance of insects.

3.23.00 PAINTING

3.23.01 All surfaces shall be sand blasted, pickled and grounded as required to produce a smooth, clean surface free of scale, grease and rust.

3.23.02 After cleaning, the surfaces shall be given a phosphate coating followed by 2 coats of high quality primer and stoved after each coat.

3.23.03 The switchgear shall be finished in light gray color with two coats of powder paint. The coating shall be done electro statically followed by stoving.

3.23.04 Sufficient quantity of touch-up paint shall be furnished for application at site.

3.24.00 ACCESSORIES

Following accessories shall be furnished along with the Switchgear :

a. Earthing equipment suitable for earthing the bus.

b. Earthing equipment suitable for earthing the outgoing cable.

4.00.00 TESTS

4.01.00 The switchgear shall be completely assembled, wired, adjusted and tested at the factory as per the relevant standards.

4.02.00 Routine Test

The tests shall include but not necessarily limited to the following:

a. Operation under simulated service condition to ensure accuracy of wiring, correctness of control scheme & proper functioning of the equipment.

b. All wiring and current carrying part shall be given appropriate High Voltage test.

c. Primary current and voltage shall be applied to all instrument transformers.

d. Routine test shall be carried out on all equipment such as circuit breakers, instrument transformers, relays, meters etc. as per relevant standard.

4.03.00 Type Test

Type test requirement shall be as given in Sub-Section E-0100.

5.00.00 SPECIAL TOOLS & TACKLES

5.01.00 A set of special tools & tackle which are necessary or convenient for erection, commissioning, maintenance and overhauling of the equipment shall be supplied.

5.02.00 The tools shall be shipped in separate containers, clearly marked with the name of the equipment for which they are intended.

6.00.00 SPARES

6.01.00 The Bidder shall submit a list of recommended spare parts for two (2) years satisfactory and trouble-free operation, indicating the itemized price of each item of the spares. The final quantity shall be decided during placement of order.

6.02.00 The Bidder shall quote and supply mandatory spare parts as per list elsewhere. The final quantity shall be decided during placement of order.

6.03.00 Each list shall be complete with specification, make, identification number, unit rate, quantity etc.

ANNEXURE A
RATINGS AND REQUIREMENTS

1.0	**SWITCHGEAR**			
1.1	General			
	Type		:	Metal-clad, draw out
	Service		:	Indoor
	Enclosure		:	IP – 4X
	Reference Standard		:	IEC-62271-200
	Internal Arc Classification		:	IAC AFLR
	Loss Of Service Continuity & Partition Class		:	LSC 2B PM
1.2	System			
	Rated Voltage	KV rms	:	11 kV± 10%
	Phase		:	Three
	Rated Frequency		:	50 Hz + 3% to -3%
	System grounding		:	Resistance Solidly Earthed Earthed
1.3	Design ambient temperature		:	51^{o}C
1.4	Rated Current inside the cubicle and at design ambient temperature of 51^{o}C		:	
	Bus bar		:	Double Busbar, 800A
	Circuit breaker In Panel Rating		:	800 A
1.5	Short Circuit Rating			
	Rated short time withstand current		:	40 kA
	Duration		:	1Sec.
	Rated peak withstand current		:	2.5 x rated short time current

1.6	Insulation level		:	
	Rated lightning impulse withstand voltage		:	75kV (peak)
	Rated one minute power frequency withstand voltage		:	28kV (r.m.s)
1.7	AC/DC Power Supply			
	Control voltage		:	110 V +10% to -15% DC for circuit breaker from DC system.
	Service voltage		:	240V ± 10%,1Ph, 50Hz ± 3%
1.8	Termination details			
	Incomer/ Tie feeder		:	Through side / top / bottom entry cable, depending on requirement.
	Outgoing feeder		:	Through side / top / bottom entry cable as per requirement.
1.09	Type test required		:	Yes
1.10	Painting requirement			
	a) Finish paint		:	Powder coating
	b) Paint base		:	Epoxy / polyurethene
	c) Paint shade		:	631 as per IS-5

2.0 CIRCUIT BREAKER

2.1	Type		:	Vacuum
2.2	No. of poles		:	Three
2.3	Rated Voltage	KV rms	:	11± 10%
2.4	Rated Frequency	Hz	:	50 ± 3%
2.5	Rated normal current at site condition	Amps	:	630A

2.6	Reference Standard	:	IEC-62271-100,
2.7	Rated Insulation Level		
	● Lightning Impulse withstand Voltage, KV peak	:	75
	● Rated one minute power frequency withstand voltage, KV rms	:	28
2.8	Mechanical Endurance Class	:	M1 –
2.9	Electrical Endurance Class	:	E1 –
2.10	Restrike Probability Class	:	C1
2.11	Rated Making & Breaking Capacity	:	
	● Rated Short-circuit breaking Current (Symmetrical), KA rms	:	
	● Percentage DC component	:	
	● Rated short-circuit making Current, KA peak	:	
	● Rated peak withstand current KA peak	:	
	● Rated short time withstand current for rated duration of 1sec., KA rms	:	
	● Rated Out of phase breaking current In % of rated Short Ckt. Breaking current	:	As per IEC
	● Rated Out of phase making current In % of rated Short Ckt. Breaking current	:	
	● Rated cable charging breaking current	:	
	● Rated capacitor bank breaking Current, KA peak	:	
	● Rated capacitor bank inrush making Current, KA peak	:	

	● Inductive current breaking capability without exceeding over voltage by 2.2 pu.		:	
2.12	First pole to clear factor		:	As per IEC
2.13	Rated Operating Sequence		:	O - 3m - CO - 3m - CO
2.14	Operating mechanism		:	Motor wound Spring charging
2.15	Operating time			
	● Opening time (ms)		:	Not more than 60
	● Closing time (ms)		:	Not more than 100
2.16	Number of trip coils		:	One
2.17	Rated Supply Voltage and frequency for			
	● Closing		:	110 V DC, 2W(85% to110%)
	● Tripping		:	110 V DC, 2W(70% - 110%))
	● Spring Charge Motor		:	110V DC, 2W (70%-110%)
	● Heater/Lamp/Socket		:	240V, 1 Ph, 2W(85%-110%)
3.0	**ISOLATORS**			
3.1	Type		:	Off-load with earth switch
3.2	No. of poles		:	Three
3.3	Rated Voltage	KV rms	:	11± 10%
3.4	Rated Frequency	Hz	:	50 ± 3%
3.5	Rated normal current at site condition	Amps	:	800A
3.6	Rated Insulation Level			
	● Lightning Impulse withstand Voltage, KV peak		:	75
	● Rated one minute power frequency withstand voltage, KV rms		:	28

ANNEXURE B

PROTECTIONS

1.0 Minimum protections to be provided for different type of circuits are listed below -

A. Transformer Incomer :
- a. IDMTL over current (51) for phase fault
- b. IDMTL over current (51N) for earth fault
- c. IDMTL over current (51SN) for stand by earth fault (for incomer from transformer only).
- d. Restricted E/F (64) (for incomer from transformer only)
- e. Differential Relay (87T) (for incomer from transformer rated5 MVA & above)
- f. Under voltage with time delay (27)
- g. VT fuse failure
- h. Circuit breaker failure
- i. Auxiliary relays for Transformer Protection like Buchholz Relay Alarm & Trip, Oil Temperature Alarm & Trip, Winding Temperature Alarm & Trip, OLTC Buchholz Alarm & Trip, Oil Pressure level and Pressure relief device operated Alarm.

B. Feeder Incomer :
- a. IDMTL over current (51) for phase fault
- b. IDMTL over current (51N) for earth fault
- c. Under voltage with time delay (27)
- d. VT fuse failure
- e. Circuit breaker failure

C. Tie feeder :
- a. IDMTL over current (51) for phase fault
- b. IDMTL over current (51N) for earth fault
- c. Under voltage with time delay (27)
- d. VT fuse failure
- e. Circuit breaker failure
- f. Synchronizing check relay, if applicable, complete with guard relay

.

D. Motor feeder : a. Thermal overload (49)

b. Phase fault (50)

c. Unbalance (-Ve seq.) (46)

d. Locked rotor (50 LR) (ref. note 12)

e. Definite time O/C (50G) for earth fault (through CBCT)

f. Differential (87) protection for motor above 1000 KW rating.

g. Vibration Monitor (39) (optional)

h. Starts per Hour (66).

i. Circuit breaker failure

j. Winding temperature

k. Bearing temperature

E. Auxiliary VFD/ Transformer : a. IDMTL over current (50/51) with high set instantaneous units for phase faults

b. Definite time O/C (50G) for earth fault (through CBCT)

c. Differential protection (for transformers rated 5MVA and above)

d. Auxiliary relays for Transformer Protection like Buchholz Relay Alarm & Trip, Oil Temperature Alarm & Trip, Winding Temperature Alarm & Trip, OLTC Buchholz Alarm & Trip, Oil Pressure level and Pressure relief device operated Alarm.

e. Circuit breaker failure.

F. Line feeder : a. IDMTL over current (51) for phase fault.

b. IDMTL over current (51N) for earth fault.

c. Circuit breaker failure.

G. Bus-coupler : a. IDMTL over current (51) for phase fault.

b. IDMTL over current (51N) for earth fault.

c. Circuit breaker failure.

d. Partial differential scheme shall be provided, wherever applicable.

2.0 In case any trip function is not available in a single relay, separate numerical relays shall be provided to achieve the requirement.

3.0 All protective relays shall be provided with self reset type of contacts.

4.0 Apart from protection relays, each breaker shall be provided with separate discrete auxiliary relays for anti-pumping (94), trip annunciation (30), trip supervision (74), electrically reset type breaker contact multiplication (52X) relay and lockout (86) functions. Lockout relay shall be hand reset type. For multifunction relays however, trip circuit supervision function as an integral feature of the relay is acceptable. Individual trip circuit supervision function shall be provided with respect to each trip coil of circuit breaker.

5.0 Numerical under voltage relays (27) with time delay relay including VT fuse failure relay shall be provided for Bus VTs.

6.0 One no. DC supply supervision relay (80) shall be provided for each panel of the switchboard.

7.0 One no. DC supply failure annunciation relay shall be provided for each incoming DC supply to the switchboard.

8.0 Auxiliary relays (hand reset type) with flag indications shall be provided for each type of transformer fault.

9.0 IDMTL relay version shall be decided as per system requirement and the same shall be finalized during detail engineering.

10.0 Zero-sequence CT and associated relay combination shall be such as to ensure a pick-up sensitivity of 10A primary ground fault current (for transformer and motor feeder only).

11.0 Bus differential protection relay (87B) shall be provided and all live parts of the Switchgear shall be covered within the differential protection zone. (optional)

12.0 Separate locked rotor protection relay (50 LR) with auxiliary relay (50 LRX) shall be furnished, if required.

ANNEXURE C

TYPICAL LIST OF DIGITAL I/O AND ANALOG SIGNALS

A. DIGITAL INPUT/OUTPUT SIGNALS

Applicable for Breakers pertaining to Switchboard.

- Close
- Trip
- Status of Circuit Breaker (On / Off / Trip)
- Status of Earth Switch.
- Circuit Breaker Failure.
- Trip Coil Unhealthy.
- Lock Out Relay Operated.
- Breaker Test Position
- Breaker Service Position
- Local Selection
- Remote Selection

Applicable for Incomer Breaker to Switchgear

- Incomer Trip selection.
- Synchronizing Check Relay (On).
- Momentary Paralleling of Supplies.
- Bus Differential relay Operated (optional)
- Phase Fault Relay (51) Operated.
- Earth Fault Relay (51N) Operated
- Stand By Earth Fault Relay (51SN) Operated.

Applicable for HT Transformers.

- Restricted Earth Fault Relay Operated.
- Differential Relay Operated.
- OTI Alarm
- OTI Trip.
- WTI Alarm.
- WTI Trip.
- Buchholz Alarm.
- Buchholz Trip.
- Rupturing of Bellows Alarm.
- Pressure Relieve Device Operated.
- OLTC Buchholz Alarm.
- OLTC Buchholz Trip.
- Lockout Switch Operated.
- Tap change in Progress.
- Tap change not completed.
- Oil Level Gauge Alarm.

Applicable for Line PT.

- Fuse Fail.

- Under Voltage Relay Operated.

Applicable for Bus PT.

- Under Voltage Relay 20% Operated.
- Under Voltage Relay 80% Healthy.
- Fuse Fail for Under Voltage Relay 20%.
- Fuse for Under Voltage Relay 80%.

Applicable for Bus Coupler.

- Auto Changeover Completed.
- Phase Fault Relay Operated.
- Earth Fault Relay Operated.
- Auto changeover blocked.
- Bus Coupler Trip Selection
- Synchronising Check Relay (On).
- Momentary Paralleling of Supplies.

B. TYPICAL LIST OF ANALOG SIGNALS (All are the Part of MFM)

Incomer

- Line current R phase, Y phase, B phase.
- Power Factor
- KW
- KVAR
- KVA
- KVAH
- KWH

LV Transformer Feeder

- Line current R phase, Y phase, B phase.
- KWH.

BUS PT

- Voltage R – Y phase, Y-B phase, B-R phase.

Line PT

- Voltage R – Y phase, Y-B phase, B-R phase.

Motor

- Line Current R Phase, Y Phase, B Phase.
- KWH.
- HR.

NOTE:-

Signal List as indicated above are indicative only. LSTK vendor shall finalize the input/output list as required during detail engineering.

SUB-SECTION: E-0004

415V MCC, 415V AC & 110V DCDB, 415V NON-SEGREGATED PHASE BUSDUCT, LOCAL CONTROL PANEL AND LOCAL PUSH BUTTON STATION

C O N T E N T S

CLAUSE NO.	DESCRIPTION
1.00.00	CODES AND STANDARDS
2.00.00	DESIGN CRITERIA
3.00.00	SPECIFIC REQUIREMENTS
4.00.00	TEST
5.00.00	SPECIAL TOOLS & TACKLES
6.00.00	SPARES
ANNEXURE-A	PROTECTION
ANNEXURE-B	RATINGS AND REQUIREMENTS (SWITCHGEAR ASSEMBLY)
ANNEXURE-C	COMPONENT/MODULE SELECTION TABLE
ANNEXURE-D	415 V NON-SEGREGATED PHASE BUSDUCT

1.00.00 CODES AND STANDARDS

1.00.01 All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) and IEC except where modified and/or supplemented by this specification.

1.00.02 Equipment and material conforming to any other standards, which ensure equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the tender.

1.00.03 The electrical installation shall meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

2.00.00 DESIGN CRITERIA

2.01.00 Power & Motor Control Centers (PMCC), Motor Control Centers (MCC) & AC/DC Distribution Boards shall be used to provide power, control and protection for A.C. and D.C. auxiliary services (motors and feeders) throughout the plant.

2.02.00 The MCC shall be metal clad, single front design, free standing, dust & vermin proof, floor mounted and suitable for indoor installation.

2.03.00 PMCC & MCC shall have double incomer & Distribution boards shall have single incomer.

2.04.00 The continuous current rating of the bus bars & incomers of the PMCCs/MCCs & DBs shall be the maximum load on the board due to all the running auxiliaries during any operating condition plus 10% margin and the biggest spare feeder rating.

All bus bars of PMCCs/MCCs and AC Distribution Boards shall be capable of withstanding the mechanical forces and thermal stresses due to 50 kA short circuit current for 1 sec.

2.05.00 Busbar of PMCC/MCC shall be made of Aluminium. Current rating of AL busbar shall be 0.5Amp/Sq.mm (Max.)

2.06.00 In-cubicle ratings of incomer and bus-section breakers/switches shall be identical to the associated bus bar rating.

2.07.00 All non-motor feeders rated below 800 A shall be fed from MCC. From rating 800 A and above, all non-motor feeders shall be fed from PCC. However, in PMCC, such restriction will not be applicable.

2.08.00 For feeder ratings of 800 A and above ACB shall be provided. For feeders less than 800A, MCCB shall be provided depending on the application. All the breakers are EDO type. All the breaker feeders shall have micro processor based external relay with communication protocol to link with SCADA, EMS system.

All the ACB incomer breakers from transformer and B/C ACB shall be of 50kA breaking capacity.

2.09.00 PCC shall be used to feed PMCC/MCC and motors rated above 110kW up to 200kW. All motors rated up to 110 kW shall be fed from MCC. However, in PMCC motor up to 200 kW rating shall be fed.

2.10.00 All motors rated 110kW & up to 200kW shall be air circuit breaker controlled with numerical motor protection relay.

2.11.00 All the motor starters up to 30 kW shall have MPCB.

Motors rated above 30kW and below 110 kW shall be DOL starter, Contactor operated by numeric motor protection relay with RS 485 communication. For motors between 30kW to 110kW, MCCB with E/F protection shall be provided.

2.12.00 3 phase Energy meters with communication facility shall be provided for all drives of 30kW and above.

2.13.00 Motors above 200 kW shall be HT motor.

2.14.00 All the Starters, Breaker feeders, MCCB feeders shall have ELR protection.

2.15.00 Deleted

2.16.00 Deleted.

2.17.00 For DC distribution boards short time rating of all components and the interrupting capacity of the breakers used will be coordinated with the fault feeding capacity of the equipment preceding it. The duration of the short time rating of all components will be minimum one (1) second.

2.18.00 All the I/C, O/G, power supply feeder, motor feeders shall have multifunction energy meters with communication protocol to link with SCADA and EMS system.

2.19.00 All the ACB incomer breakers from transformer and B/C ACB shall be of 50kA breaking capacity.

2.20.00 All motors above 30 kW will be provided with space heaters. The motor space heaters shall be supplied from 240V A.C phase-neutral supply taken from MCC & shall be equipped with adequate protection for individual space heater.

2.21.00 The PMCC/MCC & Distribution Boards will be provided with 20% of outgoing feeders of each type as spare subject to a minimum of one number of each type and rating in addition to any specific spare feeders requirement of owner to be furnished during detail engineering.

2.22.00 Local Push Button (L.P.B.) stations will be used for controlling drives from local.

2.23.00 Local Isolating Switch (L.I.S) Units will be used for local isolation of power supply to various machines.

2.24.00 The Local Control Boards/Panels (LCB) will be used for controlling the drives and shall be placed near the drives. Local/ Remote selection shall be done from this board. Necessary indications, meters, annunciations and shall also be provided on these control boards/panels.

2.25.00 All equipment except Local control board, L.I.S. Units and L.P.B stations, will be located in a clean but hot, humid, and tropical atmosphere. The LCB, L.I.S. Units and L.P.B. stations will be generally installed in a hot, humid, and tropical atmosphere, heavily polluted at places with fly ash and/or coal dust, and shall be suitable for outdoor service with degree of protection specified elsewhere in this specification.

2.26.00 All LCB, L.I.S. Units and L.P.B. stations shall be liberally sized so as to provide spacious layout of equipment and devices with sufficient working space in between.

2.27.00 For continuous operation at specified ratings, the temperature rise of various equipment/components shall be limited to the permissible values specified in relevant standards and/or this specification.

2.28.00 The MCC shall be air cooled (wet ventilation) and air cooled system shall be designed with agreed pressure. All the I/C , O/G feeders, starters , SFU shall have external padlock arrangement. Special arrangement shall be there so that It shall not be possible to open the door and insert the breaker, switch on the breakers, SFU etc. Once padlock is done.

3.00.00 SPECIFIC REQUIREMENTS

3.01.00 Construction

3.01.01 PMCC/MCCs/DBs shall be indoor, air insulated, and metal-clad type. The design construction shall be such as to permit extension at either end.

3.01.02 PMCC/MCC shall be draw out type, floor mounted &of modular design. The enclosures of PMCC/MCC shall have a degree of protection IP52& fitted with exhaust fan for ventilation.

3.01.03 The PMCC/MCC module of same rating will be interchangeable with one Another.AC/DC distribution board can be floor or wall mounted type depending on sizes.

3.01.04 PMCC/MCCs in general shall be of single-front construction unless Owner approves double front construction at execution stage due to any constraint in specific areas.

3.01.05 PMCC/MCC/DB assemblies shall comprise of a continuous line-up of dead-front, free-standing vertical sections, housing the control modules in multi-tier

formation. For PMCCS/MCCs having breaker the installation of circuit breakers shall however be limited to the bottom two tiers only. Not more than two breakers shall be accommodated in one vertical section.

All PMCCs/MCCs/DBs shall be front-wired and front-connected.

3.01.06 PMCCs/MCCs/DBs shall be fully compartmentalized with metal/insulating partitions between compartments.

Working height shall be limited between 450mm and 1800mm from floor level.

3.01.07 For all non motor feeders, a removable neutral link shall be provided in each outgoing feeder.

3.01.07 Each breaker/control module shall be housed in a separate cubicle, complete with an individual front access door having sufficient opening with concealed type hinges.

Each vertical section shall have a removable back cover. All doors and covers shall be gasketted.

3.01.08 Breaker cubicles shall be so sized as to permit closing of the front access door when the breaker is pulled out to ISOLATED position.

3.01.09 For breaker panels, all switches, lamps, and indicating instruments shall be flush mounted on the respective compartment door whereas relays and other auxiliary devices shall be mounted in a separate compartment.

For PMCC/MCC/DB modules, all push-buttons, lamps and indicating instruments shall be flush/semi-flush mounted on respective module compartment.

3.01.10 For single-front assemblies, a full-height vertical cable alley with cable supports shall be provided in each section to facilitate unit wiring.

The alley shall be liberally sized to accommodate all cables and shall have removable cover at the front for access.

For double-front assemblies, two full-height vertical cable alley with cable supports shall be provided in each section, one on either front, to facilitate unit wiring. These chambers shall be liberally sized to accommodate all cables and shall have removable front cover for access.

3.01.11 Wherever two breaker compartments are provided in the same vertical section, insulating barriers and shrouds shall be provided in the rear cable compartment to avoid accidental touch with the live parts of one circuit while working on the other.

3.01.12 A horizontal wire way extending the entire length of the assembly shall be provided of the top for inter-panel wiring.

3.01.13 PMCCS/MCCs/DBs shall be supplied with base frames made out of structural steel sections.

3.01.14 After isolation of power and control circuit connections, it shall be possible to safely carry out maintenance in a compartment with the bus bar and adjacent circuit live. Necessary shrouding arrangement shall be provided for this purpose over the cable terminations located in cable alley.

3.01.15 The minimum clearance in air between phases and between phases and earth for the entire run of horizontal and vertical bus bars shall be 25mm. For all other components, the clearance between two live parts, a live part and an earthed part, and isolating distance shall be at least 10mm throughout. Wherever it is not possible to maintain these clearances, insulation shall be provided by barriers. However, for horizontal and vertical bus bars, the clearances mentioned above should be maintained even when these are sleeved or insulated. All connections from bus bars up to fuses shall be fully shrouded to minimize the risk of phase to phase and phase to earth shorts.

3.01.16 Unless otherwise stated, equipment rating shall be as per Annexure - B.

3.02.00 Bus and Bus Taps

3.02.01 All PMCCS/MCCs/ACDBs shall be provided with three phase busbars and neutral busbar. All bus bar compartments shall be fully enclosed.

DCDBs shall be provided with two bus bars with a bus-section breaker. Each section shall receive DC power from the respective Battery, Float Charger & Float cum Boost Charger through incoming breaker.

3.02.02 Horizontal and vertical busbars and bus connections shall be of high conductivity Aluminium. Neutral busbar shall be of Copper.

The maximum temperature of busbars and bus connections shall be limited to 90^0C i.e. 40^0 C rise over 50^0 C ambient.

No diversity factor shall be allowed for temperature rise.

3.02.03 Vertical busbars shall be designed for a minimum current rating of 200 A.

3.02.04 All bus connections shall be provided with anti-oxide grease. Adequate contact pressure shall be ensured by means of two-bolt connection with plain and spring washers and locknuts.

3.02.05 Bimetallic connectors shall be provided for connections between dissimilar metals.

3.02.06 Busbars shall be colour coded for easy identification and so located that the sequence R-Y-B shall be from left-to-right, top- to-bottom, or front to rear when viewed from the front of the assembly.

3.02.07 Cross-section of the busbars shall be uniform throughout the length of the assembly. All busbars and bus connections shall be supported and braced to

withstand the stresses due to maximum short circuit current and also to take care of any thermal expansion.

3.02.08 Bolted disconnecting links shall be provided for all incoming and outgoing feeders for isolation of neutral, if necessary.

3.02.09 Bus insulators shall be non-hygroscopic, flame retardant, track resistant, high strength, sheet molded compound or equivalent polyester fibre glass molded type. Separate supports shall be provided for each phase and neutral busbar.

3.03.00 PMCC/MCC/DB Modules

3.03.01 PMCC/MCC modules shall have self-aligning power/control disconnects. All disconnects shall be silver plated to ensure good contacts. This feature and any other feature described below but which is exclusively for draw-out design are not to be considered where non-drawout (fixed) type PMCC/MCC is specified.

3.03.02 Modules of same size and type shall be physically and electrically interchangeable.

3.03.03 The design of drawout modules shall be such as to permit easy withdrawal/re-insertion of the unit with guide rails to ensure correct alignment.

3.03.04 Various module sizes should be multiples of one basic unit to facilitate modifications at site. Suitable provision for this purpose should also be incorporated in the vertical busbars.

3.03.05 Drawout modules where specified shall have three distincts positions, namely, SERVICE, TEST and ISOLATED

In the SERVICE position, both power and control circuits shall be engaged. It shall not be possible to open the module door when the module is in SERVICE position.

In the TEST position the power circuits shall be disengaged but the control circuits shall be engaged. It shall be possible to close the module door when the module is in TEST position. Racking in of the module from TEST to SERVICE position shall not be possible unless the module door in closed.

In the ISOLATED position, both power and control circuits shall be disengaged.

3.03.06 Modules shall house the control components for a circuit such as switch, fuse, contactors, relays, push-buttons, lamps, meters, etc. only the push-button actuators, lens' of indicating lamps, and transparent windows for meters shall be mounted on module door such that when the module is withdrawn, the cubicle door shall provide specified degree of protection when the module door is closed.

3.03.07 Breaker operated incomers and bus sections shall be provided with one (1) TEST-NORMAL-SWGR selector switch. Breaker operated motor feeders shall be provided with TEST-NORMAL-TRIAL selector switch.

Contactor operated motor feeder modules shall be provide with one (1) MCC-NORMAL-TRIAL selector switch.

These selector switches shall be lockable type and shall be mounted inside the panel.

3.03.08 The equipment layout shall provide sufficient working space in between the components.

3.04.00 Circuit Breaker

3.04.01 Circuit Breakers shall be draw out type, three pole, single throw, air break type with stored energy, trip free mechanism and shunt trip coil. It shall be suitable for a duty cycle of O-3 min-CO–3 min-CO.

3.04.02 All incomer breakers and motor feeder breakers shall have motor-wound spring charging mechanism.

3.04.03 Each breaker operated feeder shall be provided with protective devices as specified in Annexure-A.

3.04.04 All breakers with motor wound spring charging mechanism shall have facility of manual spring charging also.

3.04.05 For motor wound mechanism, spring charging shall take place automatically after each breaker closing operation. One open- close-open operation of the circuit breaker shall be possible after failure of power supply to the motor.

3.04.06 Mechanical safety interlock shall be provided to prevent the circuit breaker from being racked in or out of the service position when the breaker is closed.

3.04.07 Automatic safety shutters shall be provided to fully cover the female primary disconnects when the breaker is withdrawn.

3.04.08 Each breaker shall be provided with an emergency manual trip, mechanical ON-OFF indicator, an operation counter, mechanism charge/discharge indicator, and electrical anti-pumping feature.

3.04.09 In addition to the auxiliary contacts required for normal breaker operation and indication, each breaker shall be provided with the following for interlocking purpose :

a) Position/cell switch with minimum 4 NO + 4 NC contacts.

b) Auxiliary switch, with minimum 6 NO + 6 NC contacts, mounted on the stationary portion of the breaker panel and operated mechanically by a sliding lever from the breaker in SERVICE position.

Alternatively, electrically reset latching relay may be used for the purpose. The exact requirement contacts of the position/cells switch, limit switch, auxiliary switch and latching relay shall be decided by the Bidder taking into account the scheme requirement and spares. Limit/auxiliary switches shall be convertible type, that is, suitable for changing N.O. contact to N.C. and vice-versa.

3.04.10 Spring charge limit switch shall be provided for breakers with motor wound spring charging mechanism. These limit switches shall be provided with minimum 2NO + 2NC contact.

3.04.11 Limit/auxiliary switches shall be convertible type, that is, suitable for changing N.O. contact to N.C. and vice-versa.

3.05.00 MCCB

3.05.01 MCCB shall be four pole, air break, single throw type having trip free mechanism with quick make, quick break contacts. The MCCB shall have current limiting feature. Current & time both shall be selectable for co-ordination with downstream.

3.05.02 Molded case circuit breakers of identical rating shall be physically and electrically interchangeable.

3.05.03 The compartment door shall be interlocked mechanically with the MCCB such that the door cannot be opened unless the MCCB is in OFF position. Further, the compartment door can only be closed when the MCCB is in service position.

3.05.04 Short circuit release for phase and earth fault protection shall be provided with the MCCB.

3.05.05 Molded case circuit breaker shall be provided with 1 NO and 1 NC electrically separate auxiliary contact.

3.06.00 SWITCHES

3.06.01 Switch handle shall have provision for padlocking in ON and OFF position.

3.06.02 The compartment door shall be interlocked mechanically with the switch such that the door cannot be opened unless the switch is in OFF position. Means shall be provided for releasing this interlock at any time.

3.07.00 FUSE

3.07.01 Fuses shall be HRC, preferably link type, with a minimum interrupting capacity equal to the short circuit current of the LT system. It shall be drawout type. Fuses with bolted arrangement is not desirable.

3.07.02 Fuses shall be furnished complete with fuse bases and fittings of such design as to permit easy and safe replacement of fuse element.

3.07.03 Visible indication shall be provided on blowing of the fuse.

3.07.04 Motor fuse characteristics and ratings shall be chosen to ride over starting period without blowing. The fuse on incoming feeder wherever provided, shall be chosen to provide discrimination with motor/feeder fuses.

3.08.00 MINIATURE CIRCUIT BREAKER (MCB)

3.08.01 MCB shall be three/four pole, trip free, suitable for manual closing and opening and also automatic trip on overload and short circuit.

3.08.02 MCB shall be rated for 9 kA short circuit rating. It shall be quick make, quick break, and independent manual type with trip free feature. MCB shall have the following :

a. Over current protection
b. ON/OFF position indicators
c. Auxiliary contact block (wherever required)

3.08.00 A.C. Starter

3.08.01 Contactors

a) Motor starter LSTK vendors shall be of air break, electromagnetic type as per IS/IEC: 60947 suitable for DOL starting of motor and shall be of utilization category AC-3 for ordinary and AC-4 for reversing starters.

b) Contactor starters shall comply with the requirements of IS-8544 in respect of co-ordination of the characteristics of contactor, overload relay, and fuse. The type of co-ordination shall be Type-2 as per IS-8544. Contactors, SFU selected shall be one size higher than type-2 coordination.

3.08.02 Thermal Overload

a) Thermal overload relays shall be manual reset type and ambient temperature compensated with adjustable settings.

b) Single phasing preventor shall be provided as an inbuilt feature of the thermal overload relay.

3.09.00 CONTROL AND INDICATION

3.09.01 The general scheme of connections for control, interlock, and protection is shown in the enclosed drawings. Detailed requirements of individual circuits shall be developed by the Bidder.

3.09.02 All indicating lamps shall be of high intensity cluster LED type.

3.09.03 For control supply, adequately-rated 415/240V control transformers with necessary taps shall be provided. Auxiliary bus bars shall be used to distribute 240V AC control supply. The control supply of different modules shall be tapped individually from the auxiliary bus bars. Transformer ratings shall have adequate spare capacity. Control transformer shall be powered from line side of incoming switch/circuit breaker.

3.10.00 METER AND METER SELECTOR SWITCH

3.10.01 All indicating instruments (96 x 96 mm) shall be flush-mounted on front panel with 250 Deg. scale, anti-glare glass and accuracy class of + 2% full scale. Each meter shall have zero adjuster on the front.

3.10.02 All indicating instruments shall be enclosed in dust-tight cases suitable for tropical use.

3.10.03 Meters shall be compensated for temperature errors and factory calibrated to read the primary quantities directly without using a multiplying factor.

3.10.02 Motor ammeters shall have an extended suppressed end-scale range to indicate starting current (6 to 8 times full-load current).

3.10.03 Watt-hour meters shall be provided in draw out cases. Either built- in test facilities or test blocks shall be provided to facilitate testing of meters without disturbing C.T and V.T secondary connections.

3.10.04 All breaker operated incomers and motor feeders above 30 KW up to 160 KW shall be provided with 3-phase electronic energy meter with pulse output for interfacing with DCS.

3.10.05 Meter selector switches shall be maintained contact, stay-put type, with knob handle. Ammeter and voltmeter selector switches shall be four position type. Ammeter selector switches shall have made before break contacts, to prevent open circuiting of CT secondary.

3.10.06 All indicating meters shall be digital type with LED display. All Multifunction meters shall have digital display and communication port with true rms measurement facility with minimum 1% accuracy level. Digital multifunction meter shall be provided for all incoming and outgoing feeders. Bus Voltmeters shall be provided with selector switches.

3.11.00 CURRENT TRANSFORMER & VOLTAGE TRANSFORMER

Current Transformer

3.11.01 Current Transformers shall be cast-resin type. All secondary connections shall be brought out to terminal blocks where star or delta connection will be made.

3.11.02 Motor feeders rated 30 KW and above, up to and including 90 KW, shall be provided with CTs for metering. Above 90 KW, separate CTs shall be provided for metering and protection.

3.11.03 Accuracy class of the current transformers shall be :

a) Class PS/5P 20 for Differential and Restricted Earth Fault
b) Class 5P20 for other relaying
c) Class 0.5 for incomer metering & Class 1.0 for outgoing feeders

The accuracy limit factor shall be less than 5.0

3.11.04 Current transformer shall be liberally designed and shall be capable of withstanding the system fault level. The value of short circuit factor shall be guided by IS:4201. Also CT shall be designed to withstand open circuit secondary with primary rated load current for a short duration.

3.11.05 CT wirings shall be colour coded and polarity marking shall be available at panel TB. Secondary terminals shall be provided with protective covers.

3.11.06 Separate shorting links shall be provided at the terminal block for shorting and grounding CT secondary terminals inside panel.

3.11.07 VA burden of the CTs shall be adequate (15 VA minimum) for connection to remote transducers for Owner's Data acquisition system. Also, additional terminal blocks etc. as may be required shall be provided in panels.

3.11.08 CT particulars like CT ratio, burden, knee-point voltage, excitation current and secondary resistance shall be decided by the Bidders.

3.11.09 Feeders requiring remote metering and/or current monitoring shall be provided with current transducers with calibration for full-scale reading. The output shall be 4-20 mA DC of which shall correspond to the normal range.

3.11.10 CT secondary shall be rated for 1A. Separate cores shall be used for metering & protection

Voltage Transformer

3.11.11 Voltage transformers shall be cast-resin type with copper winding and shall have an accuracy class of 0.5 for metering and 3P for protection. Voltage transformer mounted on breaker carriage is not acceptable. Voltage rating for the transformer shall be 1.2 continuous and 1.5 for 30 secs.

3.11.12 High voltage windings of voltage transformer shall be protected by current limiting fuses. The voltage transformer and fuses shall be completely disconnected and visibly grounded in fully drawout position.

3.11.13 Low voltage fuses, sized to prevent overload shall be installed in all ungrounded secondary leads. Fuses shall be suitably located to permit easy replacement while the switchgear is energised.

3.11.14 VA burden shall be adequate for connection to remote transducers for DCS. Also additional terminal blocks etc., as may be required, shall be provided in panels.

3.12.00 RELAYS

3.12.01 Relays shall be of drawout design with built-in testing facilities. Small auxiliary relays may be in non-drawout execution.

3.12.02 All protective relays, auxiliary relays, and timers shall be provided with hand reset operation indicator (flag) or LEDs with pushbutton for resetting.

3.13.00 SECONDARY WIRING

3.13.01 All boards & panels shall be fully wired at the factory to ensure proper functioning of control, protection, transfer, metering and interlocking schemes.

3.13.02 Fuse and links shall be provided to permit individual circuit isolation from bus wires without disturbing other circuits. All spare contacts of relays, switches and other devices shall be wired up to terminal blocks.

3.13.03 Wiring shall be done with flexible, 1100 V grade, PVC insulated switchboard wires with stranded copper conductors of 2.5 mm^2 for control, current and voltage circuits.

3.13.04 Each wire shall be ferruled by plastic tube with indelible ink print at both end having terminal block no., terminal nos., destination no. as per wiring diagram provided by the bidder. AC/DC wires shall have separate colour coding.

3.13.05 Wire terminations shall be made with crimping type connectors with solder as insulating sleeves. Wires shall not be spliced between terminals.

3.13.06 Wiring shall be neatly bunched in groups by non-metallic cleats or bands. Each group shall be adequately supported along its run to prevent sagging or strain on the termination.

3.13.07 Colour codes shall be used for wiring as per latest revision of IS: 5578 and 11353

3.14.00 TERMINAL BLOCKS

3.14.01 650V grade, multi way terminal block complete with mounting channel, binding screws and washers for wire connections and marking strip for circuit identification shall be provided for terminating the panel wiring. Terminals shall be stud type, suitable for terminating 2 nos. 2.5 mm^2 stranded copper conductor and provided with acrylic insulating cover. Terminals for C.T. secondary leads shall have provision for shorting and grounding.

3.14.02 Terminal blocks used for interface with DCS via termination cabinet shall be suitably sized to facilitate proper termination of interconnecting cables.

3.14.03 Not more than two wires shall be connected to one terminal. If necessary, a number of terminals shall be jumpered together to provide wiring points.

3.14.04 Each terminal shall be identified with designation as per approved schematic. At least 20% of the total number of active terminals shall be furnished as spare in each panel.

3.14.04 Terminal blocks shall be located to allow easy access. Wiring shall be so arranged that individual wires of an external cable can be connected to consecutive terminals.

3.14.05 The wiring and terminals shall be so arranged that individual wires of an external cable can be connected to consecutive terminals.

3.14.06 The terminal blocks within the panels shall be mounted on vertical support brackets. The support brackets shall be tack welded to the interior sheet steel mounting plates of the cabinet. Support brackets shall not be welded directly to the walls of the enclosure. The terminal blocks shall be attached to the support brackets with round head machine screws.

3.14.07 Terminal blocks shall generally be mounted vertically with adequate spacing (not less than 100 mm) between adjacent rows.

3.14.08 The bottom of the terminal block shall be at least 200 mm above the incoming cable gland plate.

3.15.00 CABLE TERMINATION

3.15.01 Generally, all assemblies shall be designed for cable entry from the bottom. Sufficient space shall be provided for all the cables for ease of termination and connection.

3.15.02 Gland plates shall be minimum 3 mm thick. for steel and 4 mm thick for Aluminium. The gland plate and supporting arrangement for 1/C power cables shall be non-magnetic type to minimise the flow of eddy current.

3.15.03 All provisions and accessories shall be furnished for termination and connection of cables as per cable schedule, including removable gland plates, cable support, crimp type tinned copper/aluminium lugs, double compression brass glands with tapered washer (Power cable only) and terminal blocks.

3.16.00 GROUND BUS

3.16.01 A ground bus, rated to carry maximum fault current, shall be provided which shall extend the full length of the assembly.

3.16.02 All stationary units shall be directly connected to the ground bus for effective grounding. The frames of all circuit breakers and drawout V.T. modules (if any) shall be grounded through heavy multiple contacts at all times except when the primary disconnecting devices are separated by a safe distance.

3.16.03 All hinged doors shall be earthed by flexible copper braid.

3.17.00 NAME PLATES

3.17.01 Nameplates of approved design shall be provided on each cubicle, at the top of the assembly and on each instrument & device mounted on or inside the cubicle.

3.18.00 SPACE HEATERS AND PLUG SOCKETS AND ILLUMINATION

3.18.01 Each vertical section shall be provided with thermostat controlled space heater and 5A, 3 pin plug socket. Third pin of the socket shall be effectively grounded through the metallic structure.

3.18.02 In addition, motor feeders rated 30 KW and above shall be wired-up for feeding the motor space heater through suitably rated breaker auxiliary NC contact and/or contactor.

3.18.03 Appropriate lighting equipment and fixtures rated for 240V AC shall be provided in each panel for adequate internal lighting of the panel.

3.18.04 Tube, heater and receptacle circuits shall be suitable for available A.C. supply and furnished with individual ON-OFF switch.

3.18.05 The lamp shall be located at the ceiling and guarded with protective cage. Space heater shall be located near the floor so as not to pose any hazard to service personnel.

3.18.06 Cubicle heater, motor heater, socket and lamp circuit shall be provided with individual switch-fuse units. Bidder to arrange 240V AC space heater interlocked power supply with dual incomer feeder for providing power supply to Motor Space Heater other panel space heaters.

3.19.00 A.C. /D.C. POWER SUPPLIES

3.19.01 Necessary AC and DC power supplies as required for control and service shall be arranged by the LSTK vendor.

3.20.00 TROPICAL PROTECTION

3.20.01 All equipment, accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus & insects.

3.21.01 Local Push Button Stations

a) L.P.B. Stations shall be furnished in sheet steel enclosure of dust and vermin-proof, weather-proof, gasketted construction, suitable for outdoor use without canopy, and conforming to degree of protection IP-55 or better. Each LPB station shall be provided with an additional hinged cover to prevent any unintentional operation of PB by accident.

b) L.P.B. Stations shall be suitable for column/structure/wall mounting and shall be complete with push-buttons, terminal blocks, anodised aluminum inscription plate, two (2) nos. earthing terminals, removable gland plate along with crimp type tinned copper lugs and compression type glands for cable/conduit entry from top and bottom. The earthing terminals shall be suitable for connection to one (1) no. 8 SWG G.I. wire.

c) All provisions and accessories shall be furnished for terminations and connection of cables including removable gland plates, at top and bottom, cable supports and terminal blocks.

d) L.P.B. Stations shall be of the following basic type and equipped with:

Type A : One (1) set of START-STOP Push button.
Type B : One (1) set of OPEN-CLOSE-STOP Push button.
Type C : One (1) set of STOP Push button.
Type D : One (1) set of Forward-Reverse-STOP Push button.
Type E : One (1) set of OPEN-CLOSE Push button.
Type F : One (1) set of START-STOP-RAISE-LOWER Push button.

e) Push-buttons shall be of heavy duty spring return, push to actuate type.

f) Colour coding of Push Buttons

i) START / OPEN / FORWARD - GREEN
ii) STOP / CLOSE / REVERSE - RED
iii) RAISE - YELLOW
iv) LOWER – BLUE

g) All STOP buttons shall be of red colour and shall have mushroom head with pressed-to-lock and key-to-release feature.

h) All push-buttons shall have a minimum of two (2) NO and two (2) NC electrically separate contacts, rated minimum 10 A at operating voltage.

i) Wiring shall be done by 1/C-2.5 sq.mm. 1100V grade, PVC/XLPE insulated, stranded copper conductor, cable. Each wire shall be identified at both ends by ferrules with wire designation.

j) Terminals shall have provision for connecting at least two (2) nos. 2.5 sq.mm. copper cable and shall be rated for carrying continuously minimum 10 A at 110V A.C. and 1A (Inductive) at 110V D.C.

3.22.01 Local Isolating Switch Units

a) L.I.S. Units shall be furnished in sheet steel enclosure of dust and vermin-proof, weather-proof, gasketted construction, suitable for outdoor

use without canopy, and conforming to degree of protection IP-55 or better.

b) L.I.S. Units shall be suitable for column/structure/wall mounting and shall be complete with load-break switch, terminal blocks, anodized aluminum inscription plate, two (2) nos. earthing pads, removable gland plate along with crimp type tinned copper lugs and compression type glands for cable/conduit entry from top and bottom. The earthing pads shall be suitable for connection to 25 x 3 mm G.S. flat.

c) Load-break switches shall be four-pole, air break, heavy-duty type. Duty class of load-break switches shall be AC-23 for motor feeders. Motor feeder switches shall be capable of safely breaking the locked rotor current of the associated motor circuit.

d) Terminals shall be clip-on type, 10 sq.mm. minimum.

3.22.02 Local Control Boards/Panels

a) Local Control Boards may consist of a number of vertical panels mounted side-by-side, in which case, they shall be bolted together to form a compact unit. Where two panels meet, the joints shall be smooth, close-fitting, and unobtrusive.

b) The control boards/panels shall be totally enclosed type, conforming to degree of protection IP-54 or better.

c) Generally, the local control boards/panels shall be free-standing, floor-mounted, dead-front assemblies. In some cases, however, wall-mounted type control boards/panels may also be accepted.

d) Floor-mounted control boards/panels shall be assembled on channel/angle base plates with anti-vibration mountings and stainless steel kick-plates.

e) Control boards/panels shall be of folded sheet steel construction, minimum 2 mm. thick, and free from all surface defects.

f) The boards/panels shall have sufficient structural reinforcement to ensure a plane surface, to limit vibration, and to provide rigidity during shipment and installation.

g) All floor-mounted panels shall have rear door.

h) Doors shall have concealed type hinges and padlocking arrangement. Doors shall be grounded by flexible copper braid.

i) All doors and removable covers shall be provided with neoprene rubber gaskets all round and latches sufficiently strong to hold them in alignment when closed.

j) Working height of the panels shall be limited between 550 mm and 1800 mm above floor level.

4.00.00 TEST

4.01.00 The switchgear shall be completely assembled, wired, adjusted and tested at the factory as per the relevant standards.

4.02.00 Routine Tests shall be carried out as per relevant standards.

4.03.00 Type test certificates shall be furnished if so desired by the Owner. Otherwise, the equipment shall have to be type tested, free of charge, to prove the design. Type tests performed before five (5) years are not acceptable.

5.00.00 SPECIAL TOOLS & TACKLES

5.01.00 A set of special tools & tackle which are necessary or convenient for erection, commissioning, maintenance and overhauling of the equipment shall be supplied.

5.02.00 The tools shall be shipped in separate containers, clearly marked with the name of the equipment for which they are intended.

6.00.00 SPARES

6.01.00 The Bidder shall submit a list of recommended spare parts for two (2) years satisfactory and trouble-free operation, indicating the itemized price of each item of the spares. The final quantity shall be decided during placement of order.

6.02.00 The Bidder shall quote and supply mandatory spare parts as per list elsewhere. The final quantity shall be decided during placement of order.

6.03.00 Each list shall be complete with specification, make, identification number, unit rate, quantity etc.

ANNEXURE A

PROTECTION

1.0 The minimum protections to be provided for circuit breaker controlled feeders are listed below :

A) Incoming Feeders

a) 3-Inverse time O/C relays (51) for Phase faults

b) 1-Inverse time O/C relay (51N) for Earth faults

c) IDMTL Over Current (51 SN) for stand by earth fault (for incomer from transformer only)

d) Restricted E/F (64)
(for incomer from transformer only).

e) VT Fuse failure.

f) Circuit Breaker failure.

g) Sensitive earth fault detectors shall be provided in DC system to annunciate earth faults

B) i) Motor feeders rated above 110 kW and up to 200 kW shall be breaker controlled with Microprocessor based Numerical motor protection relays having the following protection features.

a) Thermal model with negative sequence current.
b) Voltage compensated acceleration.
c) Under voltage, over voltage protection.
d) Overload protection.
e) Short circuit & SC back-up.
f) Current unbalance.
g) Locked rotor protection
h) Ground fault.
i) Temperate monitoring (stator, bearing etc.).
j) Phase reversal.
k) VT fuse failure at bus VT and secondary fuse detection scheme.

Bidder shall quote suitable digital/microprocessor based numerical relay for motor protection with a minimum facility as indicated above.

ii) Motor Feeders rated up to and including 110 kW shall be MCCB and Contactor operated with the following protection features.

a) Bimetallic thermal overload relay(hand reset Contactor operated type) with in built single phasing preventor.

b) Short circuit protection by MCCB.

c) Locked rotor protection

d) Earth fault protection

e) Under voltage protection

The relay shall have facility for user interface capability, character display, keypad, LED indicator and communication port along with licensed version software.

C) Outgoing feeder : a. IDMTL over current relay (51) for phase fault – 3 Phase

b. IDMTL over current relay (51N) for earth fault.

D) Bus-coupler : Check Synchronization relay (25). (Only applicable for PMCC)

NOTES:

1. Apart from protection relays mentioned above, electrically operated breakers shall be provided with anti pumping (94), trip annunciation (3), lockout (86) and trip circuit suppression (74) relays. Lockout relay shall be hand-reset type.

2. Fuse failure relay shall be provided on the secondary side of voltage transformer to monitor fuses.

3. Multifunction numerical relays shall be selected to provide an integrated protection, continuous measurement and monitoring functions. Features such as self-diagnosis and external testing, disturbance recording, sequence of event recording, time stampings shall be available with the relay. Relevant data shall be possible to be stored in non-volatile memory backed up by battery. The relay shall have multiple setting groups, optically isolated input/output, front LCD display and menus, fixed function and programmable LEDs, keypad and password protection. All functions including protection, automation, communication, LEDs, input / output shall be programmable and can be modified, if required, using the front panel user interface. Communication port for local and remote (with suitable protocol) communication shall be located in the front and rear part of the relay. A laptop loaded with support software (complete version) shall be supplied for local off line programming, measurements, extracting and viewing of events, disturbance etc. The relay shall be housed in dust tight enclosure, suitable for IP 52 degree of protection.

   The LSTK vendor shall furnish, install & co-ordinate all relays to suit the requirements of protection, interlock and bus transfer schemes as broadly indicated in the annexure and drawings.

4. In case any trip function is not available in a single relay, separate numerical relays shall be provided to achieve the requirement.

5. All protective relays shall be provided with self reset type of contacts.

6. Synchronizing check relay (25) complete with guard relay, auxiliary relay and hard wires. (Applicable for PMCC).

7. Numerical under voltage relays (27)- 3 Phase (with fuse failure feature) with time delay relay shall be provided for all Line VT s & Bus VT s of PMCC & Emergency MCC (emergency) and for all line VT s for MCC respectively.

8. IDMTL relay version shall be decided as per system requirement and the same shall be finalized during detail engineering.

9. One no. DC supply supervision relay (80) shall be provided for each incoming DC supply to the MCC/PMCC.

10. Fuse failure relay shall be provided on the secondary side of voltage transformer to monitor H.V. & L.V. fuses.

Apart from above, suitable provision for metering and monitoring such as voltage, current, power factor, watt-hr, event record etc. shall be provided.

ANNEXURE B
RATINGS AND REQUIREMENTS (SWITCHGEAR ASSEMBLY)

1.0	ASSEMBLY		
1.1	General		
	Type	:	Metal-clad, horizontal draw out, horizontal isolation
	Service	:	Indoor
	Enclosure	:	IP – 52
	Ref. Standard	:	IS 8623/IS 60947/IEC
1.2	System		
	Rated Operational Voltage (U_e)	:	415 ± 10% V
	Rated Insulation Voltage (U_i)	:	1100 V (minimum)
	Phase	:	Three Phase, Four Wire
	Rated Frequency	:	50 Hz ± 3%
	System grounding	:	Effectively earthed through resistance.
1.3	Design ambient temperature	:	51 ^oC
1.4	Rated Current inside the cubicle and at design ambient temperature of 51°C		
	Bus bar	:	3000A
1.5	Short Circuit Rating		
	Rated short time withstand current	:	50 kA (min.)
	Duration	:	1Sec.
	Rated peak withstand current	:	As per IEC
1.6	Control voltage (for breaker)	:	110V DC + 10 % , -15%
1.7	Control voltage (internally generated):		110V AC, single phase.
1.8	Service voltage	:	240V AC +/- 10%, single phase.

1.9	Termination details			
		Incomer	:	Through top entry Non-Segregated Phase busduct
		Outgoing	:	Through bottom entry cable.
1.10	Painting requirement			
	a)	Finish paint	:	Powder coating
	b)	Paint base	:	Epoxy / polyurethane
	c)	Paint shade	:	631 to IS-5
2.0	CIRCUIT BREAKER			
2.1	Reference Standard		:	IS/IEC-60947.
2.2	Type		:	Air-Break (ACB / MCCB)
2.3	No. of poles		:	3
2.4	Rated Operational Voltage (U_e)		:	415 ± 10% V.
2.5	Rated Insulation Voltage (U_i)		:	1000 V.
2.6	Rated Impulse Voltage (U_{imp})		:	12 kV.
2.7	Rated Frequency (Hz)		:	50 ± 3%
2.8	Rated enclosed thermal current (I_{the})		:	As reqd.
2.9	Rated current (I_n)		:	As required to effect I_{th}
2.10	Rated Duty		:	As per IEC
2.11	Rated Short-circuit breaking current (Symmetrical) kA rms		:	50 (min.).
2.12	Rated short-circuit making current kA peak		:	As per IEC.

2.13	Rated short time withstand current for rated duration of 1sec.	kA rms	:	Min. 50 kA.	
2.14	Operating mechanism		:	Motor wound Spring charging	
2.15	RatedVoltage				
	a)	Closing	:	110 V DC,2W (85-110%)	
	b)	Tripping	:	110 V DC, 2W (70-110%)	
	c)	Spring Charge Motor	:	110 V DC, 2W (85-110%)	

3.0	Contactor Duty	AC	DC
		Class III – categoryClass I, AC3 for unidirectional Drives and AC4 for bi-Directional / inching drives	DC 2

4.0	Switch duty			
	Motor feeders	:	AC23	DC22
	Other feeders	:	AC22	DC22

ANNEXURE C
COMPONENT/MODULE SELECTION TABLE

MOTOR FEEDER

Type	Motor Rating	MCCB Rating	Contactor	Cable size
AU/AR	0 - 5.5 KW	32A	16A	3/c – 2.5 Sq.mm - Cu
BU/BR	5.6 - 11 KW	63A	32A	3/c - 16 Sq.mm - Al
CU	11.1 - 22 KW	63A	63A	3/c - 35 Sq.mm - Al
DU	22.1 - 50 KW	100A	100A	3/c - 95 Sq.mm - Al
EU	50.1 - 75 KW	200A	160A	3/c - 185 Sq.mm - Al
FU	75.1 - 110 KW	400A	300A	2 x 3/c - 185 Sq.mm - Al

NOTES :

1. MCCB, thermal overload relay, LSTK vendor are to be co-ordinated (Type-2) with motor rating by the LSTK vendor.

2. "U" stands for Undirectional and "R" for Reversible drives.

3. MCCB with E/F protection to be considered for motors above 30 kW.

4. Cable sizes are indicative. Sizes shall be subject to validation by design calculation as per stipulation of Specification.

OUTGOING FEEDER - AC

Type	MCCB Rating	Cable Size
AF	32A	4/c – 16 Sq.mm - Cu
BF	63A	4/c – 35 Sq.mm - Al
CF	100A	3.1/2 – 95 Sq.mm - Al
DF	200A	3.1/2 – 300 Sq.mm - Al
EF	400A	4 x 1/c – 630 Sq.mm - Al
FF	630A	7 x 1/c – 630 Sq.mm - Al

OUTGOING FEEDER – DC

Type	Switch Rating	Fuse Rating	Cable Size
DAU	16A	16A	2/C-2.5 Sq.mm. cu.
DAF	32A	32A	2/C-2.5 Sq.mm. cu.
DBF	63A	63A	2 x 2/C-16 Sq.mm - Al
DCF	100A	100A	4/C-35 Sq.mm - Al
DDF	200A	200A	2 x 4/C-35 Sq.mm - Al
DEF	400A	400A	2 x 1/C-630 Sq.mm - Al

ANNEXURE D
415 V NON-SEGREGATED PHASE BUSDUCT

1.00.00 CODES AND STANDARDS

1.01.00 All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) and IEC except where modified and/or supplemented by this specification.

1.02.00 Equipment and material conforming to any other standard which ensures equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the tender.

1.03.00 The electrical installation shall meet the requirements of Indian Electricity Rules as amended upto date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

2.00.00 DESIGN CRITERIA

2.01.00 The 415V non-segregated phase bus duct will serve as interconnection between the 415V Indoor Switchgear and outdoor/Indoor transformer terminals. It is also used for trunking connection between two separate switchgear panels, wherever applicable.

2.02.00 The 415V non-segregated phase bus duct shall be installed indoor / outdoor in a hot, humid and tropical atmosphere.

2.03.00 The portion of bus duct at the transformer end will be subjected to vibration normally prevalent for this type of installation in a power generating station/industrial plants. Suitable means shall be provided to isolate the transformer vibration from rest of the bus structure/ bus duct.

2.04.00 The current carrying capacity of the bus duct shall take into account the service conditions, including skin effect, ambient temperature, bus insulation and exposure to sunlight.

2.05.00 For continuous operation at specified ratings, temperature rise of the bus duct and auxiliary equipment shall be limited to the permissible values indicated in the annexure of this specification.

2.06.00 Bus duct shall be capable of withstanding the mechanical forces and thermal stresses of the short-circuit currents listed in the annexure without any damage or deterioration of material.

2.07.00 Bus duct and supporting structures shall be designed & constructed so as to withstand without damage the horizontal/ vertical ground accelerations due to earthquake.

2.08.00 The bus ducts shall be self cooled and shall not be equipped with blower or any other type of forced ventilation.

3.00.00 SPECIFIC REQUIREMENTS

3.01.00 General

3.01.01 The 415V bus duct shall be non-segregated phase enclosure, natural air cooled type.

3.01.02 All parts and accessories shall have appropriate match mark and part numbers for easy identification and installation at site.

3.02.00 Enclosures

3.02.01 Phases shall be enclosed in a weather-proof, dust-tight enclosure without any barrier between phases. It shall preferably be rectangular in shape adequately rigid with stiffeners as required. Enclosure for indoor run shall be IP52 protected. Outdoor enclosure shall have IP 55 degree of protection.

The enclosure shall be made of sheet steel for rated continuous current up to and including 2000A at site condition. Above 2000A bus duct enclosure shall be made of Aluminum alloy. The thickness of enclosure material shall not be less than 3mm.

3.02.02 Circumferential neoprene rubber gaskets (joint less type) shall be provided for dust tight joints with adjacent enclosure section.

3.02.03 The bus enclosure shall have extended bellows or equivalent means to allow for temperature changes and vibrations. Flexible joints shall be provided in enclosures at all points where the bus duct terminates at equipment to withstand vibration, expansion/contraction and at suitable intervals in any straight run of the bus duct where expansion and contraction would otherwise result in stresses in the supporting structures.

3.02.04 Horizontal runs of bus duct shall have suitably sloped enclosure top to prevent retention of water for both indoor and outdoor portions of the bus duct.. For outdoor runs, the shipping sections shall be provided with flange protection hood to facilitate additional protection against rain water ingress through joints.

3.02.05 Suitable inspection openings shall be provided for access to support insulators, bus joints, transformer terminals, switch gear terminals etc. All inspection openings shall have reliable sealing arrangement with neoprene gaskets.

3.02.06 Filtered drains for drainage of condensate shall be provided at the lowest points and at such locations where accumulation of condensate can be expected.

3.02.07 Shipping length of the bus duct shall be not more than three (3) meters in length.

3.03.00 Bus Conductor

3.03.01 The bus conductor shall be of high conductivity electrolytic grade copper or aluminum alloy as indicated in the annexure, supported on fine glazed porcelain / cast resin / FRP insulators fixed to enclosure.

3.03.02 The bus conductor shall be designed for bolted connections throughout the run.

3.03.03 Flexible connections shall be provided between bus sections to allow for expansion and contraction of the conductor. Flexible connection shall also be provided at all equipment terminations.

3.03.04 All contact surfaces shall be silver plated to ensure an efficient and trouble-free connection. All connection hardware shall be non- magnetic and shall have high corrosion resistance.

3.03.05 Bus bars shall be color coded at regular intervals for easy identification. Markings on the bar shall be Red for R-phase, Yellow for Y-phase and Blue for B-phase.

3.03.06 All bolted joints shall be provided with high grade stainless steel nuts bolts, plain and belle-ville washers.

3.04.00 Insulators

3.04.01 Bus support insulators shall be bus post type, interchangeable, high creep, high strength, flame retardant, non hygroscopic, wet processed, fine glazed porcelain. Alternatively good quality cast resin / FRP insulators may be offered.

3.04.02 Insulator shall be mounted in such a way so as to permit easy removal or replacement without disassembly of the bus. The insulator mounting plate shall be designed for cantilever loading to withstand the short circuit. Support span shall be taken into consideration.

3.04.03 The conductor shall be fastened on the insulator through fixed and slip joints so as to allow conductor expansion or contraction without straining the insulator.

3.05.00 Connections & Terminations

3.05.01 All matching flanges, gaskets, fittings, hardware and supports required for termination of the bus duct at the switchgears, transformers and other equipment shall be furnished.

3.05.02 In this connection the LSTK vendor is required to co-ordinate through the Engineer with the suppliers of the 415V Switchgears, transformers with regard to connection details, mechanical and thermal stresses.

3.05.03 Flexible connections both for conductor and enclosure shall be furnished:

a. At all equipment termination to provide for misalignment up to 25 mm. (1") in all directions.

b. Between bus duct supported from building steel to prevent transmission of vibration.

3.05.04 The equipment terminal connections shall be readily accessible and shall provide sufficient air gap for safe isolation of equipment during testing.

3.05.05 If the material of bus conductor and that of the equipment terminal connectors are different then suitable bi-metallic connectors shall be furnished.

3.06.00 Grounding

3.06.01 A separately run Galvanized steel flat suitably clamped along the enclosure shall be used as the ground bus. All parts of the bus enclosure, supporting structures and equipment frames shall be bonded to above ground bus.

3.06.02 Ground pad shall be bolted type to accommodate 75x10 mm. Galvanized steel flats at two points at each end of termination, complete with suitable tapped holes, bolts and washers.

3.07.00 Supporting Structures

3.07.01 All supporting structures required for hanging and/or supporting the complete bus duct shall be furnished. These include all members, indoor/outdoor posts, bolts, shims, base plates, beams, hangers, brackets, bracings and hardware.

3.07.02 All buses shall be adequately supported and braced to successfully withstand normal operation, vibration, thermal expansion, short circuit forces and all specified design loads.

3.07.03 Support shall be designed to provide tolerance of ±12 mm. (1/2") in the horizontal and vertical directions.

3.07.04 All steel members shall be hot-dip galvanized after fabrication. All hardware shall be of high strength steel with weather resistant finish.

3.07.05 Concrete foundation, building steel, concrete, inserts/plates will be provided by Owner. The LSTK vendor shall co-ordinate with the Owner for this purpose giving well in advance the details of his requirements so as to enable the Owner to arrange for the same in time.

3.08.00 Name Plate

3.08.01 Suitable name plate shall be furnished with each piece of equipment.

3.08.02 Materials for name plate shall be anodized aluminium, 3 mm thick, using white letters on black background.

3.09.00 Finish

3.09.01 Except for supporting steel structure and hardwire which shall be galvanized, all equipment shall be finished with an undercoat of high quality primer followed by two coats of synthetic enamel paints unless otherwise stated.

3.09.02 The interior surface of the bus duct enclosure shall be treated with matt black paint to enable efficient heat dissipation. The shade of exterior surface finish for indoor and outdoor portion shall be as indicated in the Annexure.

3.09.03 Pretreatment consisting of de greasing, de rusting etc. shall be done on all fabricated parts before painting or galvanizing.

3.09.04 Paints shall be carefully selected to withstand heat and weather conditions. The paint shall not scale-off or crinkle or get removed by abrasion due to normal handling.

3.09.05 Sufficient quantities of all paints and preservatives required for touching up at sites shall be furnished.

4.00.00 TESTS

4.01.00 Routine Test

Bus Duct shall be subjected to the following minimum tests :

a. Visual inspection and verification of dimensions.
b. Dry power frequency voltage withstand for 1-minute.

4.02.00 Type Test

Refer General Electrical Specification E-0100

4.03.00 All cubicles shall be completely wired up at the factory and subject to wiring check and power frequency withstand tests on control/secondary wiring.

5.00.00 SPECIAL TOOLS & TACKLES

5.01.00 A set of special tools & tackles which are necessary or convenient for erection, commissioning, maintenance and overhauling of the equipment shall be supplied.

5.02.00 The tools shall be shipped in separate containers, clearly marked with the name of the equipment for which they are intended.

6.00.00 SPARES

6.01.00 The Bidder shall submit a list of recommended spare parts for three (3) years satisfactory and trouble-free operation, indicating the itemized price of each item of the spares. The final quantity shall be decided during placement of order.

6.02.00 The Bidder shall quote and supply mandatory spare parts as per the list. The final quantity shall be decided during placement of order.

6.03.00 Each list shall be complete with specification, make, identification number, unit rate, quantity etc.

RATINGS & REQUIREMENTS

1.0	GENERAL (Applicable to all Equipment)			
1.1	Rated voltage		:	0.415 kV
1.2	Allowable voltage variation		:	±10%
1.3	Number of phases		:	3
1.4	Rated Frequency & allowable: variation		:	50 Hz ±3%
1.5	Neutral Grounding		:	Effectively grounded.
1.6	Insulation level			
	a.	1-min. dry power frequency withstand	:	3kV rms
1.7	Short Circuit Level (Symmetrical/ Momentary)		:	50 kA rms/105kA peak
1.8	Service Voltage		:	415V±10%, 3ph, 50Hz ±3%,4wire.
2.0	415V NON-PHASESEGREGATED BUSDUCT			
2.1	Type		:	Non-segregated phase, self-cooled.
2.2	Service		:	Indoor/Outdoor.
2.3	Rated Continuous Current		:	2500Amps
2.4	Design ambient temperature		:	51 Degree C
2.5	Rated hottest-spot temperature		:	
	i)	Bus conductor	:	
		Silver joint	:	105 °C
		plain or tinned joint	:	90 °C
	ii)	Bus enclosure & support structure	:	90 °C (for inaccessible part) 70 °C (for accessible part)
	iii)	Conductor temp. after short-circuit	:	250 °C

2.6	Material			
	a.	Bus conductor	:	Aluminum alloy Grade 63401 (56.5%IACS) IACS: International Annealed Copper Standard
	b.	Bus enclosure		
		≤ 2000A	:	Sheet steel
		> 2000A	:	Aluminum alloy Grade 31000 (56% IACS).
2.7	Interleaving of conductors		:	As per manufacturer's design
2.8	Rated Short time Current for duration of 1 Sec.		:	50 kA rms
2.9	Insulator			Porcelain / Cast resin / FRP
	voltage Class		:	1kV
	material		:	
	power frequency withstand Voltage		:	3kV
	Creepage		:	31mm/kV
	Earth clearance		:	25 mm
3.0	Painting			
	Base		:	
	Interior surface		:	Matt black
	Exterior surface		:	Later

SUB SECTION: E-0008

LV TRANSFORMER

CONTENTS

CLAUSE NO.	DESCRIPTION
1.00.00	CODES AND STANDARDS
2.00.00	DESIGN CRITERIA
3.00.00	SPECIFIC REQUIREMENT
4.00.00	TESTS
5.00.00	SPECIAL TOOLS & TACKLES
6.00.00	SPARES
ANNEXURE-A	RATINGS AND REQUIREMENTS
ANNEXURE-B	FITTINGS AND ACCESSORIES

1.00.00 CODES AND STANDARDS

1.01.00 All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) except where modified and/or supplemented by this specification.

1.02.00 Equipment and materials conforming to any other standard which ensures equal or better quality may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the tender.

1.03.00 The electrical installation shall meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

2.00.00 DESIGN CRITERIA

2.01.00 The auxiliary transformers shall be used to provide 415V power supply to plant auxiliaries. These transformers shall be located at different load center substations.

2.02.00 The transformer will be installed in hot, humid and tropical atmosphere. All equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth.

2.03.00 The transformer shall be capable of continuous operation at rated output under the following condition :

a.	Voltage variation	:	415V +_ 10%
b.	Frequency variation	:	50Hz +3% to -3%
c.	Combined voltage and frequency variation	:	10% (absolute sum)

2.04.00 The transformer shall be capable of withstanding the short circuit stresses due to a terminal fault on one winding with full voltage maintained on the other winding for minimum period of two (2) seconds.

2.05.00 The transformer shall be free from annoying hum or vibration. The design shall be such as not to cause any undesirable interference with radio or communication circuits.

2.06.00 The noise level shall be limited to the value specified by NEMA Standard Publication No. TR-1-1993 when measured in accordance with conditions outlines in ANSI/IEEE C57.12.90-1999/IS13964/CBIP publication.

2.07.00 Each transformer shall be rated to take care of the entire load on the respective switchgear considering the outage of the other transformer. An appropriate load factor with a minimum of 0.9 for continuously running loads and 0.2 for intermittent loads shall be considered. The rating established shall be taken into account, load variations during the course of engineering. Due consideration for reduction in capacity due to

transformer regulation shall be given. Spare capacity of at least 10% shall be available in each transformer at the time of handing over the plant.

3.00.00 SPECIFIC REQUIREMENT

3.01.00 **Tanks**

3.01.01 The tank shall be fabricated from good commercial grade steel of adequate thickness.

3.01.02 The tank wall shall be reinforced by stiffener to ensure rigidity so that it can withstand without any deformation (a) mechanical shock during transportation,(b) oil filling by vacuum, c) Short circuit forces and (d)continuous internal pressure of 35 kN/m^2 over normal hydrostatic pressure of oil.

3.01.03 All removable covers shall be provided with weatherproof, hot oil resistant, resilient gaskets. The design shall be such as to prevent any ingress of water into or oil from the tank.

3.01.04 The tank shall be provided with one set of bi-directional rollers for rolling the transformer parallel to either center line.

3.01.05 Jacking pads, lifting eyes and pulling lugs shall be provided to facilitate movement of the transformer. All heavy removal parts shall be provided with eye bolt for ease of handling.

3.01.06 Manholes/hand-holes of sufficient size shall be provided for access to leads, windings, bottom terminals of bushings and taps.

3.01.07 Suitable guide shall be provided in the tank for positioning the core and coil assembly.

3.02.00 **Core & Coils**

3.02.01 The core shall be built up with high grade, non-aging, low loss, high permeability, grain oriented, cold-rolled silicon steel laminations especially suitable for core material.

3.02.02 The coils shall be manufactured from electrolytic copper conductor and fully insulated for rated voltage. Insulation shall be of Class A.

3.02.03 Insulating material shall be of proven design. Coils shall be so insulated that impulse and power frequency voltage stresses are minimum.

3.02.04 Coil assembly shall be suitably supported between adjacent sections by insulating spacers and barriers. Bracing and other insulation used in assembly of the winding shall be arranged to ensure a free circulation of the oil and to reduce the hot spot of the winding.

3.02.05 All leads from the windings to the terminal board and bushings shall be rigidly supported to prevent injury from vibration or short circuit stresses. Guide tube shall be used where practicable.

3.02.06 The core and coil assembly shall be securely fixed in position so that no shifting or deformation occurs during movement of transformer or under short circuit stresses.

3.03.00 **Tapping**

3.03.01 Off-circuit tap change(OCTC) as specified in the annexure shall be provided on the high voltage winding.

3.03.02 The transformer shall be capable of operation at its rated kVA on any tap provided the voltage does not vary by more than ±10% of the rated voltage corresponding to the tap.

3.03.03 The winding including the tapping arrangement shall be designed to maintain electromagnetic balance between HV and LV windings at all voltage ratios.

3.04.00 **Off-Circuit Tap Changer (OCTC)**

3.04.01 The off-circuit tap changing will be affected by a gang operated switch for three-phase unit. Arrangement shall such that switch can be operated at standing height from ground level.

3.04.02 The operating handle can be padlocked at any tap position. The design shall be such that the lock cannot be inserted unless the contacts are correctly engaged.

3.04.03 The mechanism shall be provided with a mechanical tap position indicator and an operation counter.

3.04.04 All contacts shall be silver plated and held in position under strong contact pressure to ensure low contact drop and avoid pitting.

3.05.00 **Insulating oil**

3.05.01 The transformer shall be filled with mineral insulating oil suitably inhibited to prevent sludging.

3.05.02 First filling of oil along with 10% excess shall be furnished for each transformer. Oil shall be supplied in non-returnable containers suitable for outdoor storage.

3.05.03 Oil preservation shall be by conservator tank with silica gel breather It shall be complete with level gauges, pipes, drain valve, buchholz relay with shut off valves at both sides etc. The level gauges shall be so placed that same can be readable standing from ground.

3.06.00 **Bushing**

3.06.01 Bushing rated 52 kV class and above shall be oil impregnated paper condenser bushings. Bushing rated below 52kV voltage class shall be solid porcelain or oil communicating type.

3.06.02 Condenser type bushing shall be provided with oil level gauge, bottom drain plug and test terminal for measurement of loss factor (tan-delta) and capacitance.

3.06.03 Bushings shall be provided with terminal connectors of approved type and size.

3.06.04 Bushing location shall provide adequate phase and ground clearances.

3.07.00 Terminal Arrangements

3.07.01 The physical position of the terminals and the markings shall be as per relevant IS/IEC unless otherwise shown in the enclosed drawing

3.07.02 Terminals for bus duct connection shall be brought through top / side cover mounted bushings with matching flange.

3.07.03 Terminals for cable connection shall be brought out through top cover/side wall mounted bushings to a detachable cable-end box with disconnect link.

3.07.04 Cable-end box shall be self-supporting, weatherproof, air filled type with sufficient space inside for termination and connection of cables.

3.07.05 Cable-end box shall be furnished complete with removable gland plate, armor clamps and hardware.

3.07.06 In general, the arrangement shall be such as to permit removal of the transformer and core/coil assembly without dismantling the bus duct/cable installation.

3.07.07 Low voltage winding neutral shall be brought out thru' top cover mounted bushing. Two ground conductors 75x10 G.I. flats shall run from neutral bushing to the bottom of the tank over pin insulators for connection to station ground.

3.08.00 **Cooling System**

3.08.01 The transformer cooling system shall be oil natural air natural.

3.09.00 **Marshalling Box**

3.09.01 A sheet steel, weatherproof, IP55, marshalling box shall be provided for the transformer. The box shall contain all auxiliary devices except those which must be located directly on the transformer.

3.09.02 All terminal blocks for Owner's cable connection shall be located in this box.

3.09.03 The marshalling box shall be provided with cubicle lamp with door switch, space heater with thermostat and removable cable gland plate.

3.10.00 **Wiring**

3.10.01 All control, alarm and indication devices provided with the transformer shall be wired up to the terminal blocks.

3.10.02 Wiring shall be done with flexible, 650V grade PVC wires in conduit or PVC armored cable. Minimum wire size shall be 2.5 mm^2 copper. Not more than two wires shall be connected to a terminal. 10% spare terminals shall be provided.

3.10.03 Multi-way terminal block complete with mounting channel, binding screws and washers for wire connections and marking strip for circuit identification shall be provided for terminating the panel wiring. Terminals shall be stud type, suitable for terminating 2 nos. 2.5 mm^2 stranded copper conductor and provided with acrylic insulating cover.

3.10.04 All devices and terminal blocks shall be identified by symbols corresponding to those used in applicable schematic or wiring diagram. Each wire shall be identified, at both ends, with interlocking type permanent markers bearing wire numbers as per LSTK vendor's Wiring Diagrams. AC / DC wiring shall have separate color-coding.

3.10.05 Wire termination shall be made with crimping type connectors with insulating sleeves. Wires shall not be spliced between terminals.

3.11.00 **Grounding**

3.11.01 The grounding pads, located on the opposite sides of the tank, shall be provided for connection to station ground mat.

3.11.02 Grounding pad shall have clean buffed surface with two tapped holes, M10 G.I. bolts and spring washers for connection to 75x10 mm G.I. flat.

3.11.03 Ground terminals shall be also provided on marshalling box to ensure its effective earthing.

3.11.04 For continuity of earth connection, all gasketted joints shall be provided with braided copper wire jumpers.

3.12.00 **Auxiliary Supply**

3.12.01 A.C. supply will be made available to each transformer.

3.12.02 Isolating switch fuse unit shall be provided for receiving the incoming supply.

3.13.00 Not used

3.14.00 **Painting**

3.14.01 All steel surfaces shall be thoroughly cleaned by sand blasting or chemical agents as required, to produce a smooth surface free of scales, grease and rust.

3.14.02 The internal surfaces in contact with insulating oil shall be painted with heat resistant insulating varnish which shall not react with and be soluble in the insulating liquid used.

3.14.03 The external surfaces, after cleaning, shall be given a coat of high quality red oxide or yellow chromate primer followed by filler coats.

3.14.04 The transformer shall be finished with two coats of battle ship grey (IS Shade # 632) synthetic enamel paint unless otherwise indicated elsewhere.

3.14.05 The paints shall be carefully selected to withstand tropical heat, rain etc. The paint shall not scale off or crinkle or be removed by abrasion due to normal handling.

3.14.06 Sufficient quantity of touch up paint shall be furnished for application after installation at site.

3.14.07 If it is considered necessary, the transformer may be given a further coating at site by the Owner. The Bidder shall therefore indicate the type and quality of the paint with full specification for this purpose.

3.14.08 All supporting structures and hardware shall be hot dip galvanized.

4.00.00 **TESTS**

4.01.00 **Routine Tests**

During manufacture and on completion, all transformers shall be subjected to the routine tests in accordance with latest IS/IEC and its different parts.

In addition, the following tests shall be performed on each transformer:

4.01.01 Transformer tank with coolers shall be tested for leaks with normal head of oil plus 35 KN/m^2 for a period of 8 hours. If any leak occurs, the test shall be conducted again after all leaks have been repaired.

4.01.02 During fabrication stage, the tank shall be pressure tested with air at a pressure corresponding to twice the normal head of oil or normal pressure plus 35KN/m^2 whichever is lower for a period of one hour. Also the tank designed for full vacuum shall be tested for maximum internal pressure of 3.33KN/m^2 for one hour. The permanent deflection of flat plates shall not exceed CBIP specified figures on release of excess pressure of pressure test and on release of vacuum.

4.01.03 After assembly, each core shall be pressure tested for one minute at 2KV (r.m.s.) A.C. between all bolts, side plates, structural steel works and the core.

4.01.04 The wiring for auxiliary power and control circuitry shall be subjected to withstand one minute power frequency test with 2.0KV (r.m.s.) to earth.

4.01.05 Dielectric special tests as per IEC60076-3 / IS 2026 Part 3

4.01.06 Measurement of acoustic sound level

4.01.07 Measurement of zero sequence impedance(s) on three-phase unit

4.02.00 **Type Tests**

Following type tests shall be performed on one transformer in accordance with relevant standard:

a. Dielectric type test (IEC60076-3) / IS 2026 Part 3

b. Temperature rise test.

Cost of such tests, if extra, shall be quoted separately by the Bidder.

4.03.00 **Miscellaneous**

All component parts and auxiliary equipment such as oil, bushings, etc. shall be routine tested as per relevant Indian Standards.

4.04.00 **Test Witness**

Tests shall be performed in presence of Owner's representative if so desired by the Owner. The LSTK vendor shall give at least seven (7) days' advance notice of the date when the tests are to be carried out.

4.05.00 **Test Certificates**

4.05.01 Certified reports of all the tests carried out at the works shall be furnished in six (6) copies for approval of the Owner.

4.05.02 The equipment shall be dispatched from works only after receipt of Owner's written approval of the test reports.

4.05.03 Type test certificates on any equipment, if so desired by the Owner, shall be furnished. Otherwise the equipment shall have to be type tested, free of charge, to prove the design.

5.00.00 SPECIAL TOOLS & TACKLES

5.01.00 A set of special tools & tackle which are necessary or convenient for erection, commissioning, maintenance and overhauling of the equipment shall be supplied.

5.02.00 The tools shall be shipped in separate containers, clearly marked with the name of the equipment for which they are intended.

6.00.00 SPARES

6.01.00 The Bidder shall submit a list of recommended spare parts for three (3) years satisfactory and trouble-free operation, indicating the itemized price of each item of the spares. The final quantity shall be decided during placement of order.

6.02.00 The Bidder shall quote and supply mandatory spare parts as per the list attached.

6.03.00 Each list shall be complete with specification, make, identification number, unit rate, quantity etc.

ANNEXURE-A
RATINGS AND REQUIREMENTS

1.0	Application	:	Auxiliary Transformer
2.0	Service winding	:	Indoor, step down, Two
3.0	Type	:	Oil filled transformer
4.0	Number of phases of each unit (3 Ph unit)	:	3
5.0	Reference standard	:	IS 1180, IS 2026
6.0	Rated power	:	1600 kVA**
7.0	Rated voltage ratio (line to line)	:	11/0.433 kV
8.0	No. of phases	:	3
9.0	Rated frequency	:	50 Hz
10.0	Type of Cooling & Respective Power	:	ONAN (100%)
11.0	Temperature rise		
11.1	Design ambient temperature	:	51 degree Centigrade
11.2	Temperature rise above design ambient temperature.		
	a) in oil by thermometer	:	40°C
	b) in winding by resistance	:	45°C
12.0	Insulation level (SI: Switching Impulse Voltage, LI: Lightning Impulse Voltage, AC: Short duration induced& separate source AC withstand Voltage)		
	.HV- (SI/Li/AC)	:	75 kVp / 28 kV rms
	L.V- (LI/AC)	:	- kVp / 3 kV rms
	L.V Neutral – (LI/AC)	:	- kVp / 3 kV rms

13.0	Vector group	:	Dyn11
14.0	Short-circuit impedance at 75°C At principal tap	:	6.25%**
14.1	Short circuit withstand time	:	2 Sec.
15.0	Parallel operation of transformer	:	Yes, momentary
16.0	Type of taps provided	:	Offload full capacity
16.1	Taps provided on	:	H.V. winding
16.2	Range of taps	:	+/-5 @ 2.5%
16.3	Method of Tap charge control-		
	a) Manual local	:	YES
	b) Electrical local	:	NO
	c) Electrical Remote	:	NO
	d) Automatic	:	NO
17.0	System earthing		
	H.V	:	Non-effectively earthed through resistance
	L.V.	:	Solidly Earthed
20.0	Terminal arrangement -		
	H.V.	:	Aluminium XLPE cable
	L.V.		Non Segregated Phase Busduct
	L.V. Neutral	:	75 x 10 GI flat
21.0	Transformer bushing	:	HV LV LVN
21.1	Voltage class KV (r.m.s.)	:	12 1 1
21.2	Material	:	Porcelain
21.3	Min. Creepage distance mm	:	31 mm per kV
21.4	Min. Ph-Ph clearance mm	:	As per IS/IEC

21.5	Min. Ph-Gr clearance mm	:	As per IS/IEC
22.0	System fault Level		
	HV Side	:	25 kA (rms.)
	LV Side	:	50 kA (rms.)
23.0	Max. Flux density in any part of core & Yoke at 110% rated voltage	:	1.9 Tesla (max)
24.0	Max. Noise level in accordance with Conditions specified in NEMA Std. TR-1	:	As per standard code
25.0	Auxiliary supply	:	415/240V, 3 ph., 50 Hz □
		:	110 V +10%, -15% DC 2 wire

** Minimum and Indicative. Bidder to justify with back up calculation.

ANNEXURE B

FITTINGS AND ACCESSORIES

Each transformer shall be equipped with fittings and accessories as listed below :

1. Oil conservator with filler cap, drain plug, plain oil level gauge
2. Oil preservation system complete with accessories.
3. Air release plugs.
4. Explosion vent should be double diaphragm type.
5. 150 mm dial magnetic oil level gauge with low level alarm contacts
6. 150 mm dial oil temperature indicator with maximum reading pointer and electrically separate contacts for trip and alarm.

7 150 mm dial winding temperature indicator with maximum reading pointer and electrically separate sets of contacts for trip, alarm. Thermometer pockets.

6. Double float Buchholz relay with gas release cock, shut-off valve on either sides with separate sets of contacts for trip and alarm.
7. Filter valve with threaded adopter (top and bottom).
8. Drain valve with threaded adopter.
9. Sampling valve.
10. Necessary valves for detachable cooler units.
11. Jacking pads, handling and lifting lugs.
12. Cover lifting eyes.
13. Bi-directional flanged wheels and skids.
14. Clamping device with bolts & nuts.
15. Hand-hole of sufficient size for access to interior of the tank.
16. Two-grounding pads.
17. Weather proof marshalling box for housing control equipment and terminal connections.
18. H.V, L.V and LV bushing terminal connectors.
19. Rating and terminal marking plates.
20. Bushing CT(s) for phase and/or neutral side(s), where required

Note : All indication, alarm, trip contacts provided shall be rated for 0.5A at 110 V D.C. and 5A at 230 V A.C.

SUB SECTION: E-0009

BATTERY & BATTERY CHARGER

CONTENTS

CLAUSE NO.	**DESCRIPTION**
1.00.00	CODES AND STANDARDS
2.00.00	DESIGN CRITERIA
3.00.00	SPECIFIC REQUIREMENTS
4.00.00	TESTS
5.00.00	SPECIAL TOOLS & TACKLES
6.00.00	SPARES
ATTACHMENT	
ANNEXURE-A	RATINGS AND REQUIREMENT
ANNEXURE-B	FITTINGS AND ACCESSORIES
ANNEXURE-C	LIST OF ALARMS AND INDICATIONS

1.00.00 CODES AND STANDARDS

1.01.01 All equipment and material shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) except where modified and/or supplemented by this specification.

1.01.02 Equipment and material conforming to any other standard that ensures equal or better quality may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the tender.

1.01.03 The electrical installation shall meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Codes of Practice. In addition, other rules or regulations applicable to the work shall be followed. In case of any discrepancy, the more restrictive rule shall be binding.

2.00.00 DESIGN CRITERIA

2.01.00 Design Basis

2.01.01 The equipment shall be installed indoor in a clean but hot, humid and tropical atmosphere

2.01.02 DC system shall provide reliable sources of DC power supply for control, indication, protection and annunciation of the plant.

2.01.03 The battery and battery charger combination shall be such as to ensure continuity of DC supply at load terminals at all times without even momentary interruption.

2.01.04 Further the voltage at load terminals shall not exceed the limits of (+) 10% to (-) 15% of the rated voltage (i.e. 110 V DC).

2.01.05 The battery shall be sized to meet emergency load duty cycle requirement for at least one (1) hour.

2.01.06 The rated ampere-hour capacity of the cell/battery shall be at reference temperature of 27^0C, constant current discharge at 5 hours rate (C_5) and end cell voltage of 2.20 V/ cell.

2.01.07 For the purpose of estimating battery capacities, the following data shall be considered:

a)	Aging factor	0.8
b)	Design margin	20 %
c)	Temperature correction factor	As applicable.
d)	Design ambient air temperature	50 ^{o}C (Max.)
		4 ^{o}C (Min.)

2.01.08 Deleted

2.01.09 The float-cum-boost charger shall be sized to restore the fully discharged battery to full charge condition in ten (10) hours with 25% margin over maximum charging rate or to operate as a float charger with duty requirement as indicated under cl. no.-2.01.08, whichever is greater.

2.01.10 The charger shall also be capable of delivering the rated load even under the specified voltage and frequency variations.

2.01.11 For continuous operation at specified ratings, temperature rise of various components of battery & battery charger shall be limited to the permissible values stipulated in relevant standards and / or this specification or manufacturer's guideline.

2.01.12 The batteries & chargers shall be so designed that the maximum fault level on DCDB is limited to 25 KA (The actual value shall however be decided by the Bidder after substantiating the same with calculation).

2.01.13 The procedure for estimating battery capacities shall be as per guide-lines stipulated in latest revision of IEEE Std 485 for Lead Acid Battery. Derating factor for prolonged float charging shall be duly taken into account, as applicable, in estimating battery capacity.

2.01.14 All sets of batteries mentioned above shall be Lead Acid PLANTE battery.

2.02.00 System Concept

2.02.01 The battery charger shall be capable of providing the initial charging current as required for the battery.

2.02.02 Normal Float Charger (FC) of Float cum Boost Charger will be normally ON, supplying the DC load current and at the same time trickle charging the battery. The characteristics shall be such that if load is high and exceeds the charger capacity, the excess load shall be supplied by the battery. The Boost mode is basically meant for quick charging the battery at constant current mode.

2.02.03 The standby Float-cum-Boost charger will be normally in stand-by (Auto Float/ Charge) mode and will cut into the circuit automatically-

a. To provide occasional equalizing charge as required.
b. To take over the functions of float charger in case of its failure.
c. To operate in boost mode when battery voltage drops below a set value.

2.02.04 The float-cum-boost charger shall also have provision for float, equalizing and boost charging the battery through manual selection.

2.02.05 On failure of A.C. supply both chargers will go out of service and battery will take over to supply critical lighting loads without any interruption.

2.02.06 Output of the chargers shall be controlled automatically as well as manually. AUTO/MANUAL selector switch along with voltage/current setter shall be provided for this purpose.

2.02.07 Interlock shall be provided to ensure that the battery can be taken to boost mode only if the float charger is healthy and running. Suitable defeating arrangement shall also be provided for initial charging of the battery.

2.02.08 110 V DC system shall be ungrounded. Suitable ground fault detection system shall be provided in the battery charger panel to detect ground fault on either polarity for annunciation in control room.

3.00.00 SPECIFIC REQUIREMENTS

3.01.00 Layout

3.01.01 The battery and battery charger will be located indoor.

3.01.02 Sufficient clear space shall be provided for attending individual cells.

3.02.00 Battery

3.02.01 General:

a. Each set of battery shall consist of number of cells assembled together on mounting racks.

b. The battery shall be flooded cell with PLANTE Lead Acid type.

c. The plates shall be designed for maximum durability during all service conditions including high rate of discharge and rapid fluctuation of load.

3.02.02 Construction:

a. Cell container shall be made of heat & electrolyte resistant, shock absorbing, tough translucent, polypropylene or equivalent plastic material having chemical and electrochemical compatibility. The cell shall be mechanically sturdy.

b. The cell shall be provided with visual electrolyte level checks for ease in maintenance. Electrolyte level markings shall be for upper and lower limits.

c. Sufficient sediment space shall be provided so that the cells will not have to be cleaned out during normal life.

d. Separator between plates shall permit free flow of electrolyte. Proper arrangement to keep end plates in position shall be furnished.

e. Open type cells shall be provided with suitable spray arrestors and separate perforated transparent plastic covers; anti-splash type vent plug shall be provided for sealed-in type cell.

f. The cells shall be supported on insulators fixed on to the rack with adequate clearance between adjacent cells.

g. The cell terminals posts shall be provided with connector bolts and nuts, made of copper/brass effectively coated with lead to prevent corrosion.

h. Lead coated copper connectors shall be furnished to connect up cells of Battery set.

i. Positive and Negative terminal posts shall be clearly and indelibly marked for easy identification.

j. Bent copper plates, tubular copper lugs, teak Wood clamp, bolts, nuts, washers, etc. shall be furnished for connection of outgoing Aluminum conductor cables.

3.02.03 Racks:

Battery racks for supporting battery cells shall be constructed of best quality teakwood (for lead acid battery), forming a rigid structure. Racks shall be painted with at least three (3) coats of electrolyte-resistant paint of approved shade. Racks shall be free standing type, mounted on porcelain/ electrolyte – resistant high impact plastic insulators. Numbering tags for each cell shall be attached on to the racks.

3.03.00 Battery Charger

3.03.01 General:

a. The charger shall be natural air cooled, solid-state type with full wave, fully controlled, bridge configurations.

b. The charger shall be provided with microprocessor based automatic voltage control, current limiting circuitry, smoothing filter circuit and soft-start feature, under/ over voltage protection and earth fault detection.

c. Voltage / current control shall be stepless, smooth and continuous. Voltage control shall be possible either in “Auto” mode or in “Manual” mode. An “auto- Manual” selector switch shall be provided for this purpose.

d. The charger shall be self-protecting against all AC and DC transients and steady state abnormal currents and voltages.

e. Charger AC input and DC output shall be electrically isolated from each other and also from panel ground.

f. Isolation shall also be provided between power and control circuits.

g. Each battery charger shall be provided with one(1) no. voltage transducer and one(1) no. current transducer for monitoring the DC output. These

transducers shall have twin-channel output of 4-20mA and will be used for analog inputs to PLC.

h. Radio frequency suppressor/screening shall be provided with the charger to limit the noise level/interference to radio and other communication equipment to be installed in the same building.

i. The design of the equipment will be such that during the period both trickle charger unit and boost charger units are working independently the tap connection from various taps of the battery cell to the load circuit should not involve any circulating current.

3.03.02 Construction:

a) The charger shall comprise a continuous line up of free-standing, floor mounted sheet steel panels, with access from both front and rear.

b) In between the float and float-cum-boost charger panels, a central panel shall be provided. This panel shall house the battery terminals, load terminals, battery blocking diodes, and a few meters, annunciators and indicating lamps.

c) The panels shall conform to the degree of protection IP-42. Minimum thickness of sheet metal used shall be 2 mm.

d) Access doors shall be with concealed hinges and neoprene gaskets. Ventilating louvres shall be covered with fine wire mesh.

Doors over 600 mm width shall be of double-leaf design.

e) All equipment within the panels shall be arranged in modular units and laid out with sufficient space for easy maintenance.

f) All indicating instruments, control switches etc. shall be flush mounted on the front face of the panels. However potentiometer shall be provided inside the panel. Nameplates of approved size and type shall be provided for all circuits and devices both at front & inside of the panel.

g) All bus bars and bus connections shall be of high conductivity copper and adequately sized to limit the maximum temperature rise to limit the maximum temperature within the prescribed value.

h) All bus connections shall be silver-plated. Adequate contact pressure shall be ensured by means of two bolt connection with plain and spring washes and locknuts.

i) Heat-shrinkable Insulating sleeves shall be provided for busbars. All bus connections shall be colour coded for easy identification.

j) Bus bars shall be supported and braced to withstand the stresses due to maximum short circuit current and also to take care of any thermal expansion.

3.03.03 Charger Equipment:

a) All power diodes and control rectifiers shall be silicon type. Rectifier transformers shall be resin impregnated in vacuum dry type, double wound, with copper conductor and class-F insulated with temperature rise limited to class B having off- circuit tap +. 2x2.5% on primary side. LC filter suppressor shall be provided in the output to minimize ripple content and to keep the value within the specified value.

b) The diode and bridge elements shall be liberally sized for forward current, minimum momentary overloads and voltage spikes. The current and peak inverse voltage (PIV) should be chosen accordingly. Wherever necessary, power semi-conductor device shall be provided with over current and over temperature protection by using special fuses. Blocking diodes shall be fully rated and redundant so that failure of a single diode shall not incapacitate the system in any way.

c) Isolating switches shall be heavy duty, load break type, operated by an external handle with provision for padlocking in ON and OFF position.

d) AC Changeover switch shall be 3 position, 4 pole, load break type with minimum 2 NO + 2 NC auxiliary contacts. The switch shall be installed in such a manner that the operating handle shall be accessible only after opening the front door.

e) Double pole, double throw DC switch shall be load break type with 2 NO + 2 NC auxiliary contacts.

f) Control switches shall be dust protected, heavy duty, and switchboard type complete with escutcheon plates. Contacts shall be silver plated, rated 10A at operating voltage.

Selector switch shall be maintained contact, lockable stay-put type with knob handle. Meter selector switch shall be four-position type.

Ground fault detection switch shall be three-position type spring return to neutral.

g) Push button shall be heavy duty, shrouded, push to actuate type with colored button and inscription plate. Each push button shall have 2 NO + 2 NC contacts, rated 10A at 240V AC and 0.5A at 110V DC.

h) Contactor shall be air-break type with hand reset type thermal overload relays having in built temperature compensator and single phase preventor.

i) Fuses shall be HRC type and furnished complete with fuse bases and fittings of such design as to permit easy and safe replacement of fuse element. Semi

conducting device fuses shall be fast-acting. All upstream fuses shall be properly coordinated with corresponding down stream fuses.

j) Indicating lamps shall be clustered of LEDs suitable for the duty involved. The body shall be made of polycarbonate Unbreakable lens. LEDs shall be protected by inbuilt fuse with surge suppressor or leakage voltage glow protection.. Both lamps and lens shall be replaceable from front.

k) Meters shall be 96 x 96 mm switchboard type, 90 deg scale, antiglare glass, ± 1% accuracy with zero adjuster on the front.

l) Transducers shall have twin-channel output of 4-20mA and shall be used to provide analog inputs to central control room.

m) Ground fault relay shall be provided to detect DC system ground.

n) Switch-Fuse shall be provided to receive incoming AC supply.

o) Charger shall be equipped with LCD display, so the system or particular module operation parameters can be locally or remotely viewed / monitored. Following parameters to be displayed:

a. Input AC voltage
b. Input AC current
c. Charger output
d. Charger current
e. Load voltage
f. Load current
g. Battery voltage
h. Battery current

3.03.04 Alarms:

a) Solid-state, audio-visual annunciation system shall be provided for battery chargers. Annunciation system shall operate on 110 V D.C.

b) One (1) minimum twelve-point alarm facia shall be provided on each float charger and float-cum-boost charger panel, complete with proper actuating devices, circuitry, legend, push-buttons (Accept, Reset and Test), and hooter.

c) Each central panel shall be provided with one (1) minimum eight-point alarm facia, complete with proper actuating devices, circuitry, legend, push buttons, (Accept, Reset and Test) and hooter.

d) The arrangement shall be such that on occurrence of a fault, the corresponding window will light up and stay lighted until the fault is cleared and the reset button is pressed.

e) Each time a window lights up, a master relay will get energised to provide group alarm signals to PLC.

f) Alarms should be compatible to PLC.

3.03.05 Meters:

a) Each float-cum-boost charger panel shall be provided with the following meters:

i) One (1) D.C. ammeter (for charger output)
ii) One (1) D.C. voltmeter with selector switch (for charger output/battery voltage)

b) Each central panel shall be provided with the following meters :
i) One (1) D.C. ammeter (for load circuit)
ii) One (1) A.C. voltmeter with selector switch (for main A.C. supply)

3.03.06 Transducers:

Each battery charger shall be provided with one (1) no. voltage transducer and one (1) no. current transducer for monitoring the DC output.

Charger panel shall be provided with the following transducers:

a. DC voltage transducer at each charger output.

b. DC current transducer at each charger output.

c. DC voltage transducer at battery output.

3.03.07 Controls:

The following manual controls shall be provided on the front of each charger panel:-

a. Charger ON/OFF push button.

b. Selection of float or boost charge in each float-cum-boost charger.

c. Voltage setters for setting the output of float/ equalizing / boost charge. Setting shall be independent of each other so that setting of one voltage shall not require resetting other.

d. Ground fault detection switch with indicating lamps.

e. Current limit setter/ charging rate.

f. Under/Over voltage relay including battery earth fault monitoring relay.

g. Acknowledge-Reset-Test push buttons for annunciation system. The color of reset buttons shall be BLACK.

3.03.08 Lamp/Space heaters/receptacles:

a) The charger panels shall be provided with:

i) Internal illumination lamp with door switch

ii) Space heater with thermostat control

iii) 3 pin 5A receptacle with plug

iv) Communication plug

b) Lamp, heater and receptacle circuits shall have individual ON-OFF witch fuse units/MCCB and suitable for 240 V A.C. supply.

3.03.09 Wiring/Cabling:

a. The panels shall be completely wired-up. All wiring shall be routed through wiring troughs.

b. Wiring shall be done with flexible, 650V grade, PVC insulated switchboard wires with stranded copper conductors of 2.5 mm^2 for control and current circuits and 1.5 mm^2 for voltage circuits.

c. Each wire shall be identified, at both ends, with interlocking type permanent markers bearing wire numbers as per Bidder's Wiring Diagrams. AC / DC wiring shall have separate color-coding.

d. Wire termination shall be made with crimping type connectors with insulating sleeves. Wires shall not be spliced between terminals

e. All spare contacts of relays, timers, auxiliary switches and other devices shall be wired up to the terminal block.

f. Gland plate shall be of 3 mm thick, non-magnetic material and suitable for single-phase cable entry from bottom. Cable terminal board with cable lugs and double compression cable glands shall be provided in each panel for termination of incoming and outgoing cable.

3.03.10 Terminal Block:

a. 650V grade, multi way terminal block complete with mounting channel, binding screws and washers for wire connections and marking strip for circuit identification shall be provided for terminating the panel wiring. Terminals shall be stud type, suitable for terminating 2 nos. 2.5 mm2 stranded copper conductor and provided with acrylic insulating cover.

b. Not more than two wires shall be connected to any terminal. Spare terminals equal in number to 20% active terminals shall be furnished. Separate terminal blocks shall be used for AC/ DC wiring termination.

c. Terminal blocks shall be located to allow easy access. Wiring shall be so arranged that individual wires of an external cable can be connected to consecutive terminals.

d. Terminal blocks used for interface with PLC via termination cabinet shall be suitably sized to facilitate proper termination of interconnecting cables.

3.03.11 Grounding:

a. The charger panels shall have fully rated ground bus with two ground terminals, one at each end.

b. Each terminal shall comprise two-bolt drilling with G.I. bolts, nuts and bimetallic washers for connecting to 50x6 mm G.I. flat. Ground bus shall be bolted to the panel structures, effectively grounding the entire assembly. The cases of meters, relays and switching devices shall be grounded through sheet steel structure.

c. Wherever, the schematic diagrams indicate a definite ground at the panel, a single wire for each circuit thus grounded shall be run independently to the ground bus and connected thereto.

3.03.12 Tropical protection:

a. All equipment accessories and wiring shall have fungus protection, involving special treatment of insulation and metal against fungus, insects and corrosion.

b. Screens of corrosion resistant material shall be furnished on all ventilating louvers to prevent entry of insects.

3.03.13 Painting:

a. All surface shall be sand blasted, pickled and grounded as required to produce a smooth, clean surface free of scale, grease and rust.

b. After cleaning, the surface shall be given a phosphate coating followed by 2 coats of high quality primer and stored after each coal.

c. Sufficient quality of touch-up paint shall be furnished for application at site.

3.03.14 Name Plate

a) Name plates shall be provided for each panel and for each equipment/device mounted on it.

b) The material shall be anodized aluminium/ lamicoid, 3 mm thick, with white letters on black background.

c) Name plates shall be held by self-tapping screws. The size of nameplates shall be approximately 20 mm x 75 mm for equipment and 40 mm x 150 mm for panels.

d) Name plates for panels shall be provided both on the front rear and also inside of the panels.

e) Control and meter selection switches shall have integral nameplates. Name plates for all other devices shall be located below the respective devices both inside & outside of panel.

f) Instruments and devices mounted on the face of the panels shall also be identified on the rear with the instrument/ device number. The number may be painted on or adjacent to the instrument or device case.

g) Caution notice on suitable metal plate shall be affixed at the back of each panel.

3.04.00 Battery Discharge Resistor Unit

3.04.01 It shall be designed to perform period discharge tests @ C_{10} of Lead Acid Batteries. The Resistor Unit shall be made especially to check initial battery performance, guarantee smooth operation of backup system during emergencies and improve overall health and life of Battery system.

3.04.02 Resistor Unit shall be an assembly consisting of copper-nickel alloy wire grid elements supported by stainless steel tie rods. The resistor bank shall have adequate trimming facility (coarse and fine) to maintain a constant current against falling voltage during discharge operation.

4.00.00 TESTS

All equipment and components thereof shall be subject to shop tests as per relevant IS standards. The tests shall include but not limited to :-

4.01.01 Following type tests on two cells of the battery shall be carried out by the bidder, even if the Bidder submits type test certificates for Owner / Consultant's review and approval.

a. Test for capacity – test for voltage during discharge.

b. Ampere-hour test & watt-hour efficiency test.

c. Endurance test.

4.01.02 Tests on battery charger:

a. Dielectric tests.

b. Voltage regulation check from 0 to 100% load with ±10% input voltage variation.

c. Ripple content measurement.

d. Heat run test on current limiting value..

e. All other functional and routine tests as required as per relevant standard.

4.01.03 In addition to above, routine test certificates for components like contactors, relays, instruments, SCR/PWM transistors, Diodes, Condenser, Potentiometer, semi-conductors, push buttons etc. shall also be furnished for Owner / Consultant's review and approval.

5.00.00 SPECIAL TOOLS & TACKLES

5.01.00 A set of special tools & tackles which are necessary or convenient for erection, commissioning, maintenance and overhauling of the equipment shall be supplied.

5.02.0 The tools shall be shipped in separate containers, clearly marked with the name of the equipment for which they are intended.

6.00.00 SPARES

6.01.00 The Bidder shall submit a list of recommended spare parts for two (2) years satisfactory and trouble-free operation, indicating the itemized price of each item of the spares. The final quantity shall be decided during placement of order.

6.02.00 The Bidder shall quote and supply mandatory spare parts as per list else where. The final quantity shall be decided during placement of order.

6.03.00 Each list shall be complete with specification, make, identification number, unit rate, quantity etc.

ANNEXURE A

RATINGS AND REQUIREMENT

1.0	BATTERY	:	Lead Acid PLANTE
1.1	Application	:	D.C. Closing/Tripping, indicating of SWGR/PMCC, Critical Lighting.
1.2	Design Ambient temperature	:	
	a. Maximum recorded	:	As specified.
	b. Minimum	:	As specified.
1.3	Type	:	Plante
1.4	Nos. of Cells per Battery	:	As required
1.5	Battery nominal voltage	:	110 V
1.6	Battery capacity at 27ºC	:	AH (To be selected by Bidder with calculations.)
1.7	Proposed Method of working	:	
	a. Float charging (normal)	:	2.20 Volt / cell.
	b. Equalising Charge (occasional)	:	2.33 Volt / cell.
	c. Boost charging (after complete discharge)	:	2.75V / cell (max'm.)
1.8	Intermediate tapping	:	As required
1.9	Mounting	:	wooden Rack
1.10	Terminal Connection	:	Through single core fire survived cables. Cable sizes shall have to be validated by design calculation.

NOTE: Items 1.4, 1.6 & 1.7– Bidder to justify with details, if his recommended values are different from the values specified in this specification.

2.0 BATTERY CHARGER

2.1	Charger		:	Dual float cum boost charger
2.2	Type		:	Solid-state, full wave, fully controlled with Micro-processor based AVR, three-phase bridge, suitable for continuous duty application.
2.3	Enclosure		:	Sheet steel enclosure, IP-42.
2.4	A.C. Input			
	a.	Supply	:	415V, 3 phase, 50 Hz, 4 wire.
	b.	Voltage variation	:	±10%
	c.	Frequency variation	:	±3%
	d.	Combined volt + frequency variation	:	10% (absolute sum)
	e.	Short-circuit level	:	50 kA r.m.s. symmetrical.
	f.	System earthing	:	Solidly earthed.
2.5	D.C. Output			
	a.	Float charger	:	(Maximum Continuous DC load + float charging battery) plus 25% margin.
	b.	Boost charger	:	Restoring fully discharged battery to full charge condition in 10 hours for Lead Acid battery, with 25% margin over maximum charging rate.

2.6 Performance Requirements

a. The output voltage of the charger shall be regulated within ± 1% of the set value for any load variation from 0 to 100% and A.C. input voltage and frequency variations as indicated above.

b. The ripple content in charger DC output shall be limited to 1% (rms) with or without battery.

3.0 DISCHARGE RESISTOR BANK

3.1	Type	:	Potable
3.2	Construction	:	Sheet steel enclosed,

3.3	Resistor material	:	Copper-nickel alloy/stainless steel
3.4	Enclosure Protection Class	:	IP30
3.5	Cooling	:	Natural air-cooled
3.6	Rating	:	To meet the functional requirement C10 (Lead-Acid), discharge Rate
3.7	Control	:	Using rotary switches for step control of current against falling voltage with ON-OFF facility
3.8	Painting		
	Interior	:	Glossy white
	Exterior	:	Shade No.of IS-5

ANNEXURE B

FITTINGS AND ACCESSORIES

BATTERY	
Each set of battery shall be equipped with fittings and accessories as listed below.	
1	One battery log book.
2	Two copies of printed instruction sheet.
3	One no. cell testing voltmeter (3-0-3 volts) complete with leads.
4	One no. rubber syringe type hydrometer suitable for specific gravity reading.
5	Three nos. pocket thermometer.
6	One no. thermometer (0 to 100°) with specific gravity correction scale.
7	One set cell bridging connector.
8	Two nos. each Alkali resistant plastic funnels and plastic jug.
9	Battery racks suitable for accommodating the cells coated with paint.
10	Delrin insulator (with 5% extra), rubber pad etc. for rack.
11	Two nos. plastic filling bottle for filling up.
12	One pair of spanners.
13	Requisite quantity of electrolyte with 10% extra in non-returnable containers.
14	Two pairs of rubber hand gloves.
15	Two nos. cell lifting straps.
16	One set of inter cell, inter tie and inter bank connectors as required for complete installation.
17	Apron.
18	Goggles.
NOTE:	Any other accessories if required for satisfactory operation of the complete battery system shall also be included in bidder's offer and to be supplied accordingly.

ANNEXURE-C

LIST OF ALARMS AND INDICATIONS

A. LIST OF ALARMS

1.0 Following list of alarm / annunciation shall be provided.

a) AC supply failure.
b) Charger overload.
c) Charger over temperature.
d) SCR fuse blown.
e) Filter fuse blown.
f) DC output fuse blown.
g) Float charger fail
h) Battery earth fault.
i) DC system under voltage.
j) DC system over voltage.

2.0 Initiating contacts, wired to two terminals, shall be provided for group annunciation of "Battery Charger Trouble" in remote control room.

3.0 Initiating contacts for all alarm points shall also have electrically separate spare set of contacts wired to the terminal block for future use.

4.0 All alarm contacts shall be rated 0.5A at 110V DC and 5 Amp. at 240V AC.

5.0 In addition to the alarm points mentioned above, any other alarm point, if required for battery charger, shall be provided.

B. LIST OF INDICATIONS

Charger panel shall also have the following minimum indications:

a) Charger power supply ON.
b) Charger DC output healthy.
c) Control supply ON.
d) DC healthy.
e) Boost charger in operation.
f) Float charger in operation.

SUB-SECTION: E-0013

C A B L E S

CLAUSE NO.	**DESCRIPTION**
1.00.00	CODES AND STANDARDS
2.00.00	SERVICE CONDITIONS
3.00.00	DESIGN CRITERIA
4.00.00	SPECIFIC REQUIREMENTS
5.00.00	TESTS
6.00.00	SPECIAL TOOLS & TACKLES
ATTACHMENT	
ANNEXURE-A	RATINGS AND REQUIREMENTS (POWER & CONTROL CABLES)

1.00.00 CODES AND STANDARDS

1.00.01 All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) and IEC except where modified and/or supplemented by this specification.

1.00.02 Equipment and material conforming to any other standards, which ensure equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the tender.

1.00.03 The electrical installation shall meet the requirements of Indian Electricity Rules as amended upto date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

2.00.0 SERVICE CONDITIONS

All cables shall be suitable for a hot, humid and tropical atmosphere with dust and corrosive chemical fumes. All cables shall be designed to withstand the mechanical, electrical and thermal stresses under the steady state and transient / fault conditions, and shall be suitable for the proposed method of installation.

3.00.00 DESIGN CRITERIA

3.01.00 For continuous operation at specified rating, maximum conductor temperature shall be limited to the permissible value as per relevant standard and / or this specification.

3.02.00 Armouring shall be single round wire of galvanised steel for multicore cables and aluminium for single core cable.

3.03.00 Core identification for multicore cable shall be provided by colour coding.

4.00.00 SPECIFIC REQUIREMENTS

4.01.00 General Description

All cables shall be furnished in strict compliance with ratings and requirements and sizes as given in Annexure to this Specification.

4.02.00 Selection Criteria

4.02.01 In cable sizing the following are to be taken into consideration

a) Short circuit current and duration
b) Continuous current
c) Installation conditions
d) Voltage drop under normal running and starting condition.

4.02.02 Apart from above, consideration shall also be given to limit the cable to some standard sizes of using too many types.

4.02.03 The standard cable sizes ampere capacities and derating factors as given in IS will be generally followed.

4.02.04 a) For breaker protected circuits minimum size will be determined by short circuit rating. For the purpose of calculating the minimum cable size, the following fault levels and duration shall be considered.

11000 V System – 40 kA, 0.2 second for outgoing and 0.5 sec for Incoming feeder

415 V System – 50 kA, 0.12 second for outgoing motor feeder and 0.2 / 0.4 sec for incoming feeder as specified in General Electrical Specification.

b) For motor circuits the selection of size will be made ensuring that the cable shall withstand a short circuit fault directly following a second hot start.

4.02.05 For fuse protected circuit the conductor size will depend on full load current subject to voltage drop not exceeding 3% under full load conditions and 10% during motor starting conditions. For practical purposes, the minimum size shall be 6 Sq.mm for aluminium and 2.5 Sq.mm. for copper.

4.02.06 All control cables shall be of 2.5 Sq.mm copper.

4.02.07 Multicore control cables will generally have spare conductor(s) in accordance with the following chart :

Conductors required	Cables
1 or 2	1-3 / C
3 or 4	1 - 5 / C
5 or 6	1 - 7 / C
7 or 8	1 - 10 / C
9, 10, 11 or 12	1 - 14 / C
13, 14, 15 or 16	1 - 19 / C
Above 16	Two or more of above cables

4.02.08 Separate cables for each type of following services / functions as applicable shall be used for each feeder. Same multicore cable using different services shall not be acceptable.

a) Power

c) Control, interlock and indication

c) Metering and measuring

d) Alarm and annunciation

e) C T Cables

f) P T Cables

4.02.09 Separate cables shall be used for AC and DC circuits.

4.03.00 Cable Identification

Cable identification shall e provided by embossing on the outer sheath the following :

a) Manufacturers name or trademark

b) Voltage grade

c) Year of manufacture

d) Type of insulation e.g. HR85 for HR PVC etc.

e) Type of outer sheath e.g. "FRLS" etc.

f) ISI marks

g) Nominal cross sectional area of the conductor & no. of cores

5.00.00 TESTS

5.01.00 Shop Tests

The Cables shall be subject to shop tests in accordance with relevant standards to prove the design and general qualities of the Cables as below:

5.01.01 Routine tests on each drum of cables.

5.01.02 Acceptance tests on drums chosen at random for acceptance of the lot.

5.01.03 Type tests on each type of cable, inclusive of measurement of amount D.C. resistance of power cables.

5.01.04 For instrumentation cable, in addition to above, the insulation resistance test and High Voltage test at 2 kV shall be conducted.

6.00.00 SPECIAL TOOLS & TACKLES

6.01.00 A set of special tools & tackle which are necessary or convenient for erection, commissioning, maintenance and overhauling of the equipment shall be supplied.

6.02.00 The tools shall be shipped in separate containers, clearly marked with the name of the equipment for which they are intended.

ANNEXURE A

RATINGS AND REQUIREMENTS

HV POWER CABLES 11kV / 11kV GRADE

1.0 11kV / 11kV grade 90º C rating heavy duty XLPE power cable suitable for use in 11000V non-effectively earthed system conforming to following requirement and in line with IS – 7098. IS 8130 & IS 5831 and IS 3975.

1.1	Conductor	Stranded and compacted aluminium conductor of grade H2 and Class 2 for all sizes, generally conforming to IS: 8130. Stranded and compacted circular and shaped tinned copper conductor of class 2 for all sizes as specified elsewhere, generally conforming to IS: 8130.
1.2	Conductor Screen	Extruded semi-conducting compound.
1.3	Insulation	Extruded cross-linked polyethylene (XLPE)
1.4	Insulation Screen	Extruded semi-conducting compound with a layer of non-magnetic metallic tape. For single core armoured cables, the armoring shall constitute the metallic part of screening. The semi-conducting tape shall be easily strippable.
1.5	Core Identification	By colored strips applied on (For three core cables) cores or by numerals.
1.6	Inner Sheath	Extruded PVC compound conforming to type ST2 of IS: 5831 for three core cables. Single core cables shall have no inner sheath.
1.7	Armour	Galvanised single round steel wire armour for twin and multicore cables. Non-magnetic hard drawn aluminium single round wire conforming to H4 grade for single core cables.
1.8	Overall Sheath	Extruded FRLS Grade PVC compound conforming to type ST2 of IS 5831.

L. V. POWER CABLES

2.0 1100 V grade, 90ºC continuous rating under normal condition and 250°C short time rating under short circuit condition XLPE insulated FRLSH outer-sheathed heavy duty, power cable conforming to following requirement and in line with IS 7098, IS 8130, IS 5831 and IS 3975.

2.1	Conductor	Stranded and compacted plain aluminium of grade H2 and Class 2/stranded, high conductivity annealed plain copper generally conforming to IS:8130.
2.2	Insulation	Extruded Cross Linked polyethylene (XLPE).
2.3	Core Identification	By color coding
2.4	Inner Sheath	Extruded PVC compound conforming to type ST2 of IS:5831 for multicore cable. Single core cables shall have no inner sheath. Filler shall be of same material as of inner sheath i.e. ST2
2.5	Armour	Galvanised single round steel wire armour for twin and multicore cables. Non-magnetic hard drawn aluminium single round wire conforming to H4 grade for single core cables.
2.6	Overall Sheath	Extruded FRLSH PVC compound conforming to type ST2 of IS:5831.
2.7	Oxygen Index	Minimum 29%

CONTROL CABLES

3.0 1100 V grade 70º C rating PVC Control cable conforming to following requirement and in line with IS:1554, IS:8130, IS:5831 and IS:3975.

3.1	Conductor	Stranded non-compacted and circular, high conductivity annealed plain copper, generally conforming to IS: 8130.
3.2	Insulation	Extruded PVC compound conforming to type A of IS: 5831.
3.3	Inner Sheath	Extruded PVC compound conforming to type ST1 of IS:5831 for multicore cables. Single core cables shall have no inner sheath.
3.4	Armour	Galvanized single round steel wire for twin and multicore cables.
3.5	Overall Sheath	Extruded FRLS Grade PVC compound conforming to type ST1 of IS : 5831.

SUB-SECTION: E-0215

ILLUMINATION SYSTEM

C O N T E N T S

CLAUSE NO.	**DESCRIPTION**
1.00.00	CODES AND STANDARDS
2.00.00	DESIGN CRITERIA
3.00.00	SPECIFIC REQUIREMENTS
4.00.00	TESTS
ATTACHMENT	
ANNEXURE-A	AVAILABLE POWER SUPPLY
ANNEXURE - B	TYPES OF LIGHTING FIXTURES
ANNEXURE - C	ILLUMINATION LEVEL
ANNEXURE - D	RATINGS AND REQUIREMENTS OF LIGHTING TRANSFORMER
ANNEXURE - E	FITTINGS AND ACCESSORIES OF LIGHTING TRANSFORMER

1.00.00 CODES AND STANDARDS

1.00.01 All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) and IEC except where modified and/or supplemented by this specification.

1.00.02 Equipment and material conforming to any other standards, which ensure equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the tender.

1.00.03 The electrical installation shall meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

1.00.04 Major standards, which shall be followed, are listed below. Other applicable Indian standards even if not covered in the listed standard shall be followed.

a)	IS- 2062	h)	IS-1248	o)	IS-694
b)	IS-10322	i)	IS-2705	p)	IS-1554
c)	IS-8623	j)	IS-4160	q)	IS-9537
d)	IS-6064	k)	IS-2713	r)	IS-14772
e)	IS/IEC 60898	l)	IS-800		
f)	IS-13703	m)	IS/IEC-60947		
g)	IS-2026	n)	IS-2099		

2.00.00 DESIGN CRITERIA

2.01.00 Design Basis

2.01.01 The system provides lighting to all plant areas under scope of this package. In addition, it also provides lighting to selected areas during plant emergency conditions.

2.01.02 The system will be installed in an adverse industrial environment..

2.01.03 The design shall be such as to provide minimum lighting levels as specified for different areas.

2.01.04 The systems shall be suitable for operation on available power supply as described in Annexure-A.

2.01.05 All the lighting fixture shall be energy efficient type.

2.02.00 System Concept

The lighting system shall comprise the following sub-systems:-

2.02.01 Normal A.C. Lighting

This will be provided by A.C. lighting fixtures distributed throughout the plant. These lights will be ON as long as the plant A.C. supply is available.

Normal lighting fixtures will be fed from respective area lighting panels, which in turn will be connected to main lighting distribution board. The main lighting distribution boards will be fed through respective 1:1 ratio lighting transformer, which forms a part of the MLDB. Normal A.C. supply thus made available by the MLDB is 415V, 3ph, 4W, 50Hz effectively grounded. The emergency lighting load shall comprise at least 10% of the normal lighting load. The exact location and distribution of the fixtures shall, however, be finalised by LSTK vendor during detailed engineering stage.

2.02.02 Emergency A.C. Lighting

On failure of normal A.C. supply, emergency A.C. lighting will be provided in selected areas for general visibility, safe movements and operation of important auxiliaries.

Emergency lighting distribution board shall be fed through 1:1 ratio lighting transformer, which form a part of ELDB. The power for A.C. emergency lighting shall be arranged by Bidder from emergency power distribution board. The power supply for emergency lighting shall be 415V, 3ph, 4W, 50HZ, effectively grounded. Emergency power for lighting shall be arranged by contactor from existing substation 710.37. Supply, laying, termination of the above cable shall be under the scope of this package.

2.03.00 Ratings & Requirements

2.03.01 All equipment and accessories shall be designed for continuous operation under site conditions without exceeding permissible temperature rise as stipulated in relevant standards.

2.03.02 Switch, fuses, miniature circuit breakers (MCB), busbars shall be fully rated for short circuit level at the point of application. MCB shall have back-up HRC fuse if its rating is less than the available short circuit current.

2.03.03 All equipment and accessories shall have proper enclosure to suit the site conditions. Hazardous areas shall have flame-proof enclosure.

2.03.04 All wiring from lighting panels to fixtures and receptacles shall be carried out by PVC wires in G.I. Conduits.

2.03.05 Heavy duty AYWY FRLS cables will be used only for connections :

a) From main lighting board to area lighting panels

b) From street/area lighting panel to street light poles/towers.

2.04.00 Method of Calculation

2.04.01 Standard Lumen method shall be adopted for interior & exterior lighting in order to determine the number of lighting fixtures for obtaining the desired average level of illumination.

2.04.02 The coefficient of utilization shall be considered to take care of Lumen loss due to:

a) effect of room dimensions

b) absorption of light in luminaires

c) absorption of light at various room surfaces i.e. ceiling wall etc.

d) floor cavity, ceiling cavity

e) mounting height

2.04.03 A maintenance factor shall also be considered to account for the fall of illumination due to aging, pollution like dust deposit etc. Maintenance factors to be considered for various areas shall be as follows:

Area	Maintenance factor
Control Room	0.75
Switchgear/PMCC Room	0.65
General indoor area	0.60
Dusty area	0.55

2.04.04 Lux levels to be considered for various areas are given in Annexure-B.

2.04.05 Voltage drop at the fixture from the MLDB bus shall not exceed 3%.

2.04.06 Circuit loading of each lighting Panel shall be done in such a way that almost balanced loading in all the three phases is achieved.

2.04.07 At least two sub circuits shall be used for illumination of a particular area.

2.04.04 Sub circuit loading of each lighting panel shall be restricted to 2000 Watts.

2.04.05 Light loss Factor

It is recommended that in interiors with fairly clean atmosphere, for example, offices, air conditioned factory interiors etc., a light loss factor of 0.8, in interiors which are prone to accumulate dust faster, for example, most in industrial interior an LLF of 0.7 and in high dirt prone interiors an LLF of 0.6 may be adopted for calculating the no. of luminaires to be installed for a particular service illuminance.

2.04.06 To achieve the recommended luminance relationship, it is necessary to select the reflectance of all finishes of the room surfaces. The recommended reflectance values for industrial interiors and equipment are given bellow for bidder's guide lines:

Reflectance values

Surface	Reflectance Percentage
Ceiling	80-90
Wall	40-60
Desk and Bench tops, machines And equipment	25-45
Floor	not less than 20

2.04.07 Street/Area Lighting

Time switch and photocell will be used for controlling area/outdoor/coal yard lights with provision for manual override and also have the provision of proven Energy Saving Systems.

2.04.08 Remote Emergency Lighting (As applicable)

This will be provided in isolated building/area/mobile equipment by self-contained battery/ automatic charger/inverter/flood light units. These portable emergency light units will be energized automatically on loss of normal A.C. supply.

3.00.00 SPECIFIC REQUIREMENTS

3.01.00 Equipment and Material

3.01.01 Equipment and material shall comply with description, rating, type and size as detailed in this specification, drawings and annexure.

3.01.02 Equipment and materials furnished shall be complete and operative in all details.

3.01.03 All accessories, control devices, internal wiring, fittings, supports, hangers, anchor bolts etc. which form part of the equipment or which are necessary for safe and satisfactory installation and operation of the equipment shall be furnished.

3.01.04 All parts shall be made accurately to standard gauges so as to facilitate replacement and repair. All corresponding parts of similar equipment shall be interchangeable.

3.02.00 Lighting Fixtures

3.02.01 Lighting fixtures shall be designed for minimum glare. The surface finish shall be smooth, unobtrusive and scratch resistant.

3.02.02 Reflector shall be of sheet steel or aluminium, minimum 20 SWG thick, securely fixed by fastening device of captive type.

3.02.03 Fixture shall be suitable for 20 mm conduit entry and 16 SWG G.I. earth wire connection.

3.02.04 High bay fixtures shall have provision for vibration damper to ensure rated lamp life. Cost of each damper shall be separately indicated.

3.02.05 Fixture shall be furnished complete with lamps and integrally/nonintegrally or separately mounted control gear & accessories as applicable for different types of fixtures. These shall include holders, ballast, capacitor, starter, ignitors etc.

3.02.06 Fixtures shall be fully wired up to respective terminal blocks, suitable for loop-in and loop-out connection of PVC wires of following sizes:

a) Lighting fixture : 2.5 mm^2 Copper

b) Flood Light fixture : 2x2.5 mm^2 Copper

3.03.00 Lamps

3.03.01 General lighting service (GLS) lamps shall be with clear glass and screwed caps.

3.03.02 All fluorescent lamp shall be bi-pin rotary type and either cool daylight or white as per annexure. Lamp holder shall be spring loaded, low contact resistance type and shall have resistance to wear.

3.03.03 Mercury/Sodium vapour lamp shall be colour corrected type with screwed cap.

3.03.04 Lamps shall be suitable for use in position and capable of withstanding small vibrations. Restrictions and special features, if any, shall be clearly indicated in the tender.

3.04.00 Ballast/Electronic Ballast

3.04.01 Ballasts shall be heavy duty, low loss, polyester-filled type with copper winding. CFL and T5 fluorescent tube with electronic ballast or tri-phosphorous tube shall be preferred.

3.04.02 Ballast for Mercury/Sodium vapour lamp shall be provided with suitable tapping to set the voltage within range specified.

3.04.03 Ballasts shall be free from hum. Ballasts, which produce humming sound, shall be replaced, free of cost, by the LSTK vendor.

3.04.04 In multi-lamp fixture, each lamp shall be provided with individual ballast.

3.04.05 Ballast windings shall have maximum operating temperature of 120^{o}C without rated temperature rise marking.

3.04.06 It shall be Flicker-free warm start, ideal for areas with high switching frequency.

3.04.07 Electronic Ballast shall be compact, lightweight, high frequency electronic standard ballast for fluorescent lamps.

3.04.08 Electronic Ballast shall be suitable for 110 V DC and also 240 V AC.

3.04.09 Electronic Ballast shall be of such design that minimum 25% reduction in energy consumption at constant luminous flux compared with conventional gear.

3.04.10 Electronic Ballast shall not be caused to high harmonic distortion.

3.04.11 Electronic Ballast shall provide constant light independent of mains voltage fluctuation.

3.05.00 Lighting Panel/Distribution Boards

3.05.01 Lighting Distribution Boards/panels shall be metal-enclosed, cabinet type, fabricated from CRCA sheet steel minimum 2 mm thick, suitable for either wall/column mounting on brackets or floor mounting on channel sills.

3.05.03 Lighting Distribution Boards and Lighting Panels shall be so constructed as to permit free access to the terminal connections and easy replacement of parts. Front access doors shall have padlocking arrangements.

3.05.04 Lighting Distribution Boards shall have provision of cable entry from bottom and, panels shall have provision of cable entry from top and bottom, as required, with removable gland plates. Necessary double compression type brass cable glands, tinned copper/Aluminium cable lugs are to be furnished.

3.05.05 Two ground terminals shall be provided on opposite sides of each Lighting Distribution Board and Lighting Panel for connection to ground conductor.

3.05.06 Each MLDB and Lighting Panel shall be complete with designation and caution notice plates fixed on front cover and a directory plate fixed on inside of the front cover. This directory plate on the MLDB shall contain details of the Lighting Panels being fed from it including their designation, location, loading etc. The directory plate on the Lighting Panel shall contain details of the points to be controlled by each circuit including the location of the point controlled, rating of the protective units and loading of each circuit.

The plates shall be of anodized aluminium with inscriptions indelibly etched on it.

3.05.07 Bus bar shall be electrolytic grade hard drawn aluminium, colour coded for easy identification and designed for a maximum temperature of 85`C. Minimum size shall be 25 x 6 mm.

3.05.08 Board/Panel shall be fitted with phase barriers such that it is not readily possible for personnel to touch the phase busbars. Insulation barriers shall preferably be fitted around the circuit breakers such that only the surface and the toggle of the circuit breaker is available on the front.

3.05.09 Incoming and outgoing circuits shall be terminated in suitable terminal blocks.

3.06.00 Board/Panel Equipment

3.06.01 Each Distribution Board shall consist of one dry type transformer housed in the cubicle voltmeter with selector switch, C.T. operated ammeter and incoming triple pole switch. Outgoing feeder from the Lighting Distribution Board shall have switch fuse units. Proper discrimination between outgoing fuse of Lighting Distribution Board and downstream MCB of Lighting Panel should be ensured.

3.06.02 Each panel shall have an incoming triple pole switch fuse with neutral link and a number of outgoing miniature circuit breakers (MCB) as per annexure.

3.06.03 Board/Panel access door shall be interlocked with incoming switch such that the door can be opened only when the switch is in OFF position. Means shall be provided to defeat this interlock.

3.06.04 All switches shall be heavy duty, quick-make quick-break type. Fuses shall be HRC link type. Contactors shall be air break electromagnetic type. Push buttons shall be push to individual plug and switch as detailed in the annexure.

3.06.05 MCB shall be suitable for manual closing and opening and also automatic trip on overload and short circuit.

3.06.06 Time switch in street lighting panels shall be clock-switch type with ON-OFF time setting facility which shall ensure respective ON-OFF operation in every 24 hours cycle. Voltmeter/Ammeter shall be of accuracy class 2.0 or better as per IS:1248. Voltmeter/Ammeter selector switch shall be of reputed make.

3.07.00 Receptacles

3.07.01 Receptacles shall be heavy duty, complete with individual plug and switch as detailed in the annexure.

3.07.02 The conduit box of the receptacle shall be provided with earthing screws with washer and nuts welded on the surface for grounding with 16 SWG G.I. wire. Arrangement shall be provided inside the conduit box for grounding of third pin.

3.07.03 Shrouded type plug shall be provided with corresponding matching arrangement at sockets to prevent accidental contact with finger during plug insertion.

3.07.04 63 Ampere three phase four pin receptacles shall be provided at each major plant maintenance area.

3.08.00 Fans & Regulators

3.08.01 The fans shall have three well balanced blades, and shall be reasonably free from noise.

3.08.02 Fan motor shall be totally enclosed type with copper winding and class E insulation.

3.08.03 Regulator shall have minimum five steps. Electronic regulator with smooth control is preferred.

3.09.00 Switch & Switch Board

3.09.01 All switch boards/boxes shall be of bent steel construction, fabricated of 14 SWG M.S. sheet with 6 mm thick bakelite cover with brass fixing screws.

3.09.02 Switch boards/boxes located in control room and office areas shall be flush mounted type on brick wall with only the switch knob projecting outside.

3.09.03 Switch boards/boxes shall have conduit knock outs on the sides. Adequate provision shall be made for ventilation of these boxes.

3.09.04 Flush type receptacles where provided shall be so located that only the plug projects outside.

3.09.05 Switches shall have quick-make and quick-break mechanism operated by a suitable external handle complete with position indicator.

3.10.00 Lighting Poles/Towers

3.10.01 Street Light Poles

a) Street light poles shall be swaged and welded steel pole, complete with fixing brackets, weather-proof junction box and all other accessories.

b) The pole shall be coated with bituminous preservative paint on inside as well as embedded outside surface. Exposed surface shall be coated with two coats of metal primer (comprising red oxide and zinc chromate in synthetic medium).

3.10.02 Flood Light Tower

a) Flood light tower shall be a lattice structure with maintenance platform and approach ladder. All structural members and hardware shall be hot-dip galvanized.

b) Structures shall be designed for an additional load of 1500kg for maintenance crew. Deflection under maximum wind pressure shall not exceed 1 in 360. Structural design shall be as per IS-800 and subject to Owner's approval.

3.10.03 Lighting High Masts (As applicable)

Applicable standards:

The following shall be Reference Standards for loading of the High Mast:

a)	IS-875 (Part-III) 1987	-	Code and practice for design loads for Structures.
b)	IS 2062	-	Grade of M.S. Plates.
c)	IS:9595	-	Welding
d)	IS:2629	-	Galvanizing

Structure :

Lighting High Mast shall be of continuously tapered polygonal cross section, at least 20 sided, hot dip galvanized and presenting a good and pleasuring appearance and shall be based on proven In-Tension design confirming to the standards referred to above, to give an assured performance, and reliable service. The structure shall be suitable for wind loading as per IS-875 Part-III, 1987. The masts dimensions shall be as per standards.

The Mast shall be of 30M/20M height with lantern carriage to enable raising/lowering for ease of maintenance, including the Head Frame, Double Drum Winch, continuous stainless steel wire rope, in built power tool, luminaries, suitable lightning protection for high mast and lantern carriage of fixtures along with necessary power cables within the mast. The mast shall be delivered in three / two sections & shall be joined together by slip stressed fit method at site. No site welding or bolted joints shall be done on the mast.

High mast shall be complete with feeder pillar panel for power distribution to lighting fixtures and winch motor. Feeder pillar panel shall be outdoor type stand mounting with dust and vermin proof, IP 55 and constructed of 14 swg sheet steel.

3.11.00 Maintenance Equipment

3.11.01 For the maintenance of lighting fixtures within the plant buildings, the LSTK vendor shall also supply two (2) nos. free standing adjustable aluminium ladder, adjustable from 5m to 10 m.

3.12.00 Special Requirement

3.12.01 All outdoor illumination fixtures, unless fed from photo cell/time switch controlled lighting panel, have to be provided with outdoor type local switches.

3.12.02 In all the air filtration units and air handling units, one marine type lamp (of 100 Watt approx.) shall be supplied and the wiring & fixing of the same has to be done by the LSTK vendor.

3.13.00 Lighting Cables & Wires

3.13.01 Lighting Cable shall be heavy duty, 650/1100 Volt grade, multicore stranded aluminium conductor, HR PVC insulated, extruded PVC inner sheath, single round G.I. wire armoured and overall PVC sheathed to IS 1554.

3.13.02 Lighting wires shall be 650/1100Volt grade, PVC insulated, stranded conductor, single core cable conforming to IS 694, colour coded as below :

RED	for	R-Phase	BLACK	for	Neutral
YELLOW	for	Y-Phase	WHITE	for	+'Ve D.C.
BLUE	for	B-Phase	GREY	for	-'Ve D.C.

3.13.03 Wire size shall be as follows:

For point wiring beyond lighting panel i.e. from lighting Panel to junction box (main run)	:	10 sq.mm. Aluminium. Stranded conductor
From Junction box to lighting fixture	:	2.5 sq.mm.Copper. Stranded conductor.

3.14.00 Junction Boxes, Conduits and Accessories

3.14.01 Junction box shall be of 16 SWG sheet steel, hot-dip galvanized, dust and damp-proof, generally conforming to IP55.

3.14.02 Junction box shall be complete with gasketted inspection cover, conduit knock out/threaded hub and terminal blocks.

3.14.03 Junction box for outdoor use shall be weather-proof IP55 and those for hazardous location shall be flame-proof type.

3.14.04 Junction box shall have the following indelible markings :

Circuit Nos. on top
Circuit Nos. with ferrules (inside) as per drawing.
'DANGER' sign in case of 415 circuit.

3.14.05 Conduits shall be rigid steel, hot-dip galvanised, furnished in standard length of 3 meters, threaded at both ends.

3.14.06 Conduits up to and including 25 mm shall be of 16 SWG and conduits above 25 mm shall be of 14 SWG. Minimum size of conduits shall be 20 mm.

3.15.00 Nameplate

Nameplates shall be furnished for identification of devices and circuits. All switches, controls and indications shall be permanently and legibly marked in English as to clearly indicate their functions.

All lighting fixtures, receptacles, fans, junction boxes etc. shall be properly marked up indelibly with corresponding circuit numbers.

3.16.00 Samples

Owner reserves the right to call for samples if considered necessary and the same shall be submitted by the Bidder free and without any obligation.

3.17.00 Testing Equipment

3.17.01 The LSTK vendor will provide such checking and testing equipment as test lamp, buzzer, 500 volt meggar, earth meggar, lux-meter etc.

3.17.02 Other testing equipment as required will be arranged by the Owner. Alternatively, the LSTK vendor may be asked to provide the same at a mutually agreed rate.

3.18.00 Installation - General

3.18.01 Installation work shall be carried out in accordance with good engineering practices and also manufacturer's instructions/ recommendations where the same are available.

3.18.02 Equipment shall be installed in a neat workmanlike manner so that it is level, plumb, square and properly aligned and oriented.

3.19.00 Lighting Fixtures

3.19.01 Continuous rows of fluorescent tubes shall be mounted on a continuous M.S. angle for each row of lights.

3.19.02 Fixtures shall be mounted to maintain sufficient clearance from the overhead traveling crane trolley, if there is one.

3.19.03 Bracket for fixture mounting shall be fabricated at site from 40 mm conduits with a reducing socket to suit the fixtures and clamped on to the handrails. The fixing shall be strong enough to withstand vibration and high wind velocity.

If a roof over platform is available, the fixture can be pendant mounted.

3.19.04 Flood lights shall be mounted on steel base facing the tentative direction shown on approved drawings. Fixing holes shall be provided with slot to turn the fixture about 5 Deg on both sides. Bolts shall be finally tightened with spring washer.

Terminal connection to the flood light shall be made through PVC coated flexible conduits.

3.19.05 The fixtures after erection shall be marked up indelibly with corresponding circuit number for easy identification of lamp circuit.

3.20.00 Street Lighting Poles

Erection of Street Lighting poles where included in the scope of the LSTK vendor shall mean complete erection together with all its accessories including civil foundation work, installing lighting fixture, wiring and cabling work.

3.21.00 Flood Lighting Tower

3.21.01 Erection of Flood Lighting Towers where included in the scope shall mean civil foundation work also.

3.21.02 LSTK vendor shall also mount assembled fixtures, outdoor & lockable type isolating switch cubicle, install necessary cabling and wiring and make connections.

3.22.00 Conduit System

3.22.01 In case of unarmored cable, all conduits shall originate from the respective lighting panel and terminate in lighting fixtures, receptacles etc.

3.22.02 Exposed conduits shall be run in straight lines parallel to building columns, beams and walls as far as practicable. Unnecessary bends and crossings shall be avoided to present a neat appearance.

3.22.03 Conduit supports shall be provided at an interval of 750 mm for horizontal runs and 1000 mm for vertical runs.

3.22.04 Conduits shall be clamped on to approved type spacer plates or brackets by saddles or U-bolts. The spacer plates or brackets in turn, shall be fixed to the building steel by welding and to concrete or brick work by grouting as shown on drawings.

Wooden plug inserted in the masonry or concrete for conduit support is not acceptable.

3.22.05 Embedded conduits shall be securely fixed in position to preclude any movement. In fixing embedded conduit, if welding or brazing is used, extreme care should be taken to avoid any injury to the inner surface of the conduit.

3.22.06 Spacing of embedded conduits shall be such as to permit flow of concrete between them and in no case shall be less than 40 mm.

3.22.07 Where conduits are run on cable trays they shall be clamped to supporting steel at an interval of 600 mm.

3.22.08 For directly embedding in soil, the conduits shall be coated with an asphalt - base compound. Concrete pier or anchor shall be provided where necessary to support the conduit rigidly and to hold it in place.

3.22.09 Conduits shall be installed in such a way as to ensure against trouble from trapped condensation.

3.22.10 Running threads shall be avoided as far as practicable. Where it is unavoidable, check nuts shall be used.

3.22.11 Conduits shall be kept, wherever possible, at least 300 mm away from hot pipes, heating device etc. when it is evident that such proximity may impair the service life of cables.

3.22.12 Slip joints shall be provided when conduits cross structural expansion joints or where long run of exposed conduits are installed, so that temperature change will cause no distortion due to expansion or contraction of conduit run.

3.22.13 For long run, junction/pull boxes shall be provided at suitable intervals to facilitate wiring.

3. 22.14 Conduits shall be securely fastened to junction box or cabinets, each with a locknut and insulated bushing inside the box and locknut outside.

3.22.15 Screwed couplers shall join conduit lengths. Couplers shall be clearly cut.

3.22.16 Conduit joints and connections shall be made thoroughly water-tight and rust-proof by application of a thread compound, which will not insulate the joints.

White lead is suitable for application on embedded conduit and red lead for exposed conduit.

3.22.17 The Battery Room installation shall be made with acid fume proof conduits.

3.22.18 Field bends shall have a minimum radius of four (4) times the conduit diameter. All bends shall be free of kinks, indentations or flattened surfaces. Heat shall not be applied in making any conduit bend.

3.22.19 The entire metallic conduit system, whether embedded or exposed, shall be electrically continuous and thoroughly grounded.

3.22.20 Lighting fixture shall not be suspended directly from junction box in the main conduit run.

3.22.21 Conduits and fittings shall be properly protected during construction period against mechanical injury. Conduits ends shall be plugged or capped to prevent entry of foreign material.

3.22.22 After installation the conduits shall be thoroughly cleaned by compressed air before pulling in the wire.

3.22.23 In control rooms and office areas provided with false ceiling conduct run shall be concealed type, embedded in the walls.

3.23.00 Wiring

3.23.01 Wiring shall be generally carried out by PVC wires in conduits. All wires in a conduit shall be drawn simultaneously. No subsequent drawing is permissible.

3.23.02 Wire shall not be pulled through more than two equivalent 90` bends in a single conduit run.

3.23.03 Wiring shall be spliced only at junction boxes with approved type connections or terminal strips. Maximum two wires can be connected to each way of the terminal block. Splicing of only one phase shall be done in a junction box.

3.23.04 For lighting fixtures, connection shall be teed off through suitable round conduit or junction box, so that the connection can be attended without taking down the fixture.

3.23.05 For vertical run of wires in conduit, wires shall be suitably supported by means of wooden/hard rubber plugs at each pull/ junction box.

3.23.06 A.C. and D.C. circuits shall not be run in the same conduit and junction boxes. Circuits fed from different transformers shall be run through different conduits and Junction boxes.

3.23.07 Receptacle circuits shall be kept separate and distinct from lighting and fan circuits.

3.23.08 Separate neutral wire shall be provided for each circuit. Wiring throughout the installation shall be such that there is no break in the neutral wire in form of switch or fuse.

3.24.00 Cabling

3.24.01 In outdoor areas, main runs from lighting panels shall be by means of AYWY cables, directly buried in ground or laid in trenches for the underground portion and through conduit for the over ground portion.

3.24.02 Buried cables shall be laid and covered with sand/riddled earth, and protected from damage by bricks at sides and precast concrete stab at top. Buried cables shall have

cable markers at 50M interval and projecting 150 mm above ground. At cable bends and joints markers shall be provided.

3.24.03 When buried cables cross road/railway track, additional protection to be provided in form of hume/G.I. pipe.

3.25.00 Grounding

3.25.01 All lighting panels, junction boxes, receptacles, fixtures, conduit etc. shall be grounded in compliance with the provision of I.E. Rules.

3.25.02 Ground connections shall be made from nearest available station ground grid. All connections to ground grid shall be done by arc welding.

3.25.03 Panels/Boards shall be directly connected to ground grid by two nos.35 x 6 mm G.I. flats. (for panels)/two nos. 50x6 mm G.I. flats (for distribution boards).

3.25.04 All junction boxes, receptacles, lighting fixtures etc. shall be grounded with 16 SWG G.I. wire.

3.25.05 Each street lighting Pole shall be grounded at two points by two nos. 50x6 mm G.I flat risers from two (2) nos. earthing spike 40 mm dia & 3m long directly driven into ground at a depth of 1m from ground level. The junction box at each lighting pole is grounded at two (2) points from two (2) nos earthing terminals by 16 SWG GI wire. One 16 SWG G.I wire shall be taken up to the junction box from lighting fixtures and connected to grounding point.

3.25.06 Two (2) nos earthing spike 3m long & 40 mm dia directly driven into ground at a depth of 1m from ground level shall be provided for each flood lighting tower.

The sheet steel cubicle housing the power supply Isolator at base of flood lighting tower shall be connected at two (2) points from these earthing risers by 16 SWG G.I. wire - The flood lighting fixtures shall be grounded by one (1) 16 SWG G.I wire running through the lighting conduit up to the distribution box.

Two (2) nos separate spike of 3m long & 40 mm dia directly driven into ground at a depth of one (1) m from ground level shall be provided for connection of the lightning mast on top of flood lighting tower through two (2) nos 50x6 mm G. I. flat down conductor.

3.25.07 A continuous ground conductor of 16 SWG G.I. wire shall be run all along each conduit run and bonded to it every 600 mm by not less than two turns of the same size of wire. This conductor shall be connected to each panel ground bus.

All junction boxes, receptacles, fixtures etc. shall be connected to this 16 SWG ground conductor.

3.26.00 Foundation & Civil Works

3.26.01 Equipment foundations panel foundations and all other civil work will be provided by the LSTK vendor.

3.27.00 Excavation and Back Filling

3.27.01 The LSTK vendor shall perform all excavation and backfilling as required for buried cable and ground connections.

3.27.02 Excavation shall be performed up to the required depth. Such sheeting and shorting shall be done as may be necessary for protection of the work.

3.27.03 The LSTK vendor shall make use of his own arrangements for pumping out any water that may be accumulated in the excavation.

3.27.04 All excavation shall be backfilled to the original level with good consolidation.

3.28.00 Steel Fabrication

3.28.01 All supports, hangers & brackets shall be fabricated by the LSTK vendor. Necessary steel shall be supplied by the LSTK vendor.

3.28.02 Steel for fabrication shall be straightened and cleaned of rust and grease. All fabrication shall be free of sharp edge.

3.29.00 Painting at site

3.29.01 Street light poles shall be given two coats of aluminium paints after installation.

3.29.02 All steel fabrication shall be given two coats of redoxide primer followed by two coats of battleship grey shade 632 of IS-5.

3.29.03 All equipment shall be given touch-up paint as required after installation.

4.00.00 TESTS

4.01.00 Shop Tests

4.01.01 All equipment shall be completely assembled, wired, adjusted and routine tested as per relevant Indian Standards at manufacturer's works.

4.02.00 Site Tests

4.02.01 LSTK vendor shall thoroughly test and meggar all cables, wires and equipment to prove that the same are free from ground and short circuit.

4.02.02 If any ground or short circuit is found, the fault shall be rectified or the cable and/or equipment replaced.

4.02.04 It should be established to the satisfaction of the Owner that illumination in different areas are as per designed lux level.

ANNEXURE A

AVAILABLE POWER SUPPLY

1.0 System Voltage

Lighting equipment and accessories shall be designed for satisfactory operation from the following power supply sources:

1.1	A.C. Supply	:	415 Volt, 3 phase, 50 Hz, 4 wire effectively grounded system.	
			Fault Level 50 kA r.m.s. symmetrical.	
1.2	D.C. Supply	:	110 V, 2 wire, ungrounded system.	
			Fault Level 25* kA	

2.0 Permissible Variation

Equipment and accessories shall be suitable for operation over the entire range of voltage/frequency variations as listed below:

2.1	A.C. Supply	:	Voltage	± 10%
			Frequency	+3% to -3%
			Combined Voltage + Frequency	10% (absolute sum)
	D.C. Supply	:	Voltage 94 to 121 Volt.	

* Indicative only; actual value will be decided by the Bidder after substantiating the same by calculation.

ANNEXURE B

TYPES OF LIGHTING FIXTURES

1.0 LIGHTING FIXTURES & LAMPS

Each lighting fixture shall be furnished complete with associated lamp, holder and control gear fully wired up. Control should include copper ballast, electronic choke, capacitor starter, electronic-igniter (separate type), fuse connector block etc.

Well glass fittings for HPSV lamps higher wattage (250/400 W) floodlight luminaire, the control gear will be separate/non-integral type whereas for high bay, streetlight and mini flood light fixture, the control gear shall be integral type.

SL. NO.	FIXTURE TYPE	FIXTURE NO.	DESCRIPTION	AREA OF USE
1.1	SA	GE GET CI 1X28 C/S HF + Reflector 1X28 (ALM) / eqv.	Surface / pendant mounted with Al reflector commercial / decorative type luminaire suitable for 1 x 28W T5 FL	Swgr room / MCC room / Workshop / Maint. Shop / Office / Toilet / Corridor / Pantry / Stores
1.2	SB	GE GET CI 1X28 C/S HF / eqv.	Surface / pendant mounted without reflector commercial / decorative type luminaire suitable for 1 x 28W T5 FL	Swgr room / MCC room / Workshop / Maint. Shop / Office / Toilet / Corridor / Stairs / Pantry / Stores
1.3	DA	GE GET CI 2X28 C/S HF + Reflector 2X28 (ALM) / eqv.	Surface / pendant mounted with Al reflector commercial / decorative type luminaire suitable for 2 x 28W T5 FL	Swgr room / MCC room / Workshop / Maint. Shop / Office / Toilet / Corridor / Pantry / Stores
1.4	DB	GE GET CI 2X28 C/S HF / eqv.	Surface / pendant mounted without reflector commercial / decorative type luminaire suitable for 2 x 28W T5 FL	Swgr room / MCC room / Workshop / Maint. Shop / Office / Toilet / Corridor / Stairs / Pantry / Stores
1.5	DC	Philips TCS 150 2XTL5-28W MIEBT 228 / eqv.	Decorative, surface / pendant mounted mirror optics luminaire housing made up of CRCA sheet steel, powder coated white, accommodating all electrical accessories pre-wired up to a terminal block suitable for 2 x 28W TL5.	Office rooms / Corridor / Conference Room / Engineer's Room

SL. NO.	FIXTURE TYPE	FIXTURE NO.	DESCRIPTION	AREA OF USE
1.6	DD	Philips TMS 669 M 2XTL5-28W HF D6 / eqv.	Decorative, recess mounted mirror optics luminaire, housing made up of CRCA sheet steel, powder coated white, accommodating all electrical accessories pre-wired up to a terminal block suitable for 2 x 28W TL5.	False Ceiling areas (Control Room / Electronic Eqpt. Room / Office / Conference room / Engineer's Room / Corridor)
1.7	DE	GE MAR228FTL HF / eqv.	Indoor, industrial, corrosion resistant, with diffuser and reflector for lamp, ceiling or suspension mounting luminaire suitable for 2 x 28W T5 FTL.	Battery Room / Area with corrosive atmosphere
1.8	MA	Philips HPK250 1XSON250W E / eqv.	Medium and High bay non integral luminaire with aluminium 215 anodized reflector and toughened glass cover suitable for 1 x 250W HPSV lamp	General Indoor equipment area / Pump House / Workshop
1.9	MB	Philips HPK225 1XSON150W E / eqv.	Medium and High bay integral luminaire with aluminium 215 anodized reflector and toughened glass cover suitable for 1 x 150W HPSV lamp	General Indoor equipment area / Workshop
1.10	MC	Philips HPK225 1XSON250W E / eqv.	Medium and High bay integral luminaire with aluminium 215 anodized reflector and toughened glass cover suitable for 1 x 250W HPSV lamp	General Indoor equipment area
1.11	MD	Philips HPK225 1XSON400W E / eqv.	Medium and High bay integral luminaire with aluminium 215 anodized reflector and toughened glass cover suitable for 1 x 400W HPSV lamp	General Indoor equipment area
1.12	IA	Philips NXC101 1xA60-60W-CL B22 GR/ eqv.	Weatherproof bulkhead luminaire suitable for 1 x 60W GLS lamp.	staircase / exit point

SL. NO.	FIXTURE TYPE	FIXTURE NO.	DESCRIPTION	AREA OF USE
1.13	NA	Philips TRC033 2XTL-D36W IC / eqv.	Road lighting luminaire, Aluminium steel housing, gear tray cum reflector made of CRCA sheet, with acrylic cover suitable for 2X36W TL-D.	Building exterior lighting / Outdoor area lighting / Outdoor eqpt. Area
1.14	TA	Philips SGP 325 1XSON-T 150W FG / eqv.	Street light luminaire with pressure die cast aluminium housing, POT optics reflector and heat resistant toughened flat glass cover (IP 65) with 1 x 150W HPSV lamp - pole mounted	Street lighting / boundary lighting
1.15	TB	Philips SGP 325 1XSON-T 250W FG / eqv.	Street light luminaire with pressure die cast aluminium housing, POT optics reflector and heat resistant toughened flat glass cover (IP 65) with 1 x 250W HPSV lamp - pole mounted	Street lighting / boundary lighting
1.16	CA	Bajaj BJC-111 / eqv.	Surface mounting decorative luminaire with 1 x 11W CFL	Toilet / Wash basin / staircase
1.17	CB	Philips FCS 100 1XPL-C/2P 18W I 240V / eqv.	Surface mounting decorative downlight luminaire, electrochemical brightened reflector with 1 x 18W PL-C	Lobby / Staircase
1.18	CC	Philips FBH 145 M 1XPL-C/2P 18W I 240V / eqv.	Recess, decorative vertical mounting downlighter, high efficiency optics and option of multiple attachment suitable for 1X 13W/18W PL-C	Control Room / Electronic Eqpt. Room / Conference room / Office / Engineer's Room as UPS emergency light
1.19	CD	Philips FBH 145 M 2XPL-C/4P 18W HF 240V LH / eqv.	Recess, decorative vertical mounting downlighter, high efficiency optics and option of multiple attachment suitable for 2X 18W PL-C	Control Room / Electronic Eqpt. Room / Conference room / Office / Engineer's Room as UPS emergency light
1.20	PA	Philips SWF231 1XSON-T 150W A / eqv.	Compact, sturdy, general purpose with integral gear floodlight luminaire suitable for with 1 x 150W HPSV lamp	Area lighting / Yard lighting / Floodlighting purpose

SL. NO.	FIXTURE TYPE	FIXTURE NO.	DESCRIPTION	AREA OF USE
1.21	PB	Philips SWF331 1XSON-T 250W A / eqv.	Compact, sturdy, general purpose with integral gear floodlight luminaire suitable for with 1 x 250W HPSV lamp	Area lighting / Yard lighting / Floodlighting purpose
1.22	PC	Philips RVP302 2XSON-T 250W / eqv.	Compact, sturdy non integral, corrosion resistant with pre anodized aluminium reflector, floodlight luminaire suitable for with 2 x 250W HPSV lamp	Area lighting / Yard lighting / Floodlighting purpose
1.23	PD	Philips RVP302 2XSON-T 400W / eqv.	Compact, sturdy non integral, corrosion resistant with pre anodized aluminium reflector, floodlight luminaire suitable for with 2 x 400W HPSV lamp	Area lighting / Yard lighting / Floodlighting purpose
1.24	BA	Philips SWF231 1XMHN-TD 150W A / eqv.	Compact, sturdy, general purpose with integral gear floodlight luminaire suitable for with 1 x 150W metal halide lamp	Area lighting / Yard lighting / Floodlighting purpose
1.25	BB	Philips SWF331 1XMHN-TD 250W A / eqv.	Compact, sturdy, general purpose with integral gear floodlight luminaire suitable for with 1 x 250W metal halide lamp	Area lighting / Yard lighting / Floodlighting purpose
1.26	BC	Philips RVP302 2XMHN-TD 250W / eqv.	Compact, sturdy non integral, corrosion resistant with pre anodized aluminium reflector, floodlight luminaire suitable for with 2 x 250W metal halide lamp	Area lighting / Yard lighting / Floodlighting purpose
1.27	BD	Philips RVP302 2XMHN-TD 400W / eqv.	Compact, sturdy non integral, corrosion resistant with pre anodized aluminium reflector, floodlight luminaire suitable for with 2 x 400W metal halide lamp	Area lighting / Yard lighting / Floodlighting purpose

SL. NO.	FIXTURE TYPE	FIXTURE NO.	DESCRIPTION	AREA OF USE
1.28	EX	Philips (Exit Lamp) / eqv.	Escape lighting luminaire with "EXIT" sign fitted with 1x20 FLT. Each luminaire shall be self contained 6 volt battery, battery charger unit. Normally the luminaire shall be ON continuously through 240V AC supply. When AC supply goes OFF the in built battery & inverter system automatically takes on to ignite luminaire for duration of two & half (2½) hours. The battery shall be maintenance free and shall be trickle charged when 240 V AC mains supply is available.	Control Room / Electronic Eqpt. Room / Conference room / Office / Engineer's Room as UPS
1.29	FA	GE Evolve™ LED Outdoor Family IBERIA / eqv.	Die-cast aluminium housing, decorative luminaire using LED technology with symmetric and asymmetric light distribution, IP 65 rated for optical assembly with high brightness LED- pole mounted.	Street lighting / boundary lighting

2.0 LIGHTING BOARD/PANEL

Sl.No.	Type	Description
2.1	MLDB	415V A.C. Indoor type Lighting distribution board with transformer (details in Annexure-C), 415V, 200A, 3 ph, 4 wire bus, one 200A triple pole switch as incomer, 8 Nos. 100A, TP & N switch and fuse as outgoing feeders
2.2	ELDB	Emergency Lighting Distribution Board (Description same as that for MLDB above, except the incoming AC supply shall come from a DG source)
2.3	LP-1	415V A.C. Indoor type Lighting Panel with 415V, 100A, 3 ph, 4 wire bus, one (1) no. 100A TP & N switch as incomer, 18 nos. 20A, 240V, 1 pole M.C.B.s as outgoing feeders.

2.4	LP-2	415V A.C. Indoor Lighting panel with 415V, 3ph, 4W bus & one 63A TP & N Switch as incomer and 12 nos 20A 240V 1 pole MCB as outgoing feeder,
2.5	LP-3	415V A.C. Indoor type Lighting Panel with 415V, 63 A, 3 ph, 4 wire bus, one (1) no. 32 A TP & N switch as incomer, 6 nos. 20A, 240V, 1 pole M.C.B.s as outgoing feeders.
2.6	LP-4	Emergency lighting panel with description same as LP-3 but the incoming feed shall come from ELDB in place of MLDB.
2.7	LP-5	Same as LP-4 but suitable for outdoor application.
2.8	SLP	415V A.C. Outdoor type Panel with 415V, 100A, 3 ph, 4 wire bus, one 100A TP & N switch as incomer, 18 nos. 20A, 240V, 1 pole M.C.B.s as outgoing feeders. The lighting panel shall be provided with 63A contactor, frequency compensated timer switch, photo-cell switch push bottoms for automatic control of street/ area lighting with provision for manual override.
2.9	FLP	Outdoor, lockable type Isolating switch of 415V, 32A, 3 ph, 4 wire TP & N. With 2mm sheet steel/cast iron cubicle.

3.0 RECEPTACLE

Sl.No.	Type	Description
3.1	RA	5A, 240V, 2 poles, 3 pin with third pin earthed, suitable for flush mounting in office areas and control room. The switch shall be also flush mounted piano type.
3.2	RB	15A, 240V, 2 pole, 3 pin with third pin earthed, wall/column mounted, metal clad gasketed construction, 20mm conduit entry, screwed metal cover tied to it by a metal chain, weatherproof suitable for indoor/outdoor installation.
3.3	RC	63A, 415V, 3 phase, 4 pin interlocked plug and switch with earthing contact, wall/column mounted, metal clad gasketed construction, weatherproof, suitable for loop-in/loop-out connection of 4/C-35 Sq.mm. AYWY cable. These shall be fed from AC Distribution Board/Station PMCC.

4.0 CEILING FANS

Sl.No.	Type	Description
4.1	FA	1200 mm sweep ceiling fan with regulator, down rod and canopy.
4.2	FB	1400 mm sweep ceiling fan with regulator, down rod and canopy

5.0 LIGHTING POLES/TOWER

Sl.No.	Type	Description
5.1	TA/TB	Single arm/double arm swaged and welded steel pole with junction box and all accessories.
5.2	TC	30 m high lattice steel tower complete with maintenance platform, approach ladder, junction/pull boxes and all accessories.

6.0 SWITCH BOARDS

Sl.No.	Type	Description
6.1	S-1	Switch board with 1-5A switch.
6.2	S-2	Switch board with 3-5A switch and 1-5A receptacle.
6.3	S-3	Switch board with 6-5A switch and 1-5A receptacle.

7.0 MISCELLANEOUS ITEMS

Sl.No.	Type	Description
7.1	M1	10 m high car wheel mounted aluminium ladder- 1 set.
7.2	M2	Adjustable free-standing aluminium ladder height adjustable from 5 m to 10 m – I set
7.3	M3	Portable Emergency light set complete with one 20W tube light, battery, battery charger and all other accessories to be located at the top of all doors and rolling shutters : Lots

ANNEXURE C
ILLUMINATION LEVEL

1.0

a)	Transfer Point, Conveyor Gallery	:	70 Lux
b)	Switch gear Room	:	300 Lux
c)	Corridors, Walkways, Staircase	:	70 Lux
d)	Control Room with false cealing	:	300 Lux
e)	Transformer Room	:	200 Lux
f)	Toilets/ passage	:	50 Lux
g)	Battery Room	:	200 Lux
h)	Unloading Area	:	50 Lux
i)	Street Lighting	:	20 Lux
j)	office area	:	300 Lux
k)	Cable spreader room		70 Lux
l)	Compressor room		150 Lux
m)	Control room/swgr. Room (emergency lighting)		50 Lux

k) Emergency Lighting : Beside the above, at least One no. (1) emergency fixture shall be provided at entry, exit and each landing of stair cases, platforms of Electrical Substation Buildings, Control Rooms, TPs, maintenance area , unloading area, etc.

ANNEXURE D

RATINGS AND REQUIREMENTS OF LIGHTING TRANSFORMER

Type	:	VPI with insulation
KVA rating	:	As required…
Voltage rating	:	415 V/415 V
Cooling	:	AN
P.U. Impedance	:	0.04 ± 10% (indicative)
Voltage control	:	Off load tap switch/link with change of ± 5% in step of 2.5% tapping full capacity.
Vector Group	:	Dyn11
Class of Insulation	:	F (155°C)
Maximum Temperature rise over 50°C. ambient in winding by resistance	:	90°C
Neutral	:	Solidly grounded.

The secondary neutral of the transformer shall be brought out for getting a grounded 4wire supply. Each transformer shall be routine tested and one transformer shall be type tested in accordance with relevant standard.

The transformer shall be liable for rejection if the tolerance on the quoted values of losses, impedance, temperature rise, etc. exceeds the specified values of relevant standard.

The transformer shall be mounted inside sheet steel enclosure, which shall be an integral part of Lighting Distribution Board.

ANNXURE E

FITTINGS AND ACCESSORIES OF LIGHTING TRANSFORMER

The transformer shall be equipped with fittings and accessories as listed below:

1. 150 mm dia. winding temperature indicator with maximum reading pointer and electrically separate sets of contacts for trip and alarm.
2. Handling and lifting lugs both for enclosure and core-coil assembly.
3. Jacking pad for core-coil assembly.
4. Inspection cover for cable and box.
5. Door handle operated safety limit switch with 1NO + 1NC contact.
6. Ground bus.
7. IP-55 junction box.
8. Rating and terminal marking plates.

Note

All indication, alarm, trip contacts provided shall be rated for 0.5A at 110 V D.C. and 5A at 240 V A.C.

SUB-SECTION: E-0014

VVVF DRIVES

C O N T E N T S

CLAUSE NO.	DESCRIPTION
1.00.00	CODES AND STANDARDS
2.00.00	EQUIPMENT DESCRIPTION
3.00.00	DESIGN CRITERIA AND PERFORMANCE REQUIREMENTS
4.00.00	CONTROL REQUIREMENT
5.00.00	PANEL CONSTRUCTION
6.00.00	COOLING
7.00.00	EQUIPMENT/COMPONENT SPECIFICATION
8.00.00	PROTECTION, CONTROL, METERING, INDICATION AND ANNUNCIATION
9.00.00	OPERATOR CONTROL PANEL
10.00.00	FAULT DIAGNOSTIC
11.00.00	EXTERNAL POWER SUPPLY FOR AUXILIARY AND CONTROL CIRCUIT
12.00.00	RELIABILITY FEATURES
13.00.00	MAINTENANCE FEATURES
14.00.00	PAINTING
15.00.00	TESTS
16.00.00	SPARES
17.00.00	SPECIAL TOOLS & TACKLES
18.00.00	TRAINING
ATTACHMENT	
ANNEXURE - A	EQUIPMENT DATA SHEET

1.00.00 CODES AND STANDARDS

1.01.00 All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable IS/IEC except where modified and/or supplemented by this specification.

1.02.00 Equipment and materials conforming to any other standard which ensures equal or better quality may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the tender.

1.03.00 Major standards, which shall be followed, are listed below. Other applicable standards even if not covered in the listed standard shall be followed.

IS/IEC 61800	IS 14700	IEEE 519
IS/IEC 60034	IS 17123	IS 2026
IS 8130	IS/IEC 60529	IS 12063
IS 9046	IS 5553	IS 11171
IS 5553	IS 16539	IEC 61378

2.00.00 EQUIPMENT DESCRIPTION

The LSTK vendor shall be responsible for providing the complete solution for the VFD system which shall include the following components but not limited to :-

a) Isolation/converter transformer.
b) Converter (at least 12 pulse).
c) Inverter.
d) Harmonic filters, if reqd.
e) All associated controls and protective devices.
f) Enclosure for rectifier/inverter and associated controls.

Each medium voltage (MV) isolation/converter transformer will be supplied from a dedicated circuit breaker in a 11,000 volt switchgear.

3.00.00 DESIGN CRITERIA AND PERFORMANCE REQUIREMENTS

3.01.00 The system shall be energy efficient, designed as standard product and shall provide very high reliability, high power factor, low harmonic distortion and low vibration/ wear/ noise.

3.02.00 The system shall be designed to deliver the motor input current and torque for the complete speed torque characteristics of the required HT motor as per driven equipment specification with input supply variation of $\pm$10% and frequency variation of $\pm$3%. It shall be capable of withstanding the thermal and dynamic stresses and the transient mechanical torque, resulting from short circuit.

3.03.00 Each VFD will be of sufficient capacity and will produce a quality output waveform for stepless motor control from 10 to 100 percent of base speed. Each VFD will be suitable for either constant torque (CT) or variable torque (VT) loads as required by

the driven equipment. To facilitate checkout and maintenance, each VFD will be capable of sustained operation at the minimum speed (10 percent of base speed). In addition, each VFD system will be capable of operation while disconnected from the associated motor.

3.04.00 For CT loads (conveyors), each VFD will be capable of a momentary overload of 150 percent of rated motor current for 1 minute out of any 10 minute period. When the load type dictates, each VFD will be capable of producing full rated torque at any speed in the operating range.

3.05.00 If high breakaway/starting torque is required by the driven load, each VFD will provide full rated torque at standstill and will be capable of sustaining that level of torque indefinitely. Each VFD will be designed such that it will not supply fault current to the utility system.

3.06.00 The drive controller shall be equipped with microprocessor based digital regulator with programmable functions. The power control regulator logic shall provide for an acceleration/deceleration current limit curve and shall be capable of field be separately programmable from 0.1 to 20 seconds.

3.07.00 The Total Harmonic Distortion (THD) of the voltage and current at inverter output shall be as per IS/IEC 61800-4 and it shall be considered in the design of the motor.

3.08.00 Harmonics at the supply side of the drive system at primary of the main input transformer shall be restricted within the maximum allowable levels of current and voltage distortion as per recommendations in the latest edition of IEEE-519.

3.09.00 During operation, the system shall be capable of developing sufficient torque under all load condition to respond to a 20% alteration in speed set point within a time limit up to 60 seconds

3.10.00 The integrator action of the speed set point alteration shall be independently adjustable for both an upward and downward alteration. The minimum time interval between set point adjustments by the distributed control system shall be considered as 10 second.

3.11.00 The drive shall trip incase the speed exceeds 105% of the maximum operational speed or reduces to 95% of the minimum operational speed for more than 10 second.

3.12.00 The maximum allowable audible noise level from a VFD system will be 85 dB(A) at a distance of 1 m at any speed or load condition. The VFD systems with an audible noise level in excess of this limit will be provided with sufficient noise abatement treatment to reduce the sound pressure level below 85 dB(A).

3.13.00 Variable frequency drive shall be arranged so that it can be operated in a circuit mode, disconnected from the motor for startup adjustment and troubleshooting / maintenance.

3.14.00 VFD speed regulation will be ±0.5 percent without encoder or tachometer feedback.

3.15.00 Each VFD system will maintain a minimum true power factor of 95 percent when operating within 10 percent to 100 percent of rated speed. The VFD systems, including power factor correction and/or harmonic filters, will never have a leading

power factor while operating from the utility source. When a power factor correction unit is used, it will include a separate input isolating contactor with fuses, power factor correction grade capacitors (voltage class will be consistent with each VFD system's input voltage), and series harmonic decoupling reactors, all integrated into the VFD system and mounted within each VFD enclosure.

3.16.00 The failure of any power switching device [silicon controlled rectifier (SCR), gate turn-off thyristor, diode, IGBT, integrated commutated thyristor, etc.] or switching device control will not result in a process trip and will allow for continued operation of each VFD system. In the event of a device or device control failure, a VFD will annunciate and identify the specific location of the failed device and allow for continued operation until such time that repairs can be scheduled.

3.17.00 Each VFD system will be capable of continuous operation in the event of a power loss of five cycles or less.

3.18.00 Each VFD system will be capable of continuous operation with 30 percent voltage sag on the input power line.

3.19.00 Each VFD system will be able to catch and take control of a load if started while the rotating equipment (including the motor) is already spinning. Appropriate safeguards will be included in this operation to prevent damaging torque(s), voltages, or currents from impacting any of the equipment. Options will be provided for enabling or disabling this feature.

3.20.00 Each VFD system will be capable of automatically restarting in the event of an undervoltage trip, process trip or drive trip. The VFD control system will include the ability to enable or disable the automatic restart feature and to set the allowable restart time for some (but not necessarily all) conditions as appropriate for the specific application.

3.21.00 In the event of a ground fault, a VFD system will be capable of annunciating the ground fault condition and executing a trip or safely continuing to operate. The response to a ground fault will be Owner selectable. If a VFD system is tripped in response to a ground fault, the VFD system will be capable of normal operation after the fault condition has been corrected and the trip reset. The VFD system will be designed such that no risk of fire or electric shock exists during the ground fault condition.

3.22.00 All internal firing signals and other communications that link operational controls with power components (such as status and diagnostic signals) will meet noise immunity and safety requirements as defined by the applicable IS, IEC and IEEE standards.

3.23.00 Guaranteed minimum total VFD system efficiency will be as follows:

i) 96 percent at 100 percent speed and 100 percent load.
ii) 95 percent at 80 percent speed and 50 percent load.

4.00.00 CONTROL REQUIREMENT

4.01.00 The system shall operate on constant V/f supply with required voltage boost capability in low frequency mode of operation.

4.02.00 Short time voltage dip up to 20% of nominal voltage (e.g. in case of a large motor start up connected to the same bus as VFD) shall not cause the control system to stop functioning and shall not trip the drive system.

4.03.00 The system shall also be equipped with a facility which will restart the system in case of voltage dip over 20% or power interrupter for less than 2 seconds, with recovery of the voltage to its normal value. The drive shall have the facility to block this feature, if required by operator. Upon restart the converter shall be capable of synchronizing onto a rotating motor and develop full acceleration torque within 10 seconds.

4.04.00 The power controller shall be controlled to always start the motor in the forward direction. Logic shall be provided to prevent the motor from being started in the reverse direction.

4.05.00 The drive motor shall be speed controlled corresponding to 4-20mA or 0-10V reference input signal. Unless otherwise specified, upon complete loss of the users speed reference signal, the drive shall automatically run at constant speed as at 8-100% of the last speed reference available prior to the loss of signal.

4.06.00 It shall be possible to vary the speed of the drive in either manual or auto mode.

Auto/manual selection shall be from VFD panel unless otherwise specified.

- With the selector switch in “manual” mode, the operator shall be able to set the speed through keypad, mounted on front of the drive panel or from speed increase/decrease push buttons from the field. Motor operated potentiometer shall be provided as a speed set point device.

- With selector switch in “auto” mode, speed of the motor shall be controlled from a 4-20mA signal, from owner’s PLC/DCS system. Necessary equipment like protocol converter as required for interfacing with PLC/DCS shall also be provided in the drive panel.

4.07.00 The required provision for the interface with remote PLC/DCS located at control room shall be either through hardwired connection (with potential free contacts and transducers as described elsewhere in this specification).

4.08.00 Drive system shall have provision for interface with upper level automation such as substation monitoring system or electrical control system.

4.09.00 The closed loop control feedback for the drive system having output transformer shall be tapped from the secondary side of the output transformer.

5.00.00 PANEL CONSTRUCTION

5.01.00 The panel shall include suitable semi conducting power devices (Diodes/IGBT/IGCT). modules with protective devices, reactors (if required), filters (if required), control circuit, control accessories, indication and annunciation etc. The construction of the

panel shall provide effective protection against electromagnetic radiation and shall meet design requirement of integrated standards.

5.02.00 Upstream breaker "ON/OFF/TRIP" indications and remote breaker closing and trip push button shall be provided on the front door.

5.03.00 Safety Interlock shall be provided so that power cabinet can't be opened unlessthe upstream breaker is disconnected, safety-grounding switch is closed and DC link capacitor is discharged. Power source breaker can only be closed once the earthing switch is open and panel door is closed with lock defeat facility.

5.04.00 Duplicate control supply with automatic changeover shall be provided. Protection shall be provided against AC/DC transients, voltage surge etc. of power and control device.

5.05.00 The drive shall be housed in sheet steel panels fabricated with 2mm thick cold rolled sheet steel. The panel shall be suitable for indoor installation, if not otherwise specified. The panel shall be free standing with degree of enclosure protection as IP-42. The maximum operating height shall be 1800mm approximately.

5.06.00 Bolted un-drilled gland plate shall be provided at bottom. Clamp type terminals shall be used for connection of all wires up to $10mm^2$ and terminal for higher sizes shall be bolted type suitable for cable lugs. Minimum space for power cable termination shall be 600mm clear from bottom of the cable gland plate.

5.07.00 Bus bars shall be of electrolytic copper, color coded separately for AC and DC system. All the live parts shall be sleeved/shrouded to ensure complete safety to personnel intending to carry out routine inspection by opening the panel doors. All the equipment inside the panel and on the doors shall be provided with suitable nameplate.

5.08.00 All the switches, component and accessories which are essential for normal and emergency operation shall be mounted on the door and shall be operable externally. All the analog instruments, where provided, shall be switchboard type, back connected; 72x72mm.Scale shall have red mark indicating maximum permissible operating rating.

5.09.00 Each panel shall be provided with illuminating lamp/11W CFL with switch and fuse. 6/16A, 250V power socket with switch and fuse shall be provided. Each panel shall have space heater with switch fuse and variable setting thermostat.

5.10.00 Copper earth bus of min. 50x6 mm size shall be provided in the panel with provision for connection to Owner 's plant earth grid. All the non-metallic components/parts shall be connected to the main earth bus bar. Separate earth bus bar and stud for electronic control system as required shall be provided.

5.11.00 All the metal parts shall be treated so as to ensure efficient anti-corrosive protection. Hard wares shall be zinc passivated or electro-galvanized. Panel enclosure and structure supports shall be thoroughly cleaned and degreased to remove mill scale and rust etc.

External surface shall be painted Siemens grey (RAL - 7032) with two coats of synthetic enamel paint.

5.12.00 All panels shall be of same height so as to form a uniform line-up, to give good aesthetic appearance.

5.13.00 All the control wiring shall be enclosed in plastic/metal channel. Each wire shall be identified at both ends by self-sticking wire marker tapes of PVC ferrules. Power and control wiring inside the panel shall be done with BIS approved, PVC insulated, fire retardant, copper conductor wire. 1.5mm2 size wire shall normally be used provided the control fuse rating is 10 Amps or less and 2.5mm2 size for control fuse rating above 16A for electrical circuits and 0.7 mm2 for electronic circuits. All wires shall be ferruled and terminals shall be properly numbered, minimum 20% spare terminal shall be provided.

5.14.00 All electronic modules and components shall be accessible from front of panel only. Modular assemblies for both the system control electronic equipment and power electronic equipments shall be used.

5.15.00 All low voltage compartment and cabling shall be electrically and physically separated from the high voltage compartment.

5.16.00 DC link capacitor and pre charging and discharging circuit shall be preferably mounted in the rear of the panel.

5.17.00 Suitable removable type hooks shall be provided for lifting the panel.

5.18.00 Perspex type transparent insulating material shall be used for covering live compartments.

5.19.00 Drive keypad, operator control panel required for control, monitoring and measurements shall be supplied and installed outside the panel on the front door. It shall be accessible for operation without opening the front door and shall be non-removable type.

5.20.00 All the equipment shall be complete with cable glands, lugs etc. and cable glands shall be single or double compression type for indoor and outdoor equipment respectively.

6.00.00 COOLING

6.01.00 The drive panel shall be naturally cooled type as per manufacturer's standards. If unavoidable, forced type cooling system shall be provided. Cooling system shall include well-dimensioned panel, adequate cooling airflow path, module cooling fan and if necessary, panel-cooling fan shall be considered. LSTK vendor shall ensure that the panel dimensions and the flow paths have been designed for continuous running at the specified ambient without overheating. For fan cooled drives, redundant ventilating fans (N+1) shall be provided.

6.02.00 Necessary starters shall be provided within the VFD panels for the ventilation fans, any other auxiliary motor etc. The system provided shall be interfaced with drive starting and shut down such that safety interlocks such as start permit from cooling system to drive and trip signal from cooling system to drive in case of cooling system failure etc., shall be incorporated in the overall sequence logic.

6.03.00 MCB for motor space heater, auxiliary power supply if required for local panel, drive panel space etc. shall be included and mounted in easy accessible location.

6.04.00 If dry type transformers are supplied inside the VFD enclosure, the cooling units will be located separate from the VFD enclosure. The cooling system will be filled following installation of the VFD system. The heat exchangers will be 100 percent redundant, or the design of the cooling systems will allow for one heat exchanger and associated equipment to cool both VFDs (within a VFD enclosure) while the other is isolated and repaired. The cooling system liquid flow path will consist of two circuits: one internal circuit where ionized water is used and one external circuit utilizing propylene glycol to allow operation in below freezing ambient conditions. Ethylene glycol is not an acceptable alternative due to environmental and hazardous material concerns. Each VFD cooling system will maintain the system coolant within a safe minimum and safe maximum temperature to avoid thermal shock and/or condensation.

7.00.00 EQUIPMENT/COMPONENT SPECIFICATION

7.01.00 Motor

a) The motor shall be suitable for operation with a solid-state power supply consisting of an adjustable frequency inverter for speed control.

b) The motor shall be suitable for the current waveforms produced by the power supply including the harmonics generated by the drive.

c) The Motor shall be designed to operate continuously at any speed over the range 10-100 % of rated speed.

d) The permitted voltage variation should take into account the steady state voltage drop across the AC drive and all other system components upstream of the motor.

e) Motors required to be transferred to DOL, by-pass mode shall be rated for specified variations in system line voltage and frequency. Starting current of motor in DOL, bypass mode shall be limited to value in motor specifications.

f) The motor shall be constructed to withstand torque pulsations resulting from harmonics generated by the solid-state power supply.

g) The motor insulation shall be designed to accept the applied voltage waveform, within the Vpeak and dv/dt limits as per IS/IEC-61800-4.

h) The drive manufacturer shall be solely responsible for proper selection of the motor for the given load application and the output characteristics of the drive.

Other details shall be as given in the sub section-0101 of specification for Electric motors.

7.02.00 POWER TRANSFORMER

Each VFD system will be supplied with a drive converter/isolation transformer to provide common mode voltage protection and phase shifting.

If an outdoor oil-filled transformer is used, the transformer design will be a rectifier grade isolation type having a cast coil primary and secondary winding with a K Factor as in accordance with applicable standard.

The transformer will be designed for a maximum temperature rise of 55° C (top oil and average winding) over an ambient temperarture of 50° C. A sudden pressure protection relay will be provided. Control cabinets will be IP 54.

If an indoor dry type transformer is used, the transformer design will be a rectifier grade isolation type. Transformer design will be an epoxy sealed (VPE – vapor pressure impregnated and encapsulated) dry type construction, three-phase, 50 hertz, mounted on a ventilated enclosure suitable for mounting indoors. Control cabinets will be IP 52.

The transformer will be rated for an average temperature rise not to exceed 70° C at full nameplate rating above 40° C average, 50° C maximum ambient.

The transformer will be supplied with electrostatic shield, electronic temperature monitoring with alarm and trip contracts, auxiliary terminal box, distribution class surge arrester, and vibration dampers.

The information listed below will be provided in addition to the normal rating plate data in accordance with applicable standard.

Type of transformer (for example; converter supply transformer, converter output autotransformer, etc.) as description of the function of the transformer in the VFD.

Number of phases on input and output. Alternatively, the number of three-phase windings on input and output of the transformer.
Rated frequency range, if variable.
Rated voltage range, if variable.
Connection symbol or phase offsets listed in degrees.

Other details shall be as given in the sub section-E-0008 of specification for LV Transformer.

7.03.00 POWER CONVERTER

a. The static power shall consist of a line side power converter for operation as a rectifier and a load side power converter for operation as a

fully controlled inverter. Power converter shall be fast switching, most efficient and low loss type.

b. Adequate short circuit and over voltage protection shall be provided for the converter and inverter system.

c. All power converter devices shall include protective devices, snubber networks and dv/dt networks as required.

d. The current rating of the converter's semi-conductor components shall not be less than 120% of the nominal current flowing through the elements at full load of the VFD through the whole speed range.

e. All power diodes shall be of silicon type with minimum V_{bo} rating as 2.5 times the rated operating voltage.

f. The power converter circuit shall be designed so that motor can be powered at its full nameplate rating continuously without exceeding its rated temperature rise due to harmonic currents generated by the inverter operation.

g. The conversion devices and associated heat sinks shall be assembled such that individual devices can be replaced without requiring the use of any special precautions/tools.

h. The cooling system of the electronic components, if provided, shall be monitored and necessary alarms shall be provided to prevent any consequential damage to the power control devices.

i. Offered system shall also take in account the distance between drive panel and motor and system shall include all material and accessories to make system suitable for a distance of 1500M approx.

7.04.00 DC LINK REACTOR

a. Smoothing reactors for the DC link shall be designed to sufficiently decouple the rectifier and inverter portion of the converter and to limit fault currents in this circuit.

b. Unless otherwise specified, the reactor shall be dry type, air cored, air-cooled or fan cooled type located within the panel.

c. Reactor shall be suitable for withstanding earth fault continuously and for operation with the non-sinusoidal current wave shapes and DC components under all operational conditions of the system without exceeding its temperature limits.

d. Noise level shall not exceed value specified in NEMA TR-1

7.05.00 OUTPUT FILTER

VFD output current waveform should be inherently sinusoidal at all speeds, with harmonic limits as specified in this specification. Output filter shall be provided if required. Output filter capacitors shall be provided with discharge circuits to ensure that all residual stored charge is reduced to less than 50 V DC within 300 seconds after a loss of AC voltage. All capacitor shall be maintenance free and

self-healing type. The VFD system shall inherently protect motor from high voltage dv/dt stress, independent of cable length to motor. Output filter shall be an integral part of the VFD system and included within the VFD enclosure.

7.06.00 BYPASS FEATURE

a. Bypass breaker / contactor-HRC fuse complete with protection, annunciation and metering shall be provided.

b. All Variable frequency drives (VFD) having bypass feature shall have motor protection relay along with necessary control and metering etc. Switching scheme shall be such that in case of drive mal-operation, the motor could be taken on bypass control manually, while the drive could be attended by opening its isolation devices.

c. Safety interlock between inverter and bypass breaker/contactor shall be provided such that closing of healthy device is inhibited in case of external fault.

7.07.00 CT/PT/METERS

As required for the system offered and shall be suitable for variable frequency operation.

7.08.00 LOCAL MOTOR CONTROL STATION

a. The local motor control station is to be installed in the field near the motor. Components and accessories that are required in the local motor control station may be mounted on the local field mounted panel envisaged for the driven equipment.

b. Meters in the local control station shall be suitable for 4-20mA transducer outputs and shall be calibrated for the actual motor current. Further, the drives with bypass facility, the meters shall be capable of reading bypass full load and starting currents, as well as the drive current.

7.09.00 Input Power Terminations

Input and output power connections will be made to isolated, supported, and plated bus strap connections. Sufficient space will be provided for termination connections from the top or the bottom of each VFD cubicle. Space provisions will be provided for application of standard stress cones, and provisions will be provided for grounding of shielded cabling. An access door to the back of the VFD will be provided to facilitate medium voltage cable pulling.

7.10.00 Switchgear

Each VFD input section will contain a suitably rated load break disconnect switch with fuses (anti-single phasing protection will be provided) interlocked with the door. This switch will isolate a VFD for maintenance and service while the fuses provide input circuit protection for the entire system. For safety, blade position will be visible through the door. The disconnect switch will be

integrated into each VFD system so as to appear as a single integrated package. This switch will consist of dead front, completely metal enclosed vertical sections containing load interrupter switches and fuses. The door will be interlocked with the switch so that (a) the switch must be opened before the door can be opened and (b) the door must be closed before the switch can be closed. There will be a provision for padlocking the switch in either the open or closed position. The switch will have permanent "open" and "closed" switch position indicators. The switch will have a quick-make, quick-break mechanism providing full-load current interrupting capability and will have fuses that are permanently calibrated to provide short-circuit detecting and interrupting capabilities. A heavy-duty coil spring will provide the opening and closing energy. The speed of opening and closing the switch will be independent of the operator. Switch blades will be designed such that full clearance is maintained until the switch mechanism goes over toggle. There will not be any possibility of the blades arriving at an intermediate position. Insulating barriers will separate each phase and between the outer phases and the enclosure. All switches will comply with IEC 60265 and IS 9920.

8.00.00 PROTECTION, CONTROL, METERING, INDICATION AND ANNUNCIATION

8.01.00 The system LSTK vendor shall provide all the necessary system control, protection; alarm equipment and metering for the entire drive system and its auxiliary equipment.

8.02.00 Automatic sequence control shall include start-up of cooling system, auxiliary system of the motor, interlock checking, automatic start and run-up of drive, planned and emergency shutdown. The same shall be processed through microprocessor-based system.

8.03.00 PROTECTIVE FEATURES

The system offered shall incorporate adequate features, properly coordinated for the drive control and for motor but not limited to the following:

i. Incoming line surge protection.

ii. Under / Over voltage protection.

iii. Phase loss, phase reversal protection.

iv. Programmable Over current Protection and under load protection.

v. Inverter fault.

vi. Over frequency operation.

vii. Ventilation loss.

viii. Over temperature of equipment.

ix. Over speed of motor.

x. Specific motor protection, including motor winding, bearing temperatures, over current, Overload, negative phase sequence, locked rotor, differential and earth fault protections etc.

xi. System Earth fault protection.

xii. Over and under frequency, rotor earth fault, field failure protection for synchronous motor.

xiii. Additional protection for drive system.

8.04.00 CONTROL

The following controls shall be provided as a part of the operators control Panel or through separate switches.

i. Start/Stop

ii. Speed Control (Raise/lower)

iii. Auto/Manual/Test mode

iv. Local/Remote

v. Emergency Stop

vi. Start/Stop for by pass starter (where specified)

vii. Trip-Remote Breaker

viii Sequential switching of filters

8.05.00 METERING

Power quality metering will be installed in each VFD system to continuously monitor and display input and output power quality. The power quality data will include the following:

a. Input voltage [average root mean square (rms) value].

b. Input current (individual phase rms values and average rms value).

c. Input frequency.

d. Power factor.

e. Input (kW, kvar).

f. Input (kWh).

g. Input current total harmonic distortion (THD) (average of three phases).

h. Single harmonic calculation in input voltage or current (Phase A, B, or C).

i. Drive efficiency.

j. Motor voltage (rms).

k. Motor current (rms).

l. Motor speed (in rpm or percent).

m. Motor flux (percent).

n. Motor torque (percent).

o. Drive output power (kW).

p. Output (kWh).

8.06.00 INDICATION

LSTK vendor shall provide indications as required for normal operation and for easy maintenance, which shall be limited to the following indications.

i. Motor running

ii. Motor stopped

iii. VFD System Fault

iv. System ready to start

v. AC mains ON

vi. Motor over speed

vii. Rectifier output 'ON'

viii. Motor zero speed

ix. Rectifier breaker trip

Above indications may be provided as a part of the operator control panel, i.e., door mounted keypad or through hardwired indicating lamps/LEDS.

Potential free contacts of items i-iv shall be wired separately for remote indications in PLC/DCS system.

Necessary transducer shall be provided with 4-20mA output for indicating motor speed and motor current in PLC/DCS unless otherwise specified for other parameters.

8.07.00 AUDIO-VISUAL ANNUNCIATIONS

a. The system shall incorporate audio-visual annunciations for protection, for various fault conditions, for the Drive motor, Supply cables, DC Reactor and the Converter, output transformer etc.

b. Alarms shall also be included for the failure of various auxiliaries together with identifications of the failing unit, loss of cooling system, various protections devices provided for converter transformer etc.

c. Audio-visual window annunciations shall be provided on the front of the panel. All annunciations as required for normal and satisfactorily operation of the drive system shall be included as per LSTK vendor standards. These

annunciations can be part of operator console panel or separately mounted type.

d. LSTK vendor shall include audio-visual alarm as required for normal operations and maintenance of the system but not limited to the following.

1. Rectifier fuse failure
2. Main AC failure
3. Inverter fuse failure
4. Inverter overload
5. Inverter high temperature
6. Cooling system failure
7. Motor failed to start
8. Transformer failure
9. Battery monitoring healthiness
10. Communication and measurement system unhealthy
11. Motor temperature high
12. Harmonic filters monitoring

Common potential free contacts shall be provided for above annunciations and these shall be wired up to terminal block for Owner's use for remote alarm and monitoring.

9.00.00 OPERATOR CONTROL PANEL

a. Each drive shall be equipped with a front mounted operator control panel consisting of a backlit alphanumeric display and a keypad with keys for parameterization and adjusting parameter which shall be limited to Start/Stop, Local/Remote, Auto/Manual, Increase/Decrease, menu navigation and protection and measurement parameter selection, etc.

b. All parameter names, fault messages, warnings and other information shall be displayed in complete English words or standard English abbreviations to allow the user to understand what is being displayed without the use of a manual or cross-reference table. This shall also be used for the modification of all electrical values, configuration parameters, drive menu parameters, application and activity function access, faults, local control, adjustment storage, self test and diagnostics. Keypad shall be operable with password for changing the protection setting, safety interlock etc. However the parameters such as measurements, setting, and mode of drive etc. shall be allowed to be viewed without any password.

c. Operator console shall have facility / port to connect external hardware such as Lap-Top etc. Console shall have facility for upload and download of all parameter settings from one drive to another identical drive for start up and operation.

d. Drive system control also have facility to receive tripping signal from up stream breaker for tripping and also provision for closing upstream breaker after all required process parameters are achieved.

e. User-friendly software for operation and fault diagnostic shall be loaded in the drive system panel before commissioning.

10.00.00 FAULT DIAGNOSTIC

Fault diagnostic shall be built into the system to supervise the operation and failure of the system. The information regarding failure of any of the system including shut down of the system shall be available for a period of minimum 4 days (96 hours) after a shut down even though no supply would be available to the system. The system may be totally de-energized for maintenance or otherwise. It shall be possible to retrieve the record of events prior to tripping of the system or de-energisation. Auxiliary supply to the system components or to the electronics (firmware) for the diagnostics / display shall be taken care by the manufacturer for this purpose.

11.00.00 EXTERNAL POWER SUPPLY FOR AUXILIARY AND CONTROL CIRCUIT

Auxiliary power supply for devices external to VFD module, space heater supply for Motor, VFD panel space heater, auxiliary power supply for transformers, cubicle 11W CFL lamps etc. shall operate on 240 volts single phase AC provided by the owner .

All control circuit shall operate at maximum voltage of 240V AC

LSTK vendor shall include supply of all control transformers, protective devices, required accessories etc. and any other control supply voltage as required for the system shall be derived from the power supply made available by other.

12.00.00 RELIABILITY FEATURES

The expected lifetime of the drive system shall be 25 years. The system including all individual components forming part of the system shall have a minimum MTBF of 4 years.

13.00.00 MAINTENANCE FEATURES

The controller design shall incorporate the following maintenance features:

- Modular construction
- All components shall be easily accessible

Standard diagnostics to aid maintenance personnel. These shall include LED or alphanumeric displays, test or measurement points.

14.00.00 PAINTING

14.01.00 All metal surfaces shall be thoroughly cleaned and de-greased to remove mill scale, rust, grease and dirt. Fabricated structures shall be pickled and then rinsed to remove any trace of acid. The under-surface shall be prepared by applying a coat of phosphate paint and a coat of yellow zinc chromate primer. The under-surface shall be made free from all imperfections before undertaking the finishing coat.

14.02.00 After preparation of the under surface, the panel shall be provided with epoxy based powder coating. Panel finish shall be free from imperfections like pinholes, orange peels, runoff painted.

14.03.00 All unpainted steel parts shall be zinc passivated, cadmium plated or suitably treated to prevent rust and corrosion. If these parts are moving elements, then these shall be greased.

14.04.00 Final paint shade shall be Siemens grey (RAL - 7032).

15.00.00 TESTS

15.01.00 All equipment and components shall be completely assembled, wired, adjusted and tested at the factory as per applicable IEC and IS codes and according with ISO certified test procedures.

15.02.00 The tests shall include but not necessarily limited to the following :

Tests
Component tests.
Burn-in test.
Visual inspection.
Wiring and equipment test.
Insulation test.
Power circuit test.
Control and auxiliary supply circuit test.
Hardware protective trip test.
Load test.

Complete diagnostics and logic will be tested. The complete power conversion circuit will be thoroughly tested at 100 percent load for a minimum of 1 hour and then tested for 1 minute at momentary overload rating, to reduce potential problems in advance of final system testing. The load test will consist of a 3 hour test sequence with test motor load at varying levels, to ensure enhanced reliability and shorter commissioning time is achieved. The factory tests will be performed with a 1,500 horsepower motor.

In addition, system harmonic performance tests and efficiency measurements will be performed at the jobsite. A test report of the final test results will be submitted.

15.03.00 VFD Isolation Transformer Tests

The following standard (routine) tests will be made on each transformer. All tests will be made in accordance with the latest revision of test codes in IS 2026, 16539 where applicable:

Resistance measurements of all windings on the rated voltage connection of each unit and at the tap extremes of one unit only of a given rating on an order.

Ratio tests on the rated voltage connection and on all tap connections.

Polarity and phase-relation tests on the rated voltage connections.

No load loss and excitation current at rated voltage on the rated voltage connection.

Impedance and load loss at rated current on the rated voltage connection of each unit and on the tap extremes of one unit only of a given rating on an order.

Applied potential tests.

Induced potential tests.

Insulation resistance test (megger).

Insulation power factor test.

15.04.00 Test Certificate

15.04.01 Certified reports of all the tests carried out at the works shall be furnished in six (6) copies for approval of the Owner.

15.04.02 The equipment shall be despatched from works only after receipt of Owner's written approval of the test reports.

15.04.03 Type test certificate on any equipment, if so desired by the Owner, shall be furnished. Otherwise the equipment shall have to be type tested, free of charge, to prove the design.

16.00.00 SPARES

The Bidder shall submit a list of recommended spare parts for two (2) years satisfactory & trouble free operation, indicating the itemised price of each item of the spares

17.00.00 SPECIAL TOOLS & TACKLES

Special tools & tackles required for VFD system shall be supplied along with equipment. A CD of software along with necessary hardware shall be supplied.

18.00.00 TRAINING

Training session for Owner's personnel at VFD manufacturer's works & at project site shall be arranged by supplier.

ANNEXURE-A

EQUIPMENT DATA SHEET

Medium Voltage Variable Frequency Drives Specification Sheet

Technical Requirements	
Rated capacity, hp each VFD system	To be decided by Bidder
Quantity	3 Sets **
Application	Variable / constant torque as required by the driven equipment.
Nominal input voltage, volts	690V
Nominal frequency, hertz	50
Enclosure	As indicated elsewhere in this document
Ambient temperature, °C	50°C (max)
Maximum wind speed (for VFD enclosure design), km/h	3.6
Altitude, m	Less than 1000
Speed range	10 to 100 percent
Minimum continuous speed	10 percent
Accessories	As per VFD requirement
Preliminary Motor Specifications **Note: Motor data is preliminary. Actual data shall be as designed by LSTK vendor .**	
Mounting	By Bidder
Machine type	Squirrel-cage induction
Enclosure	TEFC, IP-54 for indoor, IP-55 for outdoor
Insulation	Class F; sealed with abrasion resistant coating on stator winding
Temperature rise	Class B
Standards	IEC/IS
Duty	Continuous
Rated output, hp (kW)	By Bidder
Service factor	1.0
Voltage, volts/frequency/phase	690V, 50Hz, three-phase
Speed, rpm	By Bidder
Current, amps	By Bidder
Efficiency, min. (full load)	By Bidder
Power factor, min. (full load)	By Bidder

Technical Requirements	
Starting voltage range	80 percent minimum to 110 percent maximum (nameplate)
Starting capability	VFD
Running capability	VFD
Bearings	Split sleeve
Bearing lubrication	Oil rings, self-lubricated, self-cooled
Temperature detectors	Minimum one per bearing (PT 100 3 wire), and two per winding (Pt100 3 wire)
Vibration detectors	Two per bearing (X and Y)
Terminal box	Size for two conductor sizes larger than normal; stress relief terminations
Space heater	Yes
Tests	Test procedures will be in accordance with IS and IEC
Operating torque	90 percent of full-load torque at 85 percent of rated voltage and 92 percent of rated frequency for a period of 10 minutes without injury. Breakaway, run-up/pull-up, and pull-out/breakdown torque will at all times be at least 10 percent higher than the load-torque of the driven machine, at minimum specified starting voltage. Unless specified otherwise, motor torque in percent full-load torque at rated voltage and frequency will be not less than 200 breakdown, 85 pull-up, and 90 locked rotor.
Motor shaft	Solid, direct coupled
Motor safe stall time	Motor safe stall time at minimum starting voltage will not be less than motor acceleration time at minimum starting voltage plus 2 seconds

** Indicative only. Shall be decided during detailed engineering as per mechanical system finalization.

SUB-SECTION: E-0111

ERECTION OF ELECTRICAL EQUIPMENT, CABLING, GROUNDING AND LIGHTNING PROTECTION SYSTEM

C O N T E N T S

CLAUSE NO.	DESCRIPTION
PART-I	ERECTION OF ELECTRICAL EQUIPMENT
1.00.00	SCOPE OF WORK
2.00.00	SCOPE OF SUPPLY
3.00.00	TESTS
4.00.00	DRAWINGS, DATA AND MANUALS
PART-II	CABLING, GROUNDING AND LIGHTNING PROTECTION SYSTEM
1.00.00	SCOPE OF WORK
2.00.00	SCOPE OF SUPPLY & SERVICES
3.00.00	GENERAL REQUIREMENTS
4.00.00	DESIGN CRITERIA
5.00.00	SPECIFIC REQUIREMENTS - SUPPLY
6.00.00	METHODS AND WORKMANSHIP
7.00.00	INSTALLATION
8.00.00	TESTS
9.00.00	DRAWINGS, DATA & MANUALS
ATTACHMENT	
ANNEXURE - A	SCHEDULE OF PRE-COMMISSIONING TESTS
ANNEXURE-B	DETAILS FOR CABLE TRAYS, FITTINGS & ACCESSORIES
ANNEXURE-C	DETAILS FOR FIRE-PROOF CABLE PENETRATION SEALING SYSTEM

PART-I

ERECTION OF ELECTRICAL EQUIPMENT

1.00.00 SCOPE OF WORK

1.01.00 The scope of work shall cover complete and efficient erection, testing and commissioning and putting into successful commercial operation of all Outdoor and Indoor electrical equipment supplied under this Package.

1.02.00 The scope of work shall also include all civil and structural works necessary for successful installation and commercial operation of all electrical equipment to be erected under this specification.

2.00.00 SCOPE OF SUPPLY

2.01.01 The work involves timely procurement and transportation to site in properly packed condition of all hardware, materials and miscellaneous items required to complete the erection job under this specification.

Miscellaneous steel structures, tray supports, hangers & brackets for cable trays, mounting of local panels, push button stations etc. shall be supplied. Any material or accessory, which may not have been specifically mentioned but which is usual and/or necessary shall be supplied.

2.01.02 All hardware, materials and accessories to be supplied by the Bidder shall be brand new ones of reputed make.

2.01.03 Spare Parts

2.01.04 All relevant drawings, data sheet and technical leaflets on each piece of devices.

2.02.00 Scope of Services

The work includes but is not limited to the followings:

2.02.01 Furnishing of all erection tools and tackles, testing equipment, implements, supplies, consumables and hardware for timely and efficient execution of the erection work. Hydraulic jacks or motorized jacks necessary for lifting of heavy equipment shall be provided by the LSTK vendor.

2.02.02 Transport vehicles necessary for efficient transportation of equipment from Owner's stores to site of erection and excess materials back to owner's stores.

2.02.03 Complete assembly, erection and connection, testing and commissioning, putting into successful and satisfactory commercial operations of the Outdoor and indoor Electrical Equipment and accessories listed below but not limited to:

a) L.T. Transformers
b) Lighting Transformers
c) 11kV switchgear

d) 415 V Power cum motor control centres, A.C/D.C Distribution boards, Main lighting distribution boards and miscellaneous items
e) 415 V Busduct
f) Battery and Battery Chargers
g) VVVF Drives
h) Local control Board, Local isolating switch units etc.
i) Illumination system
j) All electrical equipment and systems integral with mechanical equipment, systems and subsystems.

2.02.04 The entire erection work shall be carried out in a phased manner. A schedule of the work showing the sequence of erection shall be submitted by the bidder for this purpose.

2.02.05 The erection schedule, as approved by the Owner's Engineer shall be strictly followed by the LSTK vendor. If, for any reason beyond the control of the LSTK vendor, the work is held-up then the LSTK vendor shall bring it to the notice of the Owner's Engineer without any delay.

2.02.06 All erection work of equipment shall be carried out in a neat and efficient way so as not to impair their normal functioning in any way.

2.02.07 The pre-commissioning checks as well as commissioning of different equipment shall be carried out as per guidance of actual manufacturer's supervisor and or as per written instructions in Erection manuals. In case of any site related problem in commissioning activities, LSTK vendor shall seek advice of owner's Engineers.

2.02.08 All erection work under this specification shall be carried out strictly in accordance with the approved drawings.

2.02.09 In order to avoid concentration of stresses, all sharp edges of clamps, connectors etc. shall be rounded off.

2.03.00 Methods and Workmanship

2.03.01 All work shall be installed in a first class, neat workmanlike manner by mechanics/electricians skilled in the trade involved.

2.03.02 The erection work shall be supervised by competent supervisors holding relevant supervisory license from the Government.

2.03.03 All details on installation shall be electrically and mechanically correct.

2.03.04 The installation shall be carried out in such a manner as to preserve access to other equipment installed.

2.04.00 Consumables and Hardware

2.04.01 The LSTK vendor shall furnish all erection materials, hardware and consumables required for the completion of the installation.

2.04.02 The materials shall include but not be limited to the following :

a) Consumables : Welding rods & gas, oil and grease, cleaning fluids, paints, electrical tape, soldering materials etc.

b) Hardware : Bolts, nuts, washers, screws, brackets, supports, clamps, hangers, saddles, cleats, sills, shims etc.

c) Materials : Junction boxes, terminal blocks, connectors, ferrules, lugs, brass glands, rigid/flexible conduits, cables, ground wires etc.

2.04.03 Supply of cement, sand, stone etc. required for the execution of the contract shall be the responsibility of the LSTK vendor.

2.05.00 Testing Equipment

2.05.01 The major testing equipment that are required to be provided by the LSTK vendor are listed below :

a) Insulation Tester:
   i) Power Operated Megger -1 kV and 10 kV Grade
   ii) Hand Operated Megger – 1 kV Grade

b) Hand driven Earth Resistance Meggar, range 0 - 1/3/30 Ohms.

c) High Potential Testing Set - roller mounted type for LV, HV & EHV equipment

d) Tong testers of suitable ranges

e) Contact resistance measuring set for Micro-ohms.

f) Torque wrench of various sizes

g) Multi-meters, test lamp, field telephone with buzzer set, spirit level, different gauges etc.

h) Insulating oil testing set of range 0 - 60 kV.

i) Stream line filter for transformer.

j) Current Transformer for primary injection set

k) Relay testing and checking bench

2.05.02 Other test equipment as required will be arranged by the LSTK vendor.

2.06.00 Installation - General

2.06.01 Installation work shall be carried out in accordance with good engineering practices and also manufacturer's instructions/ recommendations where the same are available.

2.06.02 Equipment shall be installed in a neat workmanlike manner so that it is level, plumb, square and properly aligned and oriented.

2.06.03 All erection work shall be carried out in strict compliance with manufacturer's instructions and shall include all necessary adjustments, checks and measurements.

2.06.04 All internal wiring of the equipment which has been left incomplete because of shipping split or which requires minor modifications shall be carried out by the LSTK vendor.

2.06.05 The LSTK vendor shall record results of all erection tests and measurements. The LSTK vendor shall submit copies of those test results to the Owner for his reference and record.

2.06.06 High voltage test of transformer oil shall be carried out taking samples from individual transformer and also from each insulating oil drum. If the result of di-electric test is not to the satisfaction of the Engineer, oil filtration, heat run and conditioning shall be carried out for the concerned transformer to improve the dielectric strength of oil and insulation to the acceptable value.

2.06.07 The storage and installation of transformer with all its accessories shall be carried out in strict compliance with manufacturer's instructions. Extreme care shall be taken to avoid ingress of moisture and foreign particles into the transformer tank.

2.07.00 Steel Fabrication

2.07.01 All racks, supports, hangers and brackets wherever necessary shall be fabricated by the LSTK vendor.

2.07.02 Steel for fabrication shall be straightened and cleaned of rust and grease. All fabrication shall be free of sharp edges.

2.08.00 Painting

2.08.01 The LSTK vendor shall paint all racks, supports and miscellaneous steel fabrication with two (2) coats of red oxide primer and two (2) coats of synthetic enamel paint of approved shade (say battle ship grey IS shade # 632).

2.09.00 Foundation & Civil Works

2.09.01 Equipment foundations, equipment mounting structure foundation, panel foundations and other civil work will be provided by the LSTK vendor.

2.09.02 The LSTK vendor shall check these foundations before commencement of erection to ensure their suitability.

2.09.03 All final adjustment of foundation levels, chipping and dressing of foundation surfaces, setting and grouting of anchor bolts, sills, inserts and fastening devices shall be carried out by the LSTK vendor including minor modification of civil work as may be required for erection.

2.10.00 Cleaning up of Work Site

2.10.01 The LSTK vendor shall, from time to time, remove all rubbish resulting from execution of his work. No materials shall be stored or placed on passage or drive ways.

2.10.02 Upon completion of work, the LSTK vendor shall remove all rubbish, tools, scaffoldings, temporary structures and surplus materials etc. to leave the premises clean and fit for use.

3.00.00 TESTS

3.01.00 Site Tests

3.01.01 LSTK vendor shall thoroughly test and meggar all cables, wires and equipment to prove the same are free from ground and short circuit after erection and installation at site.

3.01.02 If any ground or short circuit is found, the fault shall be rectified or the cable and/or equipment replaced.

3.01.03 All equipment shall be demonstrated to operate in accordance with the requirements of this specification.

3.01.04 All equipment shall be subject to High Potential test.

3.01.05 All protective relays shall be checked for correctness of operations.

3.01.06 All current transformers shall be subjected to Primary Injection test.

3.02.00 Pre-commissioning Tests at Site

3.02.01 The installation of different type of equipment and accessory shall be tested by the LSTK vendor after completion of his erection work with an advance notice to the Engineer concerned so that he may witness the same also.

3.02.02 The test result of any installation or equipment or its parts, if considered unsatisfactory to the Engineer, the concerned installation/equipment and its accessories shall be properly rectified and tested again to the satisfaction of the Engineer by the LSTK vendor at his own cost.

3.02.03 The site tests to be carried out by the LSTK vendor on completion of installation/erection of equipment are broadly listed in Annexure-A for ready reference by LSTK vendor.

3.02.04 The major testing equipment which will be necessary for carrying out pre-commissioning tests at site are already listed in this specification.

4.00.00 DRAWINGS, DATA AND MANUALS

4.01.00 To be submitted with the Tender

4.01.01 Make, type and catalogue number of different equipment and accessories along with technical leaflets, data sheet curves etc.

4.01.02 Type test certificates.

4.02.00 To be submitted after Award of Contract

4.02.01 Dimensional drawings and data sheets for different equipment supplied under this specification.

4.02.02 Technical leaflets and data sheet on each piece of equipment/device.

PART-II

CABLING, GROUNDING AND LIGHTNING PROTECTION SYSTEM

1.00.00 SCOPE OF WORK

1.01.00 The scope of work covers complete and efficient design, supply, erection, testing and commissioning of cabling, electrical grounding and lightning protection system for the package.

2.00.00 SCOPE OF SUPPLY & SERVICES

2.01.00 Scope of Supply

Scope of supply shall include but not be limited to the followings

2.01.01 Transportation to site in properly packed condition of all materials and miscellaneous items required to complete the erection work under this specification.

2.01.02 These materials and miscellaneous items shall include but not be limited to the following :

a) Galvanized steel rigid/flexible conduits and accessories, ferrules, lugs, glands, terminal blocks, galvanized sheet steel junction boxes, cable fixing clamps, nuts & bolts, etc. as required.

b) Cable trays, Fittings and Accessories

c) Cable termination and jointing kits as necessary.

d) All necessary erection materials, consumables and sundry items including arc welding rods to complete the installation for satisfactory and trouble free operation.

e) Mild steel rods for main ground mat, grounding electrode, column & structure grounding, risers etc.,

Mild steel rod for vertical air terminals,

Materials for electronic grounding,

Galvanized steel flats for horizontal air terminals, for down conductors and for large equipment grounding

Galvanized wire (8SWG) for small equipment grounding.

f) Fire-proof cable penetration sealing system,

g) Fire retardant cable coating system.

h) Any item of works or erection materials which have not been specifically mentioned but are necessary to complete the work of Cabling, Grounding and Lightning Protection Systems shall be deemed to be included in the scope of this specification and shall be furnished by the LSTK vendor without any extra charge to the Owner.

2.02.00 Scope of Services

The scope of Cabling, Grounding and Lightning Protection Systems includes but is not limited to the following:

2.02.01 Furnishing of all erection tools and tackles, testing equipment, implements, supplies, hardware and transport for timely and efficient execution of the erection work.

2.02.02 Erection work shall be performed with respect to all the equipment/materials mentioned under 'Scope of Supply'.

2.02.03 Erection work shall also be performed with respect to the following items:

a) Cable trays and accessories

a) Power cables

b) Cables laid directly buried in ground

c) Control, instrument and special cables

3.00.00 GENERAL REQUIREMENTS

3.01.00 Codes and Standards

The electrical installation shall meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

3.02.00 Erection Schedule

3.02.01 The Bidder shall agree to adhere to the Owner's Erection Schedule if such a schedule is attached with the Specification. Alternatively, in case the target completion dates alone are indicated, the Bidder shall furnish detailed erection schedules (starting from zero date) with separate 'S' curves for Cabling, Grounding and Lightning Protection works.

3.02.02 The erection schedule, as approved by the Owner/Consultants shall be strictly followed by the LSTK vendor. If the work is held-up for any reason, attributable to him or not, the same shall be brought immediately to the notice of the Owner's Engineer.

4.00.00 DESIGN CRITERIA

4.01.00 Grounding System

4.01.01 Grounding work shall be carried out in compliance to the following standards/codes. All standards, specifications and codes of practice (COP) referred to herein shall be the latest editions including all amendments and revisions as on the date of opening of tender. In case of conflict between the specification and those standards/codes referred to herein, the former shall prevail:

a)	Indian Electricity rules	
b)	National Electrical Code	
c)	Recommended practice for hot-dip galvanizing of iron and steel	IS 2629
d)	Method of testing uniformity of coating on zinc coated articles	IS 2633
e)	COP for earthing	IS 3043
f)	Methods for determination of mass of zinc coating on zinc coated iron and steel articles	IS 6745
g)	IEEE guide for safety in AC substation grounding	IEEE 80
h)	IEEE recommended practice for grounding of industrial and commercial power systems	IEEE 142
i)	IEEE recommended practice for determining the electric power station ground potential rise and induced voltage from a power fault	IEEE 367
j)	IEEE guide for instrumentation and control equipment grounding in generating stations	IEEE 1050

4.01.02 Basic design criteria are delineated below

a) The station grounding system shall be an interconnected network of MS conductor and MS ground rods. The system shall (a) provide safety to personnel from contact of dangerous potential caused by ground fault, (b) ensure sufficient grounding current for effective relaying and (c) stabilize circuit potential with respect to ground.

b) The station grounding system shall be designed in compliance with the IEEE- 80/ IEEE- 665 considering fault current of 50kA for 1 sec. and shall be subject to approval of the Owner.

c) Actual soil resistivity measurement shall be carried out at proposed site during dry season for new units.

d) The surface resistivity shall be considered as 3000 Ohm-meter for gravel and 1000 Ohm-meter for concrete.

e) Major items of equipment, such as switchgear, transformer, motor, relay panels and control panels etc. shall have integral ground buses or connection points which shall be connected to the underground grid.

f) Electronic panels and equipment, where required, shall be grounded utilizing an insulated ground wire connected in accordance with the manufacturer's recommendations. Where practical, electronics ground loops shall be avoided. Where this is not practical, isolation transformers shall be furnished. All indoor and outdoor electrical equipment and associated non-current carrying system, metal works, support structures, buildings columns, fence, neutrals, masts, arrestors, etc. shall be connected to the plant ground system.

g) Instrumentation cable screens shall be single point bonded to the instrument earth network to minimize the effects of electrical interference.

h) For Signal/case/intrinsically safe signal, grounding of control room instruments, separate earth pit not connected to main ground grid shall be used. Control cabinets shall be connected to this separate earth pit.

i) A grounding conductor (steel wire armour in case of cables with outer sheath) shall be routed parallel to all power conductors operating above 240 volts.

j) All ground wires installed in conduits shall be uninsulated.

k) Embedded grounding grid made of GI flat at basement/grade slab as well as upper floor/suspended slabs shall be provided.

l) In addition mild steel ground pads at different locations i.e. on wall/floor/ceiling inside the buildings/tunnels/trenches shall be provided. These pads will be in turn connected to below ground level earth mat through galvanized steel flat or riser. Each ground pad shall have provision for connection of at least two GI flats.

m) Treated earth pit shall be provided for system earthing at locations where transformer neutrals are grounded. Two pits shall be provided for each neutral.

n) Dedicated treated earth pit shall be provided for lightning protection system.

o) Clean earthing for instrumentation shall be provided with dedicated earthing system and separate treated earth pits below the main control room etc.

p) Connection between the equipment earth lead and the grid conductor shall be welded. For rust protection, the welds shall be treated with zinc chromate primer and coated with zinc rich paint.

In order to meet the above design criteria, ground grid mesh will be provided for the main switchgear room, transformer area, auxiliary buildings, etc.

All electrical equipment, non-current carrying metal parts, structures, building steel, lightning protection system, transformer neutrals will be connected to this station ground grid.

4.01.03 Other major design aspects that are to be considered for grounding system are given below:

1. Ground Grid Conductor
   i) Ground grid conductor of mild steel rod shall be used.
   ii) The minimum conductor section is determined on the basis of ground fault current. This section is then increased by an allowance to account for the soil corrosion loss of 0.3 mm per year over the design life of 30 years. However, the minimum size shall be 1x40 mm dia mild steel conductor.

2. Underground Grid

i) The ground grid mesh is designed to keep the touch and step voltages within safe limits as per recommendation of IEEE 80 & IEEE665.
ii) The ground grid conductors will be buried in earth at a minimum depth of 1000 mm. The length of ground conductors below earth will be sufficient to ensure a ground resistance less than 1 ohm.
iii) The ground grid conductor will be so laid as to provide short and direct connection to building steel and major electrical equipment.
iv) Ground rods shall be provided at the points where system neutrals/lightning protections are connected to the ground grid.
v) All ground grid conductor connections will be welded type.
vi) Main Plant ground grid shall be connected with the other auxiliary building /area ground grid at least at two (2) points.
vii) For test pits, the electrode will be 100 mm dia. Heavy duty C.I. pipe with perforations. Electrodes installed in test pits will have disconnecting facilities

3. Above-ground Connections

i) Galvanized steel flats shall be used for all connections above earth.
ii) Inside building, ground conductors will be run for each floor supported on building steel and/or cable trays. These ground conductors in turn will be connected to the station ground grid through riser (at least two) coming up along building columns/cable shafts.
iii) Two separate and distinct ground connections will be provided for each electrical equipment in compliance with I.E. Rules.
iv) All connections above ground will be welded type except connection to equipment/structures which shall be bolted type.

4. Equipment Ground Lead

Equipment ground connections will be sized to carry the available ground fault current. Considerations shall also be given to mechanical ruggedness of the connections and to limit the number of sizes.

5. Electronic Equipment Grounding

i) Internal ground connection of electronic panels shall be insulated from the enclosure, frame, chassis and to be terminated to an insulated ground bus.

ii) Insulated ground bus of all electronic panels shall be connected by insulated wire to an insulated common electronic ground bar.

iii) All connection made above shall be in the form of a radial distribution system without any parallel ground paths.

iv) Electronic equipment's and systems, metal enclosures of all electronic panels shall be connected to a grounding system with

which is isolated and separate from the electrical equipment grounding system.

4.01.04 The minimum conductor sizes for connection of various equipment and structures shall be as given in the attached Notes and Details for Grounding & Lightning Protection Systems.

4.01.05 Entire erection of grounding work shall be carried out in such a way as to be capable of withstanding the intended services of carrying full short circuit level currents to ground mat without any damage/deformation.

4.02.00 Lightning Protection System

4.02.01 Lightning protection work shall be carried out in compliance to the following standards/codes. All standards, specifications and codes of practice (COP) referred to herein shall be the latest editions including all amendments and revisions as on the date of opening of tender. In case of conflict between the specification and those standards/codes referred to herein, the former shall prevail:

a)	Indian Electricity rules	
b)	National Electrical Code	
c)	COP for the protection of building and allied structures against lightning	IS 2309
d)	Recommended practice for hot-dip galvanizing of iron and steel	IS 2629
e)	Method of testing uniformity of coating on zinc coated articles	IS 2633
f)	Methods for determination of mass of zinc coating on zinc coated iron and steel articles	IS 6745
g)	IEEE guide for instrumentation and control equipment grounding in generating stations	IEEE 1050

4.02.02 Basic design criteria are delineated below:

a) The main purposes of the lightning protection system shall be (a) to provide protection to structures from lightning strokes and (b) to provide a low resistance-conducting path to lightning discharge.

b) Lightning protection shall be provided for switchgear room, other auxiliary building, and other structures.

c) Lightning protection will also be provided for building/ structures where the overall rise factor exceeds 10^{-6} as per IS: 2309.

d) For metal structures which are electrically continuous down to the ground level, no lightning protection is required except adequate grounding connections.

4.02.03 Other major design aspects that are to be considered for grounding system are given below:

a) Air termination network with down conductors and earthling electrodes will be provided on the basis of IS Code of Practice.

b) Vertical air terminals shall be of 20mm die galvanized steel rod on the structure/building.

c) Horizontal air termination of 75x10 mm GS flat conductor on the roof of the installation shall be so laid out that no part of the roof will be more than 9 meters from the nearest conductor.

d) Shielding angle for one vertical air termination shall be 45 degrees. For more than one rod, shielding angle between the rods shall be taken as 60 Degrees.

e) Down conductors of 75x10 mm GS Flat for all installations except for conveyor gallery will run along the outer surfaces of the building and shall have a test joint about 1500 mm above ground. It shall be 25x3 mm GS flat for conveyor gallery.

f) An earth electrode of size 40 mm. diameter 3 meter long MS will be provided at the connection point of the down conductor with the station ground.

g) All connections will be of welded type.

h) Risers (for Lightning protection) shall be of 1x40 (minimum) mm dia. MS rod from underground mat to minimum 300 mm above grade level/concrete floor level.

i) All other ancillary items in connection with the work described above shall be furnished to complete the work irrespective of whether such items may have been specifically mentioned or not.

4.02.04 All materials and accessories to be supplied by the Bidder shall be brand new ones of reputed make.

4.02.05 Necessary drawings, data sheets and Technical leaflets for each piece of shop produced/fabricated items.

4.03.00 Cabling System

4.03.01 Cabling work shall be carried out in compliance to the following standards/codes. All standards, specifications and codes of practice (COP) referred to herein shall be the latest editions including all amendments and revisions as on the date of opening of tender. In case of conflict between the specification and those standards/codes referred to herein, the former shall prevail:

a)	Indian Electricity rules	
b)	National Electrical Code	
c)	Steel tubes, tubular and other steel fittings	IS 1239

d)	COP for installation & maintenance of power cables up to and including 33kV rating	IS 1255
e)	Degree of protection provided by enclosures for low voltage switchgear & control gear	IS/IEC 60529
f)	Recommended practice for hot-dip galvanizing of iron and steel	IS 2629
g)	Method of testing uniformity of coating on zinc coated articles	IS 2633
h)	Flexible steel conduits for electrical wiring	IS 3480
i)	Cable Glands	IS 12943
i)	Methods for determination of mass of zinc coating on zinc coated iron and steel articles	IS 6745
j)	Compression type tubular in-line connectors for aluminum conductors of insulated cables	IS 8309
k)	Conduits for electrical installation	IS 9537
l)	Joints & terminations for polymeric cables for working voltages from 6.6kV up to & including 33kV : performance requirements & type tests	IS 13573
m)	Conduit systems for electrical and communication installation	IS 14930

4.03.02 Erection of cabling work shall be carried out in such a way as to provide a reliable and assured electric power supply system to all auxiliaries.

4.03.03 Cables will generally be laid on cable trays, cable trench, cable rack, overhead supported from building steel/structures or cable bridge/cable trestle. Cable trench shall be avoided as far as possible in outdoor areas. Cables shall not be buried directly in ground unless explicitly permitted in some areas.

4.03.04 Cable shall be laid on cable trays along overhead pipe bridges. Where such overhead pipe bridges are not available, overhead pipe trestles are to be erected for taking the cable racks/trays. Cables buried directly in ground are not acceptable.

4.03.05 In indoor mechanical equipment areas like compressor houses, overhead cable trays shall generally be used.

4.03.06 For underground crossing of railways, road, etc. additional protection shall be provided in form of Hume pipe or concrete encased rigid steel conduits (duct bank).

4.03.07 A.C. and D.C. circuit will not be run in same cable. Further, separately fused circuit will run in separate cables.

4.03.08 Cables for redundant equipment system shall be run in separate trays, as far as possible.

4.03.09 Erection of cabling work shall be executed keeping in view all necessities and requirements of firefighting codes.

4.03.10 Suitable embedded steel inserts shall be provided on wall/floor/ ceiling surfaces for welding of cable tray bracket in order to make the cable tray system withstand, in addition to normal tray cable loadings, horizontal/vertical accelerations due to seismic forces for indoor trays and also wind load for outdoor trays.

4.04.00 Erection work to be carried out under this specification shall conform to the 'Notes and Details for Cabling System' given in Annexure-B and the drawings attached to this specification.

5.00.00 SPECIFIC REQUIREMENTS - SUPPLY

5.01.00 Equipment and Material

5.01.01 Equipment and material shall comply with description, rating, type and size as detailed in this specification, drawings and annexures.

5.01.02 All accessories, fittings, supports, hangers, anchor bolts etc. which form part of the equipment or which are necessary for safe and satisfactory installation and operation of the equipment shall be furnished.

5.01.03 All parts shall be made accurately to standard gauges so as to facilitate replacement and repair. All corresponding parts of similar equipment shall be interchangeable.

5.02.00 Conduits and Accessories

5.02.01 The LSTK vendor shall provide and install all conduits, mild steel pipes, flexible conduits, rigid PVC pipes, etc. complete with accessories like tees, bends, adopters, locknuts, pull boxes, conduit plugs, caps, etc. as required for the cabling work. Conduits shall be furnished in standard length of 5 meters, threaded at both ends.

5.02.02 Conduits diameter up to and including 25mm size shall be of 16 SWG and conduits above 25 mm diameter shall be of 14 SWG. Minimum diameter of conduits shall be 20 mm.

5.02.03 Conduits shall be made of hot-dip galvanized steel with an organic corrosion resistant ID coating. In chemical handling areas, battery room, etc., the exterior surface shall be further coated with chromate and polymer for better resistance to corrosion. Conduits, fittings & accessories shall have ISI mark.

5.02.04 For sizes above 63 mm, hot dip galvanized - both on inside and outside - steel pipes with necessary fittings & accessories shall be provided and installed by the LSTK vendor. The pipes and fittings shall be of heavy duty class with relevant ISI mark.

5.02.05 Flexible conduits complying to relevant IS and made with bright, cold-rolled, annealed and electro-galvanized mild steel strips shall be used between embedded conduits/pipes and the motor terminals. It shall also be used between fixed conduit and any equipment with vibration or equipment requiring regular removal.

5.02.06 Non-metallic conduits made of HDPE outer jacket with friction-reducing permanent internal lining shall generally be used for control & instrumentation cables in some areas where cable trays do not exist and where the runs are straight ones Necessary fittings & accessories as may be required for the installation shall also be provided.

5.03.00 Junction Boxes

5.03.01 Technical requirement for both non-metallic type and galvanized steel Junction Boxes are given below. Unless the choice is specifically mentioned in the General / Lead Electrical Specification or elsewhere in the tender document, galvanized steel Junction Boxes shall be offered.

5.03.02 Non-metallic Junction Boxes

a) Material of the Junction Boxes shall be halogen-free and silicon-free, glass fibre-reinforced polycarbonate for outdoor use and/or for cable sizes more than 50 sq.mm. Material shall be ABS/ polycarbonate for indoor use and/or for cable sizes up to 50 sq. mm. Junction boxes for use with fire-survival cables shall be of Duro-plast / powder-coated metal.

b) Material of all non-metallic junction boxes shall be fire retardant and self-extinguishing in accordance with UL 94 V0. It should be tested at Glow Wire test for 960º C.

c) Boxes shall be suitable for continuous operation at an ambient temperature range of -10º C to +80º C.

d) The impact strength of polycarbonate enclosures/boards i.e. the degree of protection against mechanical shock load shall be in accordance with EN 50298-98 for IK 08 (5 Joule).

e) Degree of protection shall be IP 66 to EN 60529. Junction boxes shall have integrally embedded gaskets made of Polyurethane.

f) Allowing a minimum of 20% spare terminals after complete termination, the terminal board for control and instrumentation JBs shall have 6 /12 / 24 / 36 / 48 ways.

g) Doors shall have stainless steel quick fastening screws.

h) The boxes shall be complete with all brackets/fasteners as required for installation on walls, columns and structure.

5.03.03 Steel Junction Boxes

a) Junction boxes with IP 55 degree of protection, shall comprise of a rectangular parallelepiped case constructed from cold rolled sheet steel of minimum thickness 2mm. Top of the box shall be arranged to slope towards the rear of the box. Gland plate shall be 3mm thick sheet steel with neoprene/synthetic rubber gaskets. All junction boxes shall be of adequate strength and rigidity, hot dip galvanized as per relevant IS, and suitable for mounting on wall, column, structures etc. The boxes shall be complete with M8 earthing stud and all brackets/fasteners as required for installation.

b) No. of Ways:6 / 12 / 24 / 36 / 48 with 20% spare terminals after termination.

c) Outdoor JBs shall be similar but with a canopy at the top.

d) Doors shall be hinged and lockable and shall be made of the same material as the case. The doors shall have industrial heavy-duty hinges. The doors shall be easily but firmly lockable with quick release fastener.

e) The junction boxes shall have the following indelible markings:

i) Circuit nos. on top by white-stenciled paint at site.

ii) Circuit nos. with ferrules (inside) as per approved drawing.

iii) Danger sign in case of 415V circuit.

5.04.00 Terminals

5.04.01 Multiway terminal blocks of approved type, complete with screws, nuts; washers and marking strips shall be furnished for connection of incoming/outgoing wires.

5.04.02 Each control cable terminal shall be suitable for connection of 2 nos. 2.5 sq.mm. stranded copper conductors without any damage to the conductor or looseness of conductors.

5.05.00 Cable Termination & Straight Through Joints

5.05.01 Bidder shall supply cable termination and jointing kits in requisite quantity for H.T. Power Cables, L.T. Power, Control Cables, Instrumentation Cables, etc. along with all accessories & consumables required for making termination and joints complete. Those shall be of proven design and make which have already been extensively used and type tested.

5.05.02 Components shall be pre-moulded type, taped type or heat-shrinkable type. 11kV grade joints and terminations shall be type tested as per IS: 13573.

5.05.03 Kits shall be complete with the alumunium solderless crimping type cable lugs and ferrule as per DIN standard.

5.06.00 Cable Glands

Cable shall be terminated using double compression type cable glands. Cable glands shall conform to IS 12943/ BS 6121 or to EN 50262. Ingress Protection rating for cable glands with seal, when offered conforming to EN 50262, shall be minimum IP 66 in line with BS. Cable glands shall be made of tinned brass gland, double compression type complete with necessary armour clamp and tapered washer, etc. Rubber components shall be of neoprene or better synthetic material and of tested quality. Cable glands shall match with the sizes of different cables supplied/erected.

5.07.00 Cable Lugs

Cable lugs shall be suitable for termination of different cross-sections of H.T./L.T./Control/Instrumentation cables and shall be of following types :

i) Aluminium tubular terminal end for solderless crimping to aluminium conductors.

ii) Copper tubular terminal end for solderless crimping to copper conductors.
Solderless crimping of terminals shall be done by using corrosion inhibiting compound. The cable lugs shall suit the type of terminals provided on the equipment. Lugs for control/instrumentation cables shall be PVC insulated/sleeved type.

iii) Cable lugs for control cable termination shall be insulated. These lugs shall be pin type/flat type/ring type/U type to suit the terminals provided in the panels.

5.09.00 Cable Clamps and Straps

5.09.01 Trefoil clamps for single core cables shall be pressure die-cast aluminium or fibre glass or nylon with necessary G I fasteners. Trefoil clamps shall have adequate mechanical strength to forces generated by peak value of maximum system short circuit current.

5.09.02 Cable clamps required for multicore cables on vertical run shall be made up of 25x3mm size aluminium strip. For clamping the multicore cables, self-locking, de-interlocking type fire-resistant nylon clamps/straps of sufficient strength shall be used.

5.10.00 Consumables and Hardware

Described in Part-I of electrical equipment erection

5.11.00 Testing Equipment

Described in Part-I of electrical equipment erection

6.00.00 METHODS AND WORKMANSHIP

6.01.00 All work shall be installed in a first class, neat workmanlike manner by mechanics/ electricians skilled in the trade involved.

6.02.00 The erection work shall be supervised by competent supervisors holding relevant supervisory license from the Government.

6.03.00 All details on installation shall be electrically and mechanically correct.

6.04.00 The installation shall be carried out in such a manner as to preserve access to other equipment installed.

7.00.00 INSTALLATION

7.01.00 General

7.01.01 Installation work shall be carried out in accordance with good engineering practices and also as per manufacturer's instructions/ recommendations where the same are available.

7.01.02 Equipment shall be installed in a neat workmanlike manner so that it is level, plumb, square and properly aligned and oriented.

7.01.03 Cable installation work shall mean erection of cable trays/racks, supports, hangers, junction boxes, conduits, laying of cables either in ground or on trays inside trenches tunnels/overhead trays in conduits, etc. dressing and clamping, jointing and termination inclusive of supply of necessary jointing/ termination kits, lugs, glands, ferrules, tapes, etc. and other accessories, grounding of cable armour. In case of direct laying in ground, all excavation work, necessary back-filling, supply of bricks and protective concrete slabs, removal of excess earth shall be part of the installation work.

7.01.04 Grounding installation work shall mean erection, jointing/ brazing/ welding, connection and painting, testing of ground conductors including supply of necessary steel/copper.

7.01.05 Lightning protection system installation work shall mean erection, jointing, welding, connection and painting, testing of air termination network, down conductors, shielding masts, connection to ground grid, electrodes, risers, horizontal conductors, etc. of lightning protection system.

7.02.00 Cable Trays

7.02.01 Pre-fabricated cable trays and accessories shall be assembled & erected at site. Adequate spaces will be provided to facilitate installation of cable system and to allow routine inspection and modification after installation.

7.02.02 Cable trays either inside concrete trenches or inside buildings and racks inside cable shafts shall be aligned and leveled properly. All tray runs shall be installed parallel to the trench/building walls and floors except otherwise noted in the approved drawings.

7.02.03 As far as practicable, cable trays shall be supported from one side only in order to facilitate installation and maintenance of cables from the other side.

7.02.04 The cable trays shall be supported in general at a span of exceeding 1.25 metres horizontally and 1.0 metre vertically.

7.02.05 Sufficient spacing not less than 250 mm shall be provided between trays and maintained to permit adequate access, for installing & maintaining the cables.

7.02.06 Complete cable tray support structure after installation shall be inspected/ tested for welding strength, straightness, accuracy, use of proper sizes and compliance to drawings.

7.02.07 Complete cable tray and accessory installation work shall be inspected/tested for proper alignment, leveling, use of proper accessories, high quality workmanship, etc.

7.02.08 The LSTK vendor shall remove the RCC/steel trench covers whenever required and shall again place the same in their positions after the erection work in the particular area is completed or when further work is not likely to be taken up for some time.

7.02.09 Whenever any pipe/conduit/cable tray emerges out or enters into a building care should be taken to ensure that no water enters into the building.

7.02.10 Cable trays in areas subject to excessive coal dust, oil spillage, mechanical damage or accessible to personal contact shall be provided with raised sheet metal tray covers, installed on upper tray in horizontal run and front in vertical run.

7.02.11 Cable trays/racks shall be so arranged that they do not obstruct or impair clearances of passage way.

7.02.12 Cable tray/conduit system will be so designed as to accommodate maximum pulling tension and minimum bending radius of cable.

7.02.13 Cable tray/conduit system will be constructed to prevent drainage of water into equipment or building.

7.02.14 Cable tray/conduit system shall be electrically continuous and grounded.

7.02.15 Different voltage grade cables will be laid in separate trays when trays are run in tier formation. Power cables will normally be on top trays and control/instrumentation cable on bottom trays.

7.03.00 Cable and Conduits

7.03.01 The LSTK vendor shall install, terminate and connect up all cable and conduits as per drawings and cable schedules.

7.03.02 The drawings shall be strictly followed except where obvious interference occurs. In such cases, the routing shall be changed as directed and/or approved by the Engineer.

7.03.03 Approximate lengths of cable and conduit runs will be shown by the LSTK vendor in the cable schedule for guidance only. Before commencement of work the LSTK vendor shall take actual measurements and prepare his own cable-cutting schedule to reduce wastage to a minimum.

7.03.04 The LSTK vendor shall also maintain and submit when requested, a record of cable insulation value when drawn from store, after laying, before and after termination/jointing.

7.03.05 Where direct heat radiation exists, heat isolating barriers, shall be adopted for cabling system.

7.03.06 Cabling/wiring in offices, laboratories, control rooms etc. shall be taken through concealed G.I. or rigid PVC pipes as directed by the owner's Engineer.

7.03.07 At certain places where hazardous fumes/gasses may cause fire to the cables, cable trenches after installation of cables shall be sand filled.

7.04.00 Conduit and Accessories

7.04.01 Conduit/pipes shall be used only in short lengths in certain areas where required and/or as directed by the Engineer.

7.04.02 The LSTK vendor shall furnish all conduits complete with accessories as required.

7.04.03 Conduits shall be flexible type in general. However, rigid type steel conduit if required shall also be supplied by the LSTK vendor.

7.04.04 Except for inside an enclosure wherever the cable enters or leaves the conduit, the conduit end shall be sealed by suitable sealing compound, having fire withstand capability.

7.04.05 The entire metallic conduit system, when embedded or exposed shall be electrically continuous and grounded.

7.04.06 Where it is possible for water or other liquids to enter conduits, sloping of conduit runs and drainage of flow points shall be considered.

7.04.07 Pull boxes will be installed between termination points where required to facilitate cable pulling, but at a maximum interval of 30 meters.

7.04.08 Conduits shall be firmly fastened within 900 mm of each junction box/pull box/cabinet/fitting, etc. Conduits shall be supported at least every 2000 mm.

7.04.09 Conduits shall be sized so that conduit fill (ratio of total cable area to conduit area) shall not exceed the following:

One Cable	:	53%
Two Cable	:	31%
Three Cables & Up	:	40%

7.05.00 Cables : Storage and Handling

7.05.01 Cable drums shall be stored on hard and well-drained surface so that they may not sink. In no case shall the drum be stored on the flat, i.e., with flange horizontal.

7.05.02 Rolling of drums shall be avoided as far as practicable, for short distance, the drums may be rolled provided they are rolled slowly and in proper direction as marked on the drum. In absence of any indication, the drums may be rolled in the same direction as it was rolled during taking up the cable.

7.05.03 For unreeling the cable, the drum shall be mounted on jacks or on cable wheel. The spindle shall be strong enough to carry the weight without bending. The drum shall be rolled on the spindle slowly so that the cable should come out over the drum and not below the drum.

7.05.04 While laying cable, cable rollers shall be used at an interval of 2000 mm. The cables shall be pushed over the roller by a gang of people positioned in between rollers over a suitable distance. Care shall be taken so that kinks and twists or any mechanical damage does not occur in cables. Only approved cable pulling grips or other devices shall be used. Cables shall not be dragged on ground or along structure while laying out from cable drums. Cable shall not be pulled from the end without having intermediate pushing arrangement. Bending radius of the cable during installation shall not be less than what is specified by the manufacturer.

7.05.08 Empty cable drums shall be returned to the Owner.

7.06.00 Cable Laying

7.06.01 Cable shall generally be installed in ladder type prefabricated trays except for some short run in rigid/flexible conduit for protection or crossings.

7.06.02 Cables laid on trays and risers shall be neatly dressed and clamped with self-locking type fire resistant nylon ties at an interval of 750 mm. for horizontal and vertical runs, in case of both power, control and instrumentation cables.

7.06.03 Single core power cables for 3 Ph. AC circuits shall be laid in trefoil formation and suitably clamped with self-locking type fire resistant nylon ties at an interval of 750 mm.

7.06.04 L.T. multicore power cables with cross-sectional area of 95 sq.mm and above and all H.T. multicore power cables and shall be clamped individually by self-locking type fire resistant nylon ties.

7.06.05 L.T. power cables of cross sectional area less than 95 sq.mm and all control and Instrumentation cables shall be clamped in bunches with self-locking type fire resistant nylon ties. The number of cable in one bunch shall not exceed eight (8).

7.06.06 Prior to laying of cables inside the indoor and outdoor trenches, the LSTK vendor shall properly clean the trenches.

7.06.07 In outdoor areas, buried cables shall be laid and covered with sand/riddled earth and protected from damage by bricks at sides and precast slab at top.

7.06.08 When buried cables cross road/railway track, adequate protection shall be provided in the form of hume/galvanised iron pipes laid at a minimum depth of 1 meter below ground.

7.07.00 Cable Tags & Markers

7.07.01 Each cable and conduit run shall be tagged with numbers that appear in the cable and conduit schedules. Cables and conduits shall be tagged at their entrance, bends, every 30.0M and exit from any equipment, junction box. When a cable/conduit passes through a wall, tags shall be fitted on both sides of the wall.

7.07.02 The tags shall be of aluminium with the number punched on it and securely attached to the cable by not less than two turns of 16 SWG G.I. wire. For single core cable the wire shall be of non-magnetic material.

7.07.03 Location of cable joints, if any, shall be clearly indicated with cable marker with an additional inscription 'cable-joint'.

7.07.04 LSTK vendor shall furnish and install all tags and markers stated above.

7.07.05 For buried cable, the marker shall project 150 mm above ground and shall be spaced at an interval of 30 meters and at every change of direction.

7.08.00 Cable Termination and Connection

7.08.01 Termination and connection of cables shall be done strictly in accordance with manufacturer's instruction, drawings and/or as directed by the Engineer.

7.08.02 Work shall include all clamping, fitting, fixing, soldering, tapping, compound filling, cable jointing, crimping, shorting and grounding as required for the complete job. All equipment required for all such operations shall be of LSTK

vendor's procurement. Furnishing of all consumable materials such as soldering material, electrical tape, sealing material as well as cable jointing kits shall be included in the offer.

7.08.04 Cable joint kits for all cables shall be supplied by LSTK vendor under this specification. Responsibility for proper termination shall lie on the LSTK vendor. Guarantee for termination shall also have to be given by LSTK vendor.

7.08.05 The equipment will be generally provided with blank bottom plates for cable/conduit entry and cable end box for power cables.

7.08.06 The LSTK vendor shall perform all drilling, cutting on the blank plate and any minor modification work required to complete the job.

7.08.07 If the cable end box or terminal enclosure provided on the equipment is found unsuitable and requires major modification, the same shall be carried out by the LSTK vendor.

7.08.08 Control/instrumentation cable cores entering control panel/ switchgear/ MCC, etc. shall be neatly bunched and served with PVC perforated tape to keep it in position at the terminal block.

7.08.09 The LSTK vendor shall put ferrules on all control cable cores in all junction boxes and at all terminations. The ferrules shall carry terminal numbers as per drawings. All ferrules shall be coloured, plastic & interlocked type.

7.08.10 Spare cores shall be similarly ferruled, crimped with lug and taped on the ends. Spare cores shall be ferruled with individual cable number.

7.08.11 Termination and connection shall be carried out in such a manner as to avoid strain on the terminals.

7.08.12 All cable entry points shall be properly sealed and made vermin and dust proof. Unusual opening, if any, shall be effectively closed. Sealing work shall be carried out with approved sealing compound having fire withstand capability for at least three hours.

7.08.13 Strips and special tools like manually or pneumatically driven gun/pistol for termi-point/equivalent connection shall be supplied by the LSTK vendor.

7.09.00 Cable Joints

7.09.01 Cable shall be installed without joints as far as practicable.

7.09.02 If however jointing becomes necessary, it shall be made only by qualified cable jointer and strictly in accordance with manufacturer's recommendation.

7.10.00 Grounding

7.10.01 If supply and laying of the underground mat is included in the scope of the LSTK vendor, the LSTK vendor will plan and organize works to lay the grounding mat in the same sequence in which the building and equipment foundation is being done.

7.10.02 Underground mat will be made of mild steel rods laid underground in length and breadth of the area at a depth of minimum 1 meter below grade level. All crossings and straight run shall be arc welded for good electrical continuity. Ground conductors, when crossing underground trenches, directly laid underground pipe and equipment foundation, if any, shall be at least 300 mm below the bottom elevation of such trenches/pipes as shown in the relevant drawing.

7.10.03 LSTK vendor shall carryout the interconnection among various peripheral earthing grids/mats, steel structures, lightning protection system as well as grounding of all electrical equipment, etc. The grounding work shall be carried out as per provisions of I.E. rules, Indian standards and Annexure-E: Notes & Details for Grounding & Lightning Protection System.

7.10.04 Grounding shall be done by conductors of adequate sizes (size shall be selected by the Bidder with supporting calculation, if not specified) and the same shall be connected to the risers of main ground mat.

7.10.05 For fabricated cable trays, a separate ground conductor (50x6 mm G.S. flat) shall run along the entire length of each route of cable tray being suitably clamped on the cable tray. Individual cable trays of each section shall be connected to above ground conductor through 50x6 mm G.S. flat to maintain continuity of ground path.

7.10.06 All ground conductor connections shall be made by electric arc welding/ brazing unless otherwise specified. Ground connections shall be made from nearest available station ground grid risers. The rods/connection shall be coated with cold galvanizing /weather resistance anti corrosive paints.

7.10.07 All ground conductors shall be painted black for easy identification.

7.10.08 Equipment ground connections, after being checked and tested by the Engineer, shall be coated with anti-corrosive paint.

7.10.09 Whether specifically shown or not in Project drawings, all conduits, trays, cable armour and cable end box, electrical equipment such as motors, switchboards, panels, cabinets, junction boxes, lockout switches, fittings, fixtures, etc. shall be effectively grounded.

7.10.10 If there is no provision to ground the L.T. transformer neutral at transformer end, to make an effectively earthed 415V system the neutral bus of all 415V

distribution boards shall be connected to ground grid at two different and distinct points.

7.10.11 Ground Electrode

Ground electrodes are to be fabricated and driven into the ground by the side of mat conductor. All connections to the conductors shall be done by are wilding process.

7.10.12 Risers

Risers are required for connecting the equipment and structures with the ground mat. These will be 1x40 mm dia (minimum) M.S. rod. laid from ground mat to above ground level properly clamped or supported along the outer edge of the concrete foundation. Connection to the ground mat shall be done by arc welding and the other end is to be kept free at least 300 mm above grade level/concrete floor level unless otherwise shown.

7.10.13 Column Grounding

All columns are required to be grounded by 1x40 mm dia (minimum) M.S. rod from ground mat. Laying, supporting along with foundation, connecting at ground mat are within the scope of this specification. At least 300 mm length of the above rods shall be left free above the grade level/concrete floor level for connection with columns.

7.10.14 Electronic Equipment Grounding

Internal ground connection of electronic panels shall be insulated from the enclosure, frame, chasis and to be terminated to an insulated ground bus.

Insulated ground bus of all electronic panels shall be connected by insulated wire to an insulated common electronic ground bar.

All connection made above shall be in the form of a radial distribution system without any parallel ground paths.

Electronic equipment's and systems, metal enclosures of all electronic panels shall be connected to a grounding system with which is isolated and separate from the electrical equipment grounding system. Separate Earth pit shall be made by 3M X 3M MS Rod.

7.11.00 Painting

LSTK vendor shall paint steel fabrications at site with two (2) coats of red oxide primer and two (2) coats of battleship grey (shade no. 632 of IS:5) synthetic enamel paint. In case a different kind of primer or a finish shade is mentioned in the Lead/General Specification due to specially corrosive atmosphere, the same shall be followed.

7.12.00 Galvanizing

Galvanizing shall be uniform, clean, smooth, continuous and free from acid spots. Should the galvanizing of the samples be found defective, the entire batch of steel has to be re-galvanized, at LSTK vendor's cost. The amount of zinc deposit shall not be less than 610 grams per square meter of surface area. Additionally, the thickness of the zinc deposit at any spot shall not be less than 75 microns. The Owner reserves the right to measure the thickness of zinc deposit by appropriate instrument and reject any component which shows thickness of zinc at any location less than 75 microns.

7.13.00 Excavation and Back Filling

7.13.01 LSTK vendor shall perform all excavation and backfilling to the original level with good consolidation as required for buried cable and ground connections. Sheeting and shoring shall be done as necessary for protection of the work.

7.13.03 LSTK vendor shall make his own arrangements for pumping out any water that may be accumulated in the excavation.

7.14.00 Steel Fabrication

7.14.01 All racks, trays, supports, hangers & brackets wherever necessary shall be fabricated by the LSTK vendor.

7.14.02 Steel for fabrication shall be straightened and cleaned of rust and grease. All fabrication shall be free of sharp edge and burns so as not to cause any damage to personnel or cables.

7.15.00 Cleaning up of Work Site

7.15.01 The LSTK vendor shall, from time to time, remove all rubbish resulting from execution of his work. No materials shall be stored or placed on passage or drive ways.

7.15.02 Upon completion of work, the LSTK vendor shall remove all rubbish, tools, scaffoldings, temporary structures and surplus materials etc. to leave the premises clean and fit for use.

8.00.00 TESTS

8.01.00 Shop Tests

8.01.01 All equipment shall be completely assembled, wired, adjusted and routine tested as per relevant Indian Standards at manufacturer's works.

8.01.02 Tests on panels/junction boxes shall include :

a) Wiring continuity tests.

b) High voltage and insulation tests.

c) Operational tests.

8.02.00 Site Tests

8.02.01 LSTK vendor shall thoroughly test and meggar all cables, wires and equipment to prove the same are free from ground and short circuit.

8.02.02 If any ground or short circuit is found, the fault shall be rectified or the cable and/or equipment replaced.

8.02.03 All power cables after installation and prior to connections shall be subjected to High Potential tests. Also the insulation resistance values shall be measured both before and after Hipot test for comparison. The leakage current shall also be measured during the Hipot test at site.

Cable cores shall be tested for :

a) Physical damage

b) Continuity

c) Correctness of connections as per relevant wiring diagram

d) Insulation resistance to earth

e) Insulation resistance between conductors

f) Proper earth connections of cable glands, cable boxes, cable armour, screens etc.

8.02.04 All equipment shall be demonstrated to operate in accordance with the requirements of this specification.

8.03.00 Test Certificates

8.03.01 Type test certificate on any equipment, if so desired by the Owner, shall be furnished. Otherwise the equipment shall have to be type tested, free of charge, to prove the design.

9.00.00 DRAWINGS, DATA & MANUALS

9.01.00 To be submitted with the Tender

9.01.01 Make, type and catalogue number of different electrical items and accessories along with technical leaflets, data sheets etc.

9.01.02 Typical General arrangement drawings showing constructional features, fixing arrangement of pre-fabricated cable trays.

9.01.03 Bill of Materials for cable trays and accessories, conduits & accessories.

9.01.04 Layout of Grounding system & lightning protection system showing connection and other details along with backup design calculations and detailed write up.

9.01.05 Bill of materials for grounding and lightning protection system.

9.01.06 Drawing showing details of equipment grounding.

9.02.00 To be submitted after Award of Contract

9.02.01 Make, type & catalogue number of cable termination kits, joints & accessories.

9.02.02 Detail dimensional drawings showing constructional features, grounding, fixing arrangement etc.

9.02.03 Bill of Materials for Pre-fabricated cable tray and accessories, Conduits & accessories.

9.02.04 Dimensional G.A. drawings and data sheets for different equipment and items supplied under this specification.

9.02.05 Layout drawing of Grounding system and Lightning protection system showing connection details along with backup design calculation and detailed write up.

9.02.06 Bill of material for grounding system and lightning protection system.

9.02.07 Drawing showing details of equipment grounding system.

ANNEXURE- A

SCHEDULE OF PRE-COMMISSIONING TESTS

1.0 Transformers

a) Insulation Resistance of windings

b) Checking of Phase Sequence Test

c) Continuity Test

d) No load voltage ratio at all tap positions

e) Checking of Vector Group

f) Tap changer operation check (Mechanical and Electrical) including indication and alarm circuits.

g) Magnetising Current Check at 415V, 3φ, 50 c/s, supply for all the three phases.

h) Measurement of Winding resistance

i) Cooler control, indication and alarm circuits

j) Breather (Check for Silicagel)

k) Buchholz relay operation

l) Low oil level for Main tank

m) Physical line connections as per phasing diagram

n) Neutral connection to earth effectively.

o) Calibration of different temperature indicators, relays and switches.

2.0 Switchboards/MCC/Distribution Board/Panels

a) Measurement of Insulation Resistance of Bus-bar System.

b) Measurement of I.R. of Control Circuit.

c) Functional check of circuit components.

d) Continuity check of different circuits.

e) Calibration test of Relays and Meters.

f) Space heater operation

g) Annunciations

3.0 Lightning Arrester

a) Check for connections to ground and line.

b) Continuity check (in case of Metal Oxide Silicon type only).

c) Operation check of discharge counter.

4.0 Grounding

a) Continuity of grounding connection.

b) Testing of Earth Resistivity of Individual Electrode.

c) Testing of Earth Resistivity of the combined earthing system.

5.0 Battery

a) Acid filling, charging/discharging cycles.

b) Checking of polarity, voltage, specific gravity, temperature etc.

6.0 Battery Charger

a) Insulation resistance test.

b) Test on transformer (I.R., voltage ratio).

c) Automatic voltage regulator & annunciator operation & testing.

d) Load test.

7.0 Motor

a) Insulation test of winding by Meggar.

b) Proper direction of rotation.

c) RTD, BTD operation.

8.0 Relays & Meters

a) Calibration test.

b) Operation/Performance test.

NOTE

Apart from the tests listed herein and also as mentioned elsewhere in the specification, if any other test (tests) is (are) necessary as per relevant standards, CBIP recommendations, Code of Practice, Manufacturer's recommendations etc., the same shall have to be carried out by the LSTK vendor without any implication within the quoted price.

ANEXURE-B

DETAILS FOR CABLE TRAYS, FITTINGS & ACCESSORIES

1.00 CABLE TRAYS AND FITTINGS

1.01 Cable trays shall be of pre-fabricated ladder/perforated type sheet steel complete with matching fittings like brackets, elbows, bends, reducers, Tees, crosses, tray cover etc. and hardware's like bolts, nuts, washers, GI straps, hook etc.as required. Cable trays shall be ladder type for power and control cables , and perforated type for instrumentation cables.

1.02 Cable trays, fittings and accessories shall be factory-fabricated out of rolled mild steel sheets and hot dip galvanized as per relevant IS.

1.03 Cable trays shall be supplied in standard length of 2.5 meters and in standard width of 150mm, 300mm, 450mm and 600mm.

1.04 Mild steel sheets used for fabrication of cable trays and all fittings except the side coupler plates shall be of 2mm thickness. 3mm sheet shall be used for side coupler plates.

1.05 Perforated tray cover shall be provided for vertical cable shafts up to a height of 2.5 meters from floor level. It shall be bolted to the structural framework of the vertical raceway.

2.00 GALVANIZING REQUIREMENT

2.01 Galvanizing shall be uniform, clear, smooth and free from acid spots. Should the galvanizing of the samples be found defective, the entire batch of steel will have to be re-galvanized at LSTK vendor's cost.

2.02 The amount of zinc deposited shall not be less than 610 gram per square meter of surface area and in addition the thickness of the zinc deposit at any spot whatsoever, shall not be less than 75 microns. The Owner reserves the right to measure the thickness of zinc deposit by elcometer or any other instrument and reject any component, which shows thickness of zinc at any location to be less than 75 microns.

3.00 SUPPORT SYSTEM FOR CABLE TRAYS

3.01 Cable tray support system shall be pre-fabricated factory-galvanized.

3.02 Support system for cable trays shall consist of two components viz. main support channel and cantilever arm/bracket. The main support channel shall have provision for fixing cantilever arm either on one side or on both sides as per requirement.

3.03 The cable tray system shall be erected at site by assembling brackets, clamps, fittings with miscellaneous fasteners. Welding of any short will not be permitted.

3.04 Cable support system shall be able to withstand

a) Weight of the cable tray

b) Weight of the cables
c) Point load of 75kg on each span

Factor of safety of minimum 1.5 shall be considered.

4.00 TESTS

4.01 The LSTK vendor shall perform all tests necessary to ensure that the material and workmanship conform to the relevant standards and that such tests are adequate to demonstrate that the equipment will comply with the requirement of this specification.

4.02 Deflection of the cable tray under the specified withstand loading condition shall be limited to $1/180^{th}$ of span.

ANNEXURE-C

DETAILS FOR FIRE-PROOF CABLE PENETRATION SEALING SYSTEM

1.00 GENERAL

1.01 The Fire proof sealing, fire stop system and fire protection coating system are required to prevent spreading of fire from one place to other place (or one zone to other zone) through the openings in wall / floor, cables laid in trays / racks and openings below Electrical Switchgear, MCC, DB,/ Cabinets, Panels etc.

1.02 The fire-proof cable penetration (FPCP) sealing system shall conform to the requirement of BS: 476 Part 20, IS 12458 (latest edition with all amendments).

2.00 SCOPE OF WORK

The scope of work includes but is not limited to the following items of supply and installation:

i) Fire Stops in wall and floors

ii) Fire stops below switchgear, MCC, Switchboards, DBs, junction boxes / panels / cabinets, etc. which are floor mounted type

iii) Fire retardant coating to be applied for installed cables

iv) Fire proof barrier walls

v) Fire proof doors

vi) Minor civil and structural works for installation of the entire work

vii) Necessary erection materials, consumables and sundry items to complete the work for satisfactory and trouble free operation

viii) Any special tools & tackles

ix) Conducting the type test of fire proof sealing system in presence of Owner's Engineers

x) All relevant Drawings, Data sheets and instruction manuals

3.00 DESIGN CRITERIA

3.01 Fire Proof Cable Penetration Sealing System

The material / components used for fire-proof sealing (FPCP) system shall be provided to meet the following requirements:

i) The product shall be age tested for not less than 30 years.

ii) Shall be free from shrinkage or cracking; should achieve smoke and gas tightness during fire and should be modifiable.

iii) Not to generate toxic or corrosive gas and cause harm to the personnel handling the system.

iv) Prohibition of production of acid or alkali during gas generation.

v) Shall be repellant to pest / rodent / termite.

vi) Expansion co-efficient - very low which is to be comparable with masonry concrete.

vii) Not soluble / reactive to acid, water, alkali.

viii) Thermal conductivity - low.

ix) The material in contact with the cables in the FPCP sealing system shall be compatible with the material used for outer sheath of cables.

x) It should not have any adverse effect on the cables and should not alter the current carrying capacity of the cables.

xi) Retrofit in design to accommodate not less than 15% more addition of cables depending upon the size of cables, physically and chemically stable.

xii) Capable of withstanding vibrations, drop-loads, foot traffics, mechanical loads, etc.

xiii) The sealing system shall maintain its integrity and perform satisfactorily even after
a. Remaining in water for a long time.
b. Accelerated thermal aging.
c. Sustaining vibrations.

xiv) The design and construction of FPCP sealing system shall specifically take into account the fact that under seismic disturbances, normal load, short circuit and fire conditions, the cable / cable trays will be subject to movement, expansion and oscillation and this shall not result in any damage or cause dislocation of the FPCP sealing system or the material constituting the FPCP sealing System.

xv) Non-hygroscopic, non-inflammable and shall not get affected over a period of time due to humidity, moisture and ozone etc. and should not contain volatile solvents which may cause a fire hazard during application.

xvi) The fire sealing system to be installed at floor openings below C&I panels, control panels/boards etc. in Electrical Room, Control Room shall have a fire rating of not less than two (2) hours. The fire sealing system to be installed at all other places like the rest of the wall and floor crossings of cables/cable trays, openings below Switchgears/Boards etc. shall have a fire rating of one (1) hour. The system shall be stable after application of water jet in the exposed side in order to extinguish fire.

3.02 Fire Protection coating to be applied on installed cables:

A. The cables shall be coated with fire protection material of 2 mm dry thickness at the strategic locations as follows so as to limit the spread of fire:

i) At fire stops in walls and floors on either side up to 500 mm length.

ii) At fire stop below Electrical Switchgears/ MCCs/ Panels/ Cabins, etc. on one side coating of 500 mm length, i.e., on the cable vault side / cable trench side.

iii) Length of 500 mm on all sides of the junction/crossing of cabling work in open cable routes/ cable trench.

iv) In fire risk areas and where specified at suitable intervals as decided upon side conditions in open cable routes.

v) Where necessary and specified at site intervals along cable routes in cable trenches.

vi) The coating shall be applied evenly on the cables only.

B. The fire protection coating shall have the following properties/composition:

i) Asbestos-free, non-volatile, not eatable by vermin, harmless and non-irritant to human skin.

ii) Not affecting the current carrying capacity of the cables and the properties of the installed cables.

iii) It shall delay fire damage to cables and prevent flame spreading meeting the requirement of IS 10810/IEC - 60332.

iv) Coating material shall show no signs of cracking and peeling when the coated cable is bent to the radius of minimum 12 times the diameter of the maximum size cable at 180°C.

v) The limiting oxygen index of the material shall not be less than 60% as per IS 10810 / ASTM D 2863.

vi) Life expectancy equivalent to the cable installations.

3.03 The various openings in the cable vault, vertical/ horizontal raceways of cables penetrating walls/ floors and the bottom of Electrical switchgears/ MCCs/ distribution boards/ Cabinets/ Panels shall be provided with fire stop systems. Cables passing through the openings at various locations are laid on various tiers of the cable trays/ racks in the bunch formation. Bidder shall visit the site to assess and get acquainted with the type of cable installation where fire stops and fire protection coating are to be provided. In case steel frames are required to be fabricated and fixed in the openings, the fabrication of frame & fixing of the same shall have to be done by the LSTK vendor without any extra cost. The necessary steel section for fabrication of frames shall be supplied by the LSTK vendor without any extra cost. Any civil works required to be done in the openings shall be carried out by the Bidder. Bidder shall also include one set of tools & accessories required for addition or removal of cables after the seal is made.

4.00 TYPE TEST ON PENETRATION SEALS

4.01 The type tests for fire proof/ penetration seal for floor and wall opening/ fire stop system for bottom of electrical switchgear/ MCC/ panel base are as under:

i) Fire rating test

ii) Hose Stream test

iii) Accelerated aging test

iv) Fire rating test on the penetration seal system built out of accelerated aged components followed by hose stream test

v) Temp. rise test for cable in the fire stop

vi) Water absorption test followed by fire rating test

vii) Flame Resistance test for fire retardant coating material

viii) Anti-rodent test

4.02 Fire Rating Test

This test shall be carried out to prove the guaranteed power rating duration of the system in respect of stability, integrity and insulation characteristics of the complete system. The penetration seal system as a whole conforming to ASTM E814 and as per BS:476 Part-8 shall be built with the necessary component. The fire test shall be built with the necessary component.

The test specimen of the penetration seal built with 9-10 nos. armored cables of various sizes passing through the seal shall be fitted to the gas fired furnace and shall form the upper most face of the furnace. The gas fired furnace shall have provision to achieve standard time temperature characteristics for fire tests as mentioned in BS-476 Part-8, according to which the temperature required to be maintained are as under:

Heating time (minute)	30	90	120	150	180	210	240
Furnace temp (°C)	821	886	1029	1062	1090	1113	1133

The pressure inside the furnace at the time of test shall be more than 2 mm water gauge. The penetration shall be subjected to fire test with surface exposed to controlled fire in the furnace conforming to time / temperature characteristics as mentioned above. During the test, temperatures of both the faces of the penetration seal i.e. one which is exposed to fire and the other unexposed, shall be measured by calibrated thermocouples after regular interval of 5 minutes. At least 3 thermocouples shall be provided for temperature measurement of each face.

4.03 The results at the end of the tests shall be interpreted or failure criteria as under:

i) The system is deemed to have failed to maintain stability if there is a total collapse of the penetration seal.

ii) In case cracks are seen on the face of the penetration seal or cracks through the seal system through which the flame / or gas can pass, the system is deemed to have failed to maintain integrity. The development of crack is characterized by ignition cotton wool held near the seal on the unexposed surface at a distance of about 30 mm from the aperture.

iii) In case the mean temperature rise of unexposed surface of seal exceeds 140°C above the initial temperature or temperature of unexposed surface exceeds 180°C, the system shall deemed to have failed in respect of insulation characteristics.

iv) Temperature measurement on the unexposed side of the penetration seal specimen shall be measured by the thermocouple on the surface of penetrating items and on fire stop material in accordance with ATME-814/UL 1479 at a distance of 25 mm from fire stop material and penetration items respectively.

4.04 Hose Stream Test:

The intention of the hose stream test is to ascertain whether the penetration seal assembly maintains its stability on application of water jet after withstanding the fire for 3 hours i.e. the guaranteed fire rating duration.

The test apparatus for this test shall be similar to the one used for carrying out the fire rating test. The penetration seal system shall be subjected to the action of hose stream at the nozzle pressure of 30 psi supplied for a duration of 1.5 sec./ sq. of exposed area. The hose stream shall be applied with 1.1/ 8" dia. nozzle at a perpendicular distance of approximately 17 ft. from the center of the assembly on a line approximately 270 deg. from the line normal to the center for the test assembly. The water stream shall be applied within 4 minutes and 30 seconds after completion of fire rating test.

However, this period shall not exceed more than 10 minutes in case of practical difficulties experienced by testing stations. The application of water stream shall be maintained throughout the test duration and shall traverse the complete fire stop system.

The fire stop assembly is deemed to have passed the hose stream test successfully if no through projection of water is noticed on the unexposed surface of the seal. Further on completion of hose stream test, the appearance of the penetration seal system shall not alter substantially indicating thereby that the stability of the system has been maintained.

4.05 Accelerated aging test

The intention of accelerated aging test is to ascertain whether the artificial aging of the systems and components thereof results into change in the mechanical properties or in the form. In order to simulate aging, artificial aging shall be resorted to.

For the purpose of subjecting the penetrations seal system components to accelerated aging, the system / components shall be stored for 336 hours in air furnace where the temperature of the inside air, shall be maintained at 100° C. However, for system components in pliable form, system component shall be stored for 448 hours in air furnace where temp. of air inside the furnace shall be maintained at 75° C. It is assumed that the changes occurring during test period would roughly correspond to the effect on aging over a period of about 40 years.

After completion of 336 hours / 448 hours, the mechanical properties such as tensile strength element, elongation and hardness of the material (as may be applicable) shall be tested. These results shall be compared with corresponding values before subjecting to accelerated aging test.

The change in the form of system / components shall also be compared with the form before the tests to ascertain whether the system / components thereof have undergone any permanent change.

In case the mechanical properties before and after the accelerated aging do not indicate substantial change, the system shall be deemed to have passed the accelerated aging test. Similarly the variation in the form of the system components at the end of the test shall not indicate permanent deformation which is likely to affect the ceiling properties of the system.

4.06 Fire Rating test After Accelerated Aging:

Intention to this test is to ascertain whether the penetration seal built out of components already subjected to accelerated aging still passes the fire rating test for guaranteed fire rating duration.

The test apparatus for this test shall be similar to the one used for fire rating test mentioned above. The assembly or the penetration seal shall be carried out with the components which were subjected to accelerated aging test based on the test procedure mentioned above. In case there is a problem of co-ordination with the test station, the prototype assembly may be subjected to aging in manufacturer's works under the conditions mentioned above and live fire test should be carried out at manufacturer's works in presence of Owner's representative.

In live fire test, the temperature of fire shall be of the order of 1000° C at the end of 3 hours. The test shall be carried out at atmospheric pressure.

The interpretation of test results for failure shall be similar to those mentioned under fire rating test/live fire test above.

4.07 Temperature rise test for cable in the fire stop:

This test shall be carried out to ascertain whether due to inadequate dissipation of heat at the location of fire stop, the temperature of cable conductor or outer sheath in contact with the fire stop, rises beyond the acceptable limits due to which whether any derating is required for cables.

Fire stop systems shall be erected with, at least 8-10 armored cables, specially power cables. While laying the cable through penetration seal, thermocouple shall be placed on the outer surface of cable in contact with the fire stop system. The location shall be selected where there exists possibility of inadequate dissipation of heat from cables to the atmosphere due to fire stop components. Two thermocouples shall also be located on the two surfaces of the fire penetration seal system. Similarly thermocouples shall also be placed on the other surface of cables where there exists contact of free air without any obstruction so as to enable adequate nature cooling.

In case the temperature of outer surface of the cable in contact or inside the fire stop system does not exceed 75° C, it is inferred that no derating of cable is required for cable when used in conjunction with the particular fire stop system.

Test shall be repeated with reduced current till the temperature of cable outer surface in contact with fire stop system is limited to 75°C. The rate of the current so guaranteed by the cable manufacturer as free air rating shall be the derating factor.

4.08 Water Absorption Test:

The test specimen shall be immersed in fresh clean water at a temp. of 20°C. The test specimen must be separated from the bottom and sides of the soak tank by at least 10 mm and it shall be covered by approximately 25 mm of water. At the end of the 24 hours soak period, the specimen shall be removed from the water and moped up with a damp cloth.

Fire rating test after water absorption is to ascertain whether the penetration seal subjected to water absorption still passes the fire rating test for guaranteed fire rating duration.

Test apparatus for this test shall be similar to the one used for fire rating test. In case there is problem of coordination with test stations, the prototype assembly may be subject to water absorption test at manufacturer's works followed by live fire test which should be carried out at manufacturer's works in presence of Owner's representative. In line fire test, the

temperature of furnace shall be of the order of 1000°C at the end of 3 hours. The test shall be carried out at atmospheric pressure.

4.09 Flame Resistance Test for fire Retardant Coating Material:

Sample strips shall be of ½ " wide, 12" long and approximately 70 mills in thick (without any reinforcement). Each strip shall be held vertically (clamped at the top) in a natural gas burner flame, (blue cone of flame touching bottom edge of sample) for 10 minutes. The flame shall then be removed and observation shall be recorded. In case, any flaming of the samples should cease after the removal of gas burner. White charred length of the sample should not exceed 1 &½".

4.10 Anti-Rodent Test:

Physical tests:

a) This test shall be carried out to ascertain the anti-rodent properties of the components of the Fire proof sealing system.

b) This test shall be carried out at approved test station performing sealing system tests on pharmaceutical products. The complete Fire Proof sealing system shall be subjected to attack of inspect / vermin such as rate for about 20 days.

c) At the end of the test condition of the surface of Fire Proof sealing system the test material shall be compared with the surface condition before commencement of the test. The fire stop shall be deemed to have passed this test in case no marks of growth are seen on the surface.

5.00 TEST CERTIFICATES

5.01 Certified copies of all tests carried out at works and at site shall be furnished in requisite number of copies.

5.02 Test reports shall be complete with all details and shall also contain limit valves specified in the relevant standards, wherever applicable, to facilitate review of Test Report/ Certificates.

5.03 The fire proof sealing system shall be installed only after receipt of approval of the test reports.

5.05 Testing Charges

The Bidder has to indicate that unit rates for conducting the type test successfully along with the offer, which will be considered for evaluation of tender.

SECTION – III/3 : TECHNICAL PART CONTROL AND INSTRUMENTATION

SECTION – III/3 – TECHNICAL PART CONTROL AND INSTRUMENTATION

1.00.00 GENERAL SPECIFICATION – PLANT INSTRUMENTATION & COMMUNICATION

1.01.00 System Description

This specification deals with entire Design, Supply, Erection & Commissioning of Instrumentation & Controls and Close Circuit Television Systems of Alumina Unloading and Transportation System for (NALCO) Atanu, Orissa, India.

A complete PLC based control system along with CCTV is envisaged for monitoring and control of the entire plant.

General

The instrumentation & control systems and communication systems under the scope of this package mainly consist of PLC, additional I/O card of existing PLC, Control Room Monitoring equipment, Local Field Instruments, Transmitters, local panels, junction boxes, cabling from sensor / MCC to Marshalling Rack through local panel / junction boxes, short & long cable trays, erection hardware of field Instruments, structural steel, commissioning spare etc., but not limited to them. Similarly a complete CCTV System, shall be required for this project.

1.02.00 Codes & Standards

Instrumentation and control equipment will be in accordance with the latest applicable standards of the following.

- Indian Standards (IS)
- Institute of Electrical & Electronics ENGINEER (IEEE)
- Instrument Society of America (ISA)
- National Electrical Manufacturers' Association (NEMA)
- American National Standards Institute (ANSI)
- Scientific Apparatus Manufacturers' Association (SAMA)
- American Society of Mechanical Engineers (ASMA)
- International Electro-technical Commission (IEC)
- American Society for Testing Materials (ASTM)
- Underwriters' Laboratories (UL)
- Institute of Printed Circuits (IPC)
- Deutsche Institute Normale (DIN)

All other national standards meeting or exceeding the requirements of the above listing shall also be considered.

1.03.00 Metering Bases and Chart Units

The following system of units shall be followed throughout the specification unless otherwise mentioned.

a)	Temperature	:	Degree Celsius (deg.C)
b)	Level	:	Meter
c)	Flow (Solid)	:	TPH

1.04.00 Plant Utilities

1.04.01 Power Supply

The Bidder will arrange for necessary Power Supply. Any conversion / stabilization for voltage shall also be carried out by the Bidder. Bidder will arrange 3 phase, 4 wire, and 415V AC supply from emergency power distribution board terminated at a convenient point. Any conversion/ stabilization for voltage ranges for the use by Bidder shall be carried out by the Bidder.

1.04.02 Air Supply

Instrument air tapping, further distribution of instrument air shall be done by the successful LSTK vendor. Accumulator, if at all required, for the operation to be provided by the successful LSTK vendor.

1.05.00 Scope of Work

1.05.01 Scope of Supply

Scope of supply by LSTK vendor includes the following but not limited to the same. If any other item is required for successful operation of the plant, the same shall be in LSTK vendor scope of supply.

- 1 no. of hot redundant Programmable Logic Controller, commercial grade PC based HMI, necessary Software, Printer, Network Switch, for New PLC and relevant accessories like Cables, U.P.S, etc.
- 1 (One) numbers of Operator's Station, 1 (One) number of Engineering station cum Operator Station (both 24" LED Monitor) for New Control Room.
- Redundant OPC (OLE for Process Control) Server for New Control Room.
- 1 no. of additional LAPTOP with Latest configuration (Win10,i7 10th Gen,8 GB DDR4 RAM,14" display,1 TB HDD) shall be supplied by LSTK vendor.
- Additional I/O card of Siemens S-7 300 PLC in existing Control Room – 2 to accommodate additional I/O and Graphics up gradation of existing HMI along with hook up of existing Siemens S-7 300 PLC & New PLC at New Control Room over redundant Fiber Optic communication. Necessary hardwire & software like Network Switch, Fiber Optic, Converter (if any) etc.
- Additional I/O card of Rockwell Control Logic PLC with Flex I/O & additional I/O panel in existing GTC-8 Control Room to accommodate additional I/O and Graphics up gradation of existing HMI along with hook up of existing Rockwell Control Logic PLC & New PLC at New Control Room over redundant Fiber Optic communication. Necessary hardwire & software like Network Switch, Fiber Optic, Converter (if any) etc.
- All Field Instruments such as sensors, transmitters, converters, indicators etc. along with Hart communicator.

- 2 nos. of Camera Server cum operator station with 24" LED Type Monitor & 1 no. of 74" Large Video Screen at New Control Room for CCTV system.
- One no A4 laser printer has been considered at New Control Room.

  The Existing PLC (situated at GTC-8 & Control Room -2) will be connected to New PLC (situated at New Control Room) through redundant fiber optic ring communication. The Fiber Optic shall be minimum 6 Fiber, Armored & single mode.

- 10 nos. of Fixed Cameras & 10 nos. of PTZ (Pan, Tilt, Zoom) Camera for CCTV monitoring & control along with 2 no. of Server cum Operator Station, 1 no. of 74" large video screen & accessories.
- Local Control Panel if any.
- Instrument Signal Cables, Power Supply Cables, Single Mode Fiber Optic cable, Junction Boxes, Small & Long cable Tray, Erection Hardware Stanchion & structural steel etc.
- Electrical accessories like control hand switch, indicating lamp, self-illuminated pushbutton, relays, Push button switches with emergency stop / lock etc. if any.
- 1 no. of parallel redundant UPS with individual Lead Acid SMF battery bank for each UPS at New Control Room for PLC System, CCTV System.
- All system furniture along with operator chairs shall be supplied by the LSTK vendor.

1.05.02 Scope of Service

Erection & Installation

Installation of all sensors, instruments and transmitters, local control panels, junction boxes etc. under the scope of supply. Cable laying and interconnection, tray laying for connectivity among the following to be ensured.

- Field Instruments to Junction Box (JB)
- Junction Box (JB) to Local Control Panel (LCP), if any
- MCC to Local Instrument Panel (LCP), if any
- Local Control Panel (LCP) to PLC
- Local JB/ panel to PLC cabinets
- Interfacing of all safety / sequence interlock, start/stop of rotary / static equipment with control system.
- Proprietary / Integral Instrumentation pertinent to the free issue items if any.

Calibration & Commissioning

Calibration & Commissioning: Individual calibration of all erected instruments, control loop commissioning and complete system testing under the scope of supply and services including the point to point testing of all signals between PLC station and remote station.

Bidder to furnish the list of proprietary control integral with the equipment. This suggested proprietary control of the equipment should be made in line with the following criteria.

- Safety of the equipment/personal
- Operational ease of the equipment
- Interlocks for integration of the equipment with rest of the system.

Control Room

LSTK vendor has to provide entire New Control Room. LSTK vendor to satisfy the Civil / Architectural, Illumination, False flooring & celling, Air Conditioning aspect of the building as specified in the respective section of this specification.

While designing New Control Room following to be envisaged:

1. The Control Room shall have Plant visibility.
2. The False Floor level of the Control Room shall match with the finished floor level of the rest.
3. The Head room Space of the Control Room shall be such that it can accommodate the panel. Tentative dimension of New Control Room 10 x 10 meter.

The tentative space requirement for Control Room is marked in the Layout. The exact space requirement will be finalized during detail engineering.

2.00.00 FIELD INSTRUMENT & AUTOMATION

DESIGN CRITERIA & CONTROL PHILOSOPHY

2.01.00 Design Criteria

PLC based control system has been envisaged for monitoring and control of the entire package (Alumina Unloading &Transportation) from HMI (Human Machine Interface). User-friendly operational facility from LED Monitor and keyboard / mouse based operator's station, with the help of windows based software has been envisaged for the project. The PLC system will be interfaced with the operator's station through HMI software. All OS & ES will be 24" LED type monitor. The PLC based System architecture has been envisaged for automation system (Refer Automation System Architecture for Alumina Unloading &Transportation System: 14L08-DWG-I-001, Rev-1). The control and monitoring system shall have facility to monitor process parameters, status of drives and control of all relevant process variables and operate any equipment from Plant Graphics on operator's station. Plant graphic screens will be prepared for each plant section and may be observed on all operator station. The control and monitoring system shall have facility to display all process abnormality with defined priority

and trip alarms for the corrective action by the operator. The system shall have facility to display alarm status and historical curves on all operator station.

Surge protection of solid-state equipment including Control System will conform to the Surge Withstand Capability (SWC) per ANSI C37-90a (IEEE Std. 472).

The instruments and control equipment shall be logically grouped in a functional sequence for convenient operation.

Isolated analog output of 4-20 mA DC and separate temperature element(from duplex one) shall be provided.

Bin level indicator (Radar type) in the each hopper will be provided. Apart from that, for choke sensor, Tuning fork type level switch will be provided for Hi and Hi-Hi level.

Bidder has to furnish necessary document to establish the correctness of Selection of different type of Instruments. However, following are the minimum guide line for instrument selection:

a) All Level transmitters are Radar Type unless otherwise specified.

b) All level switches are tuning fork type unless otherwise specified

c) For less than 200 Deg C RTD and greater than 200 Deg C Thermocouple is required.

2.02.00 Control Philosophy

In order to have better supervision, operation and control of the Alumina unloading & Transportation plant, microprocessor based redundant Programmable Logic Controller (PLC) suitable for industrial control system has been envisaged. The control system shall have the facilities for remote monitoring and sequential control, including local operation of individual equipment, audio and visual fault annunciation, normal status display, signaling, data logging, report generation, data storage for historical analysis, data display and printing etc. The PLC will be situated in the New Control Room. Ref: Automation System Architecture Drawing (14L08-DWG-I-001, REV-1).

Hot Redundant PLC System (i.e. Redundant CPU, Communication Processor, Power supply of each rack) has been envisaged. I/O card will be non-redundant. Make sure all information will be available in the PLC System.

Rockwell make Control Logic PLC with Flex I/O shall be preferable for new PLC which may fulfill better inventory.

Besides the above new PLC, additional I/O of the following area shall be accommodated in the respective area existing PLC (Ref: Automation System Architecture Drawing, 14L08-DWG-I-001, REV-1):

- Control Room - 2 PLC
- GTC - 8 Control Room PLC

Control Room -2 PLC:

Existing Control Room -2 have non redundant Siemens S-7 300 PLC. Additional I/O of the silo 1 & 2 area shall be accommodated in existing Control Room – 2 PLC. There is free space in the existing I/O panel to accommodate the additional I/O card. LSTK vendor has to supply additional I/O card along with all accessories like back plane PCB, Terminal Block, interposing relay etc. to accommodate additional I/O. The supplied I/O cards shall have sufficient numbers of channel so that it can accommodate all the requirement of process and shall have about 30% of spares channels available for future use . LSTK Vendor to ensure that all I/O cards & accessories shall be from same make, family of hardware as that of existing one. Graphics up gradation of existing HMI along with hook up of existing Siemens S-7 300 PLC & New PLC at New Control Room over redundant Fiber Optic communication under the LSTK Vendor scope. Necessary hardwire & software like Network Switch, Fiber Optic, Converter software (if any) etc. shall be supplied by the LSTK Vendor.

Refer: Tentative layout of the existing Control Room – 2 (14L08-DWG-I-CR-002, Rev-0)

GTC-8 Control Room:

Existing GTC-8 Control Room have redundant Rockwell Control Logic PLC with Flex I/O. Additional I/O of the silo 5 & 6 area shall be accommodated in existing GTC-8 Control Room PLC. There is free space in the GTC-8 Control Room to accommodate the additional I/O Panel. LSTK Vendor has to supply additional I/O Panel with I/O card, Communication card along with all accessories like back plane PCB, Terminal Block, interposing relay etc. to accommodate additional I/O. The supplied I/O cards shall have sufficient numbers of channel so that it can accommodate all the requirement of process and shall have about 30% of spares channels available for future use . LSTK Vendor to ensure that all I/O cards & accessories shall be from same make, family of hardware as that of existing one. Graphics up gradation of existing HMI along with hook up of existing Rockwell Control Logic PLC & New PLC at New Control Room over redundant Fiber Optic communication under the LSTK Vendor scope. Necessary hardwire & software like Network Switch, Fiber Optic, Converter software(if any) etc. shall be supplied by the LSTK Vendor.

Refer:Tentative layout of the existing GTC-8 Control Room (14L08-DWG-I-GTC-008, Rev-**1**)

The purpose communication with existing PLC & New PLC is to get rid of the issues of any overlapping of command regarding silo filling, necessary interlocks to be incorporated in the existing PLC as well as new PLC. Ref: Automation System Architecture Drawing (14L08-DWG-I-001, REV-1).

This being a Brown Field Project, it is advised that LSTK Vendor has to visit the site before quotation.

Local panels, if at all offered for the drives like Air Blower, Compressor etc, will be placed near to drives.

Switchgear related input will be connected to PLC for information of electrical system & report generation. It is envisaged that IED will be connected to Network switch with Peer to Peer Communication and MFM will be connected to PLC through RS 485 communication with daisy chain. Hardwired electrical I/O will be connected to PLC directly through control cable.

Following facilities have been envisaged for the PLC system as minimum:

1) Real time automatic centralized control (starting and stopping) from control room for all equipment in accordance with a pre-determined sequence (both for starting and stopping) for normal operation of the plant so as to ensure safe and efficient operation of entire plant.

2) Stopping of any equipment from the control station located near the drive of respective equipment under all conditions including emergency.

3) The wagon unloading control and silo selection shall be carried out from the new control room. The signals indicating faults on the silos shall be visualized in the above of control room. Selection of silo to be filled will be made by an operator MANUALLY according to Alumina level in different silos. These levels will be indicated by devices designed to show at any given time the level of alumina in storage.
   When wagons have been emptied, unit should be stopped in reverse order i.e. equipment nearest wagons first. Any incident, equipment stoppage or blocking will be reported to unloading station by audio-visual signal.

4) Stopping of conveyors in case of emergency by safety Switches etc. provided along the conveyors. Tripping of any conveyor will trip upstream conveyors & downstream conveyors sequentially after a time lag. Safety switch has been envisaged both side of all conveyors maintaining standard distance. Safety Switch status will be displayed in the HMI.
   Each safety switch will be addressed to MCC. Hardwired multiplication will be done in the McCone contact will be connected to PLC and other one will be connected to MCC for hardware interlock.

5) Safety interlocks of the equipment should be provided hard-wired into the drive level i.e. in McCall the drive safety related switches shall be multiplied in the MCC to make two contacts other than that used in the scheme. One set of contact shall be sent to the PLC and the other set of contact shall be used to MCC / Sw. Gr. to realize the drive safety interlock. This will ensure minimum Drive Safety aspects of all the Drives. The operation logic of the drives is explained in the “Drive Logic” Dwg.(Dwg No: 14L08-DWG-I-DP-001/002, Rev –1). However the logic for the safe operation of each equipment will be developed during detail engineering

6) Bin level indicator (Radar type) in the each hopper will be provided.

7) PLC System will be communicated with VVF drives & other 3rd party system through soft communication depending on the system protocol, if any.

8) Starting and stopping of any desired equipment can be done independently from local control stations located near the respective motors / drives for maintenance / repair / testing by selecting remote / local mode of operation from the LPBS.

9) Sounding audio alarm / warning system prior to starting of the plant for information to plant personnel / maintenance staff to keep a safe distance from equipment under operation.

10) Special care should be taken so as to ensure availability of signal to & from PLC & field keeping the furthest distance between PLC & field instruments in design consideration.

The control of all equipment will be done from the New Control Room .The operating station will have password protected facility for issuing of command.

Control logic for the entire plant will be achieved by programmable logic controller (PLC) with ladder logic having features such as auto-mode; manual mode; operator guide mode; and stimulation mode.

2.03.00 Operation Philosophy

The following modes of operation of the plant have been envisaged.

a) Local/Remote Selection

For every drive there will be a Local/Remote Selector Switch near the drive, preferable in the same plague of Local Push Button Station. The Selector Switch is kept in Local position during testing, commissioning only. Normally the Selector Switch will be kept in Remote position.

b) Remote Operation

Drives can be started from Remote Mode i.e. HMI stations provided there is no safety interlocks active & Local/Remote Selector Switch kept in Remote position. Also in this type of operation, the sequential starting of the drive can be performed by group selection mode as well as individual selection mode provided there is no safety interlock active & process interlock are alive.

Drives can be stopped from Remote Mode i.e. HMI stations irrespective of any situation. The drives will stop automatically in case safety interlock is active.

d) Local Operation Mode

Drives can be started from Local Mode i.e. through LPBS provided Local / Remote Selector Switch are selected in Local mode.

Drives can be stopped from Local Mode i.e. LPBS irrespective of any situation. The drives will stop automatically in case safety interlock is active.

e) ***Emergency Operation***

One no emergency push button is envisaged for every drive. This push button will be physically situated on the operator console in Control Room. The emergency push button will be directly hardwired to MCC/ SW GR for stopping of the drive irrespective of any situation.

f) Conveyor Operation Philosophy

In case of tripping of any intermediate conveyor in a chain of conveying system, the feed end conveyor has to stop first. With a pre-set time gap adjacent downstream conveyor shall stop sequentially.

In case of starting a chain of conveyor, the discharge end belt has to be started first. The adjacent belts will be started with a preset time gap sequentially towards feed end.

- Operation of Siren

  A safety warning through siren/hooters near the drive for the field personnel & safety of major drive a pre-set time followed by a definite time when drive will start.

  Note 1: In case of the drives having Auxiliaries following philosophy to be adopted:

  The Start Permissive Command to be generated in PLC for the main drive to start.

  Note 2: In case of the Standby drive following philosophy to be adopted:

  For all the drives having one stand by drive there shall be a SS for selection of the drive.

REDUNDANCY:
A system component shall be termed as redundant if it takes over the operation automatically on the failure of the main component without causing any interruption in the system and upsetting the process. The repaired or replaced device shall be brought in line only through operator action.

HARDWARED REDUNDANCY:
In hardware redundancy the failure of CPU is sensed in hardware level itself and thus change over time is less than 100 milisecond with bump less transfer of control to the healthy processor without affecting the plant operation.

All the Processors, communication components and power-supplies are to be considered 1:1 hardware hot redundant.

2.04.00 Field Instruments:

Instrumentation sensing, transmission, measuring & computing systems will be electronic and final control elements such as control valves etc. shall be pneumatic in general.

Signal transmission from field to control room and vice-versa will be in the current mode i.e. 4-20 mA DC through signal isolator having gain adjustment feature.

All field Instruments are envisaged to be Smart type giving output with superimposed digital signal conforming to HART protocol.

All safety switches of the conveyor belt shall have individual local indication as well as remote indication.

All temperature elements RTD/Thermocouple will be duplex type. Temperature transmitters will be used for all temperature elements to generate 4-20 mA signals. Up to 200^0C RTD shall be used, more than that Thermocouple may be used.

All site pressure transmitters shall have provision of local indication as well as signal to the control room for indication. However, all transmitters shall have in built local indication.

Level measurements shall be Ultrasonic Type for liquid & Radar Type for solid. All level transmitters shall have display unit at 1 meter above grade level. For open environment the enclosure housing the controller shall be of IP67 protection. Only separate transducer & transmitter will be accepted in this context.

Pull chord switch shall be intelligent type.

All field instrument installation shall have suitable approach for maintenance.

Canopy shall be provided for all open environment installation.

All field instrument enclosure shall have IP 67 protection for open environment installation. Others may have IP 65 protection.

All Solenoid Valve for pulsing/purging of the bag filter system shall be actuated by centralized PLC (not a local PLC) directly through interposing relay or contactor.

The dedusting system shall be provided with differential pressure transmitter having local indication as well as in the PLC.

All pressure switches should have a process connection of 3/8" BSP (M) preferably and all pressure gauges should have a process connection of ½" NPT (M).

All field instruments will be terminated in the local junction box. Individual & overall shielded, twisted pair (1.0 sq. mm) cables shall be used for analog signals. Over all shielded (1.5 sq. mm) core cable shall be used for Digital signals. Multicore or Multipair cables will be used from local junction box to the marshalling cabinets or Input/output terminal blocks of PLC system. All cable shall be ATC Cu cable

LSTK Vendor to furnish necessary document to establish the correctness of type of control valve & its material of construction and different type of liquid are concerned. The general minimum guide lines for valves are as follows:

a) For Water, Steam the valve should be Globe type.

b) Hand Wheel is required for all valves unless otherwise specified.

c) Control valves shall be Equal Percentage with Class IV Leakage as a minimum.

2.05.00 TECHNICAL SPECIFICATION OF FIELD INSTRUMENTS

INDEX OF FIELD INSTRUMENT SPECIFICATION

- Instrument Signal Cable
- Control Cable
- Pressure Transmitter
- Radar Level Transmitter
- Pressure Gauge
- Junction Box (Instrument)

Certain minimum parameters for various items are included below. However the final Parameters shall be as per system requirement, and shall be finalized during detail engineering.

2.05.01 INSTRUMENT SIGNAL CABLE

Type	:	Twisted pair
Conductor	:	20 AWG multistrand annealed tinned copper
Inner sheath	:	Extruded PVC
Lays per meter	:	25 to 30
Mode of wrapping layers	:	Mylar tape and filler chord
Mode of individual & overall shielding	:	Aluminized mylar tape wrapped with 25% overlapping.
Overall sheath of cable	:	FRLS PVC
Continuous operating temperature	:	70^0C
Voltage grade	:	600 Volt
Signal drain wire	:	Continuous tinned copper under the aluminium side of the screen
Core identification	:	By standard colors as well as numbering at frequent intervals.
Standard pairs	:	1 pair, 2 pairs, 4 pairs, 8 pairs, 12 pairs, 16 pairs – as applicable.
Preferred features	:	(i) G.I. wire/strip armouring (ii) Annealed tinning through electrolysis process.
Accessories	:	(i) Flexible & rigid conduit with necessary fittings as applicable. (ii) 5mm perforated cable trays wherever applicable. (iii) 300mm cable trays. (iv) Lockable – unlockable type PVC/nylon cable straps. (v) All other accessories required for decent installation. (vi) Fork-type termination lugs for all terminal points.

2.05.02 CONTROL CABLE

Type	:	Multi-core
Conductor	:	1.0 mm^2 multi-strand annealed tinned copper
Inner sheath	:	Extruded PVC
Continuous operating temperature	:	70^0C
Voltage grade	:	600V
Armouring	:	Rounded GI wire/strip with overlapping
Overall sheathing	:	FRIS PVC/ Fluropolymer insulation.
By standard colors as well as numbering at frequent intervals.	:	By standard colors as well as numbering at frequent intervals.
No. of cores	:	3/4/7/12/19 as applicable
Accessories	:	(i) Flexible & rigid conduit with fittings.

(ii) Cable trays with mounting accessories.

(iii) Lockable - unlockable type PVC/ nylon cable straps.

(iv) Fork-type termination lugs for all termination points.

2.05.03 DIFFERENTIAL PRESSURE

Type	:	(SMART type) Capacitance / Induction type.
Transmitter	:	2-Wire.
Output signal	:	4-20 mA DC (linear).
Signal processor unit	:	Silicon on solid-state circuitry.
Measuring element	:	Capsule/diaphragm depending on line pressure/fluid.
Measuring diaphragm/capsule material	:	AISI-316 (SS).
Static / overload pressure	:	Max. static pressure on either side without permanent deformation or accuracy loss.
Range	:	To be about 1.5 times normal value.
Span adjustment	:	1:4 (min.).
Zero adjustment	:	Easily accessable.
Zero suppression / elevation	:	Suppression - 150% of span (min). Elevation - 50%of span (min).
Enclosure	:	IP-65 as per IS/IEC-60529
Output ripple	:	0.25% of span (max.).
Output indicator	:	To be provided.
Nameplate	:	Suitable Tag No.
Body	:	CS / SS depending upon fluid condition.
Ambient temperature	:	65 deg.C
Load impedance	:	750 Ohms at 24 Volts (min.)
Process connection	:	½" NPT (F)
Performance		
a) Accuracy (combined)	:	± 0.5 % of span or better.
b) Repeatability	:	± 0.05% of span or better.
c) Sensitivity	:	± 0.1 % of span or better.
d) Hysteresis	:	± 0.05% of span or better.
e) Temp. effect on calibration	:	Not to exceed ± 0.5 % of span per 50 deg.C regardless of rate of change
f) Power supply effect	:	± 0.005 % per volt.
Sealing / Isolation	:	Extended diaphragm with 3m SS armored capillary or extension cable for corrosive & dirty fluid applications. Material for separator diaphragm depending on application (whenever required).
Accessories	:	a) Universal mounting bracket suitable for pipe and wall mounting. b) High tensile carbon steel U-bolt. c) Installation accessories as per relevant installation drawing.
Preferred feature	:	a) Test plug connection and cut out terminals physically separated from other electronics.

b) Isolated 4-20 mA signal.

2.05.04 PRESSURE GAUGE

Type	:	Bourdon
Sensing element material	:	Bourdon – AISI 316 SS for pressure above 40 Kg/Sq.cm.g and where type of fluid demands the same.
Movement material	:	AISI 304 SS / Non-ferrous metal.
Case material	:	Die cast aluminium, stove enameled, black finish, threaded bezel ring, clear glass cover conforming to IP-65 as per IS/IEC-60529 .
Dial size	:	150 mm in general.
Scale	:	Black lettering on white background in 270° arc.
Range selection	:	Normal process pressure – 70% of range approximately.
Over-range protection	:	125% of maximum range by internal stop. External stop at zero.
Adjustment	:	External micrometer screw for zero adjustment.
Process connection	:	½" NPT (M) bottom connection for local mounting, back connection for panel mounting (if so required).
Performance	:	Overall accuracy ± 1.0% of span.
Operating ambient temperature	:	70 deg.C (max. continuos).
Safety feature	:	Neoprene safety diaphragm at the back.
Accessories	:	a) Stainless steel union nut & tail piece per pipe union. b) Snubbers for pulsating fluid application. c) SS-316 with Teflon coating diaphragm seats (with capillary extension, if reqd.) for corrosive, viscous, solid bearing or slurry type process fluid with 5m armored capillary. d) 3 way SS gauge cock. e) Installation accessories as required. f) Necessary mounting bracket for outdoor.
Codes & accessories	:	a) ASME PTC 19.2 (2010). b) IS: 3624 1987.(reaffirmed 2004)

2.06.00 PROGRAMMABLE LOGIC CONTROLLER

2.06.01 SYSTEM DESCRIPTION

The Control System mainly consist of Electrical Accessories, Programmable Logic Controller system, I/O card, Human Machine Interface, Logic Software, Single /Multi core Cables, UPS etc. but not limited to them.

The responsibility of the Bidder is to supply/lay/terminate field cable from instrument to JB / Local Panel and the main raceway cables from these the local panel / local J.B to the marshalling rack of the PLC System.

1.1 The Owner shall be consulted in case of any conflict noticed in this specification. The Bidder shall not deviate from this specification without the prior approval from the Owner.

1.2 Bidder shall furnish a detailed list of deviations / confirmations clause-wise described in this specification and data sheet. Bidder must provide enough supportive reason for the deviations.

1.3 Bidder shall quote as optional offer for following items also (to be made valid for 1 year):

a) Recommended Spares for 2 years trouble free operation.

b) Consumables for six months.

However, any spare required for startup, commissioning & performance guarantee will be arranged by the Bidder without any extra cost. Regarding Recommended Spare Owner will have option to place order for any quantity or any item within six (6) months from the date of placement of L.O.I.

2.06.02 CODES & STANDARDS

Programmable logic controller system will be in accordance with the latest applicable standards of the following.

- Indian Standards (IS)
- Institute of Electrical & Electronics Engineer (IEEE)
- Instrument Society of America (ISA)
- National Electrical Manufacturers' Association (NEMA)
- Scientific Apparatus Manufacturers' Association (SAMA)
- International Electro-technical Commission (IEC)
- Electronic Industries Association (EIA)

All other national standards meeting or exceeding the requirements of the above listing shall also be considered.

2.06.03 Power Supply

Bidder will arrange 3 phase, 4 wire, 415 V AC supply from their emergency power distribution board. Any conversion/ stabilization shall be carried out by the Bidder.

2.06.04 SCOPE OF WORK & SERVICES

Scope of Supply

Scope of supply by Bidder grossly includes the following.

1 no. hot redundant Programmable Logic Controller, HMI, All Software related to successful operation of Automation System, Network Switch, Cables, UPS etc. Refer Automation (PLC) System Architecture (DWG No- 14L08-DWG-I--001, REV-1).

1 (One) numbers of Operator's Station, 1 (One) number of Engineering station cum Operator Station (both 24" LED Monitor) for New Control Room.

CCTV: Control room along with a 74" wall hanging screen for monitoring and control of CCTV cameras.

1 no. of additional LAPTOP with Latest configuration shall be supplied by LSTK Vendor.

Additional I/O card of Siemens S-7 300 PLC in existing Control Room – 2 to accommodate additional I/O and Graphics up gradation of existing HMI along with hook up of existing Siemens S-7 300 PLC & New PLC at New Control Room over redundant Fiber Optic communication. Necessary hardwire & software like Network Switch, Fiber Optic, Converter (if any) etc.

Additional I/O card of Rockwell Control Logic PLC with Flex I/O & additional I/O panel in existing GTC-8 Control Room to accommodate additional I/O and Graphics up gradation of existing HMI along with hook up of existing Rockwell Control Logic PLC & New PLC at New Control Room over redundant Fiber Optic communication. Necessary hardwire & software like Network Switch, Fiber Optic, Converter (if any) etc.

This PLC system shall be hooked up with existing PLC system. Requirement any hardware for the hook up shall be provided by the Bidder.

Redundant OPC (OLE for Process Control) server in the New Control Room

One no A4 laser printer has been considered at New Control Room.

The Fiber Optic shall be minimum 6 Fiber, Armored & single mode.

Besides PLC there shall be data cable from RI/O's (Supplied by Bidder) situated at the various location of the field.

Bidder to supply following as a minimum. Bidder may propose some other component if, felt necessary.

The Interposing Relay necessary for exchange of "Start Command" /"Stop Command" from Control Room to MCC and "Started Feed Back"/ "Stopped Feed Back" from MCC to Control Room.

All PLC outputs to be routed through fuse terminal having LED type fuse blown indication and interposing relay board having dual ended potential free relay contacts having suitable contact rating.

The Terminal Block for terminating field wires in the PLC shall be "Lever type fused terminal with LED type fuse blown indication".

All I/O interrogation shall be through Non UPS power supply only. In this regards Digital Input Isolation scheme shall be maintained. (Refer: Digital Input Isolation Scheme Drawing: 14L08-DWG-I-DI-001, Rev-0).

24 VDC power supplies used in the PLC panel shall be configured in hot redundant mode through Diode Bridge. DI shall be envisaged for monitoring the health of these power supplies and corresponding alarm to be generated in the HMI screen in case of failure. (Refer: 24 VDC Power supply drawing – 14L08-DWG-I-PS-001 Rev-0).

Switchgear related input will be connected to PLC for information of electrical system & report generation. It is envisaged that IED will be connected to Network switch with Peer to Peer Communication and MFM will be connected to PLC through RS 485 communication with daisy chain. Hardwired electrical I/O will be connected to PLC directly through control cable

Entire Multicore Cable required to take the signal from Local Control Panel / Field Junction Box to PLC is in the scope of supply of the Bidder. Grossly the types of cable are Twisted Pair, Screened Instrument Cable for Analog input / Output to PLC. Triad Cable for Motor RTD to PLC, Control cable for Digital Input / Outputs to PLC, Power Cable to feed UPS Power to the special instruments and Optical Fiber Cable for networking.

a) All Power Cable from UPS at New Control Room to field, required for powering of the special instruments. The distribution from Field Power Junction Box to Individual instruments.

b) All communication cable necessary for picking up the data from local PLC to the switch shall be in the scope of supplier. Bidder to Supply, lay and terminate Communication cable.

c) All Communication cable shall be armored. All Communication cable shall be Redundant so that in case of breakage of one, other can be used.

d) UPS output power distribution through a Distribution Box contain MCB's of appropriate rating are to be included in the scope of supply, erection, commissioning which shall be installed in the control room & field also.

The Uninterrupted Power Supply (UPS) system will supply regulated, filtered and uninterrupted 240V, 50 HZ, single phase power within 1% voltage regulation to PLC, HMI, Printer etc. for Automation System, Local control panel and other critical loads like CCTV. The UPS system batteries will be Ni-Cad heavy-duty sealed pack maintenance free. UPS are envisaged for New Control Room. The UPS shall be 2 X 100 % paralleled redundant. Basic architecture of UPS drawing (14L08-DWG-I-UPS-001, REV-0) shall be used as ready reference.

Voltage	:	230 V AC
Frequency	:	50 Hz
Switchover time	:	5 Millie second

Following criteria to be full filled:

a) The KVA of UPS should be such that it can cater to 50% additional load.
b) There should be SCVS at the input side.
c) The battery should be Lead Acid SMF (Sealed pack Maintenance Free)
d) The back-up time will be minimum 120 minutes.

Interposing Relays with suitable contact rating shall be supplied for all digital outputs. All digital outputs shall be Potential free contacts.

Data highway shall be Hot Stand by connecting all sub-system. Communication Processor shall also be Hot Stand by.

Scope of Service

1 Bidder to estimate the length of multicore cable. Bidder to do the Cable Schedule Dwg. The multicore cable will be laid / terminated by the Bidder.
2 Typical cable specification is enclosed. Bidder to confirm that the same is acceptable for performance of the system satisfactory.
3 The Grounding of the entire system is the responsibility of the Bidder. There shall be discrete System / Electrical Grounding & Safety / Power Grounding.
4 Development of Logic & HMI shall be in the scope of the Bidder.
5. Installation of HMI & ON Line PLC S/W, Development of SCADA screens, Application logic software.
6. All Scada screens shall be developed in consultation with NALCO.
7. Application program MUST be developed in LADDER LOGIC only.
8. Paper based license to be provided no dongle based license is acceptable.
9. All the software licenses (PLC, Microsoft, Antivirus etc.) must be purchased in the name of "Smelter Plant, National Aluminium Company Limited, Nalconagar, Angul". The documentary evidence in this regard must be submitted to NALCO.
10. All the HMI stations/CCTV servers shall be loaded with Antivirus software having 3 Year license

The following to be clearly spelt out by Bidder in his offer:

a) Training

Minimum numbers of personnel to be trained by the Bidder at their place and at site are furnished below

	At Owner Site			At Bidder Site
	Eng	Sup	Tech	Eng
Plant Operation	3 ( )	3 ( )	6 ( )	1 ( )
Plant H/W maintenance	2 ( )	3 ( )	3 ( )	1 ( )
HMI, Logic S/W	2 ( )	3 ( )	Nil	2( )

Number of Days shall be kept blank in the () to be filled in by the Bidder.

All Charges excluding that of TRAINING to be borne by the Owner

ERECTION & INSTALLATION

Supply, laying and termination of multi-core / pair instrument signal & control cable is in the scope of Bidder.

POWER SUPPLY AND ITS DISTRIBUTION

All type of power supplies generation and further distribution of power supply shall be in Bidders' scope. The distribution network for interrogation voltage shall be designed such that a single fault in any branch shall not cause trip of the logic other than where fault has occurred.

THIRD PARTY INTERFACE

There could be Third party PLC with some special equipment, if any. Bidder has to establish the Bit Map & protocol for smooth operation of drives.

AFTER SALES SUPPORT

System LSTK Vendor has to ensure after sales service support for Ten (10) years after commissioning. Letter of PLC manufacturer shall be submitted along with technical part.

2.06.05 DESIGN CRITERIA & CONTROL PHILOSOPHY

Design Criteria

Instrumentation & Control System envisaged shall consist of a Programmable Logic Control System with integrated monitoring system of the significant variables. Any improvement in system design from the Bidder may be accepted provided the Project Schedule and requirements of the plant remain unaffected.

The operator interface shall be through operator station, monitors and Keyboards at the New control room. There shall be 1 no of operator stations & 1 no of OS cum ES, each with dedicated monitor and keyboard. One no of A4 laser printer will be considered in the operator console. Monitors shall be of 24" size LED screen, high resolution 1280x1024 pixels. Display update time shall be 1 to 2 sec.

Hot Redundant PLC System (i.e. Redundant CPU, Communication Processor, Power supply of each rack) has been envisaged. I/O card will be non-redundant. Make sure all information will be available in the PLC System.

Rockwell make Control Logic PLC with Flex I/O shall be preferable for new PLC which may fulfill better inventory.

Besides the above new PLC, additional I/O of the following area shall be accommodated in the respective area existing PLC (Ref: Automation System Architecture Drawing, 14L08-DWG-I-001, REV-1):

- Control Room - 2 PLC
- GTC - 8 Control Room PLC

Control Room -2 PLC:

Existing Control Room -2 have non redundant Siemens S-7 300 PLC. Additional I/O of the silo 1 & 2 area shall be accommodated in existing Control Room – 2 PLC. There is free space in the existing I/O panel to accommodate the additional I/O card. LSTK Vendor has to supply

additional I/O card along with all accessories like back plane PCB, Terminal Block, interposing relay etc. to accommodate additional I/O. LSTK Vendor to ensure that all I/O cards & accessories shall be from same make, family of hardware as that of existing one. Graphics up gradation of existing HMI along with hook up of existing Siemens S-7 300 PLC & New PLC at New Control Room over redundant Fiber Optic communication under the LSTK Vendor scope. Necessary hardwire & software like Network Switch, Fiber Optic, Converter (if any) etc. shall be supplied by the LSTK Vendor. The Control room-2 is within 50 m radius of Silo 1 & 2. Cable and cable tray will be provided by successful bidder as per requirement to be decided during detail engineering

Refer: Tentative layout of the existing Control Room – 2 (14L08-DWG-I-CR-002, Rev-0)

GTC-8 Control Room:

Existing GTC-8 Control Room have redundant Rockwell Control Logic PLC with Flex I/O. Additional I/O of the silo 5 & 6 area shall be accommodated in existing GTC-8 Control Room PLC. There is free space in the GTC-8 Control Room to accommodate the additional I/O Panel. LSTK Vendor has to supply additional I/O Panel with I/O card, Communication card along with all accessories like back plane PCB, Terminal Block, interposing relay etc. to accommodate additional I/O. LSTK Vendor to ensure that all I/O cards & accessories shall be from same make, family of hardware as that of existing one. Graphics up gradation of existing HMI along with hook up of existing Rockwell Control Logic PLC & New PLC at New Control Room over redundant Fiber Optic communication under the LSTK Vendor scope. Necessary hardwire & software like Network Switch, Fiber Optic, Converter (if any) etc. shall be supplied by the LSTK Vendor. The GTC-8 Control room distance from Silo 5 & 6 is approx. 170 m. Cable and cable tray will be provided by successful bidder as per requirement to be decided during detail engineering

Refer: Tentative layout of the existing GTC-8 Control Room (14L08-DWG-I-GTC-008, Rev-0)

Since the Project involves networking with multi LSTK Vendor PLC (SIEMENS S7 300, Rockwell's Control Logic with Flex I/O, etc.) including bidirectional communication / transfer of data, redundant OPC server is envisaged for New Control Room.

All contacts from MCC for Start/Stop/Trip feedback of LT motors shall have contact rating of 230V AC 5A and the same to be terminated at the I/O Racks in the Control Room.

All Analog Input channels should have isolated grounding; Digital Input may have common ground.

Controllers with following facilities:

a) The % loading of the processor should be such that the following scan time remains unaffected:
b) 500 M Sec scan time for all Interlock
c) 2 Sec scan time for Temperature signal related to monitoring only
d) 1 Sec scan time for all other Analog & Digital Open Loop.
e) Processor shall be Hot redundant and the redundancy shall be achieved through hardware and not through software.
f) The SOE inputs pertinent to electrical system will have a scan time of 1 m sec.

Input devices to power and receive 4-20 mA from 2 wire/ 4 wire transmitters, low value signals from thermocouple/RTDs, Switches etc. Output devices to drive, VVFD etc.

Special care should be taken so as to ensure availability of signal to & from PLC & field keeping the furthest distance between PLC & field instruments in design consideration.

Dual fiber optic cable should be considered to which RI/O's will be connected through patch panel.

The electrical interface with the PLC will be as follows:

a) For LT drives (>30KW<160KW) current, voltage, power transducer output will be made available to PLC as analog input (4-20 ma). The transducer is detailed under electrical section of this package.

b) For the HT drives, incomer, bus coupler, outgoing feeder etc. wherever numerical relays are being used, the soft connecting with PLC is envisaged.

c) The type of connectivity (either peer to peer or daisy chain) will depend on the protocol used in the numerical relay.

d) Any hardware including cables shall be in the scope of supply.

e) The facility should be provided to monitor & parameterize the numerical relays from the engineering station.

2.06.06 PLC Specification

- Programmable logic controller (PLC) shall be at least 32 Bit processor based system, which shall be used to execute all the process and safety shutdown interlocks of the plant. PLC shall be capable of handling Analog loops also.

- Hardware based Redundancy of CPU is envisaged. Software redundancy is not acceptable.

- PLC Software shall be OPC (OLE for Process Control) compatible. All Hardware & Software shall be same family.

- The Digital Output cards shall have Built in Relay to send the commands to MCC and the Digital Output cards shall have built in Relay along with 24 DC Voltage to drive the SOV's.

- All I/O & I/O interface cards shall be hot swappable.

- The DI/DO cards shall not be more than 32 I/O's. Similarly AI cards shall not be more than 16 Inputs and AO cards shall not be more than 8 output.

- The system shall be highly reliable and shall have well proven record of operating satisfactorily in the mineral processing plant for a minimum of Three year for the similar application for the offered PLC platform.

- Rack based redundant Power supply units shall be provided for individual I/O rack and processor i.e. Two (2) No's of Power supply in each I/O Rack. Suitable battery backup shall be provided for memory protection.

- 24 VDC power supplies (if any) used for I/O interrogation shall be configured in hot redundant mode through diode bridge. DI shall be envisaged for monitoring the health of these power supplies and corresponding alarm to be generated in the HMI screen in case of failure.

- Operation of the PLC shall be completely unaffected by a momentary power loss of the order of 20 M Second.

- The Scan time of programmable controller shall be a maximum of 250 milli second. Scan time of PLC shall be defined as the cycle time taken by the system to read input, process input executing logic and update control output for all the logic and manipulated variable configured within the system.

- On-line replacement of any modules (CPU, Power Supply, Networking Module, I/O Module) shall be possible in such a way that the removal and addition of any module shall be possible without de-energizing the system i.e. hot swappable. Further there shall not be any interruption in the system while replacing a faulty module except for the inputs/outputs which are being handled by that module.

- Bidder to offer latest version of PLC Bidder to produce the document where in date of launching of the product is mentioned.

- Alarm and event logging, Separate Alarm & Event page should be available in all HMI.

- Processor and the Back Up memory should be such that it can take care of the following:

  a) Total 1000 history points having following frequency and period:

     i) 200 tags to be stored for 15 days with a sampling rate of 1 sec.

     ii) 500 tags to be stored for 30 days with a sampling rate of 2 sec.

     iii) 500 tags to be stored for 30 days with a sampling rate of 5 sec.

  b) Unlimited nos. of Dynamic Graphics pages.

2.06.07 Spare Philosophy

The system shall have following minimum spare capability:

a) I/O racks of PLC shall have 20% spare slots for installing I/O modules of each type in future. These racks shall be part of the offer. Each installed I/O card shall be such that it can take care of 10% I/O additional input to the existing one.

b) The processor system shall have the capability to execute logic for these additional I/Os. In addition it shall be possible to extend memory by additional 20% at a later stage.

c) Power supply module shall be capable to take load of the above mentioned spares.

d) The PLC console shall have capacity to meet all requirements for the additional input/outputs as mentioned above.

e) Wherever relays are used to interface process input/outputs with PLC, 20% additional relays shall be provided. In addition 20% spare space shall be provided in cabinets to install 20% additional relays in future.

f) Wiring/termination and terminals shall be provided to meet spares as mentioned above.

g) Network switch shall have 20% spare ports.

h) Paper and ink required for printer, copier or any other consumable item should be supplied along with the system required for minimum of six months after commissioning and handing over.

2.06.08 System Configuration

The system shall consist of following major sub-systems:

- Input /Output Sub-system

  The I/O modules shall be mounted in the I/O racks located in the New Control Room i.e. a general purpose unless otherwise specified. I/O devices interface with PLC shall be at I/O racks only. Channel level Diagnostics of I/O modules is preferred. However, Card level Diagnostics on HMI is the minimum requirement.

  I/O Cards shall be Back Plane (Rack mounted). Each I/O shall be protected against the reversal of polarity of the power voltage to I/O. This being a Alumina, special care should be taken against protection of dust.

  Each I/O module shall have a LED per channel to indicate the status of each input/output. Ground of each channel should be separate in case of Analog Input/output cards having multi-channel. For Digital I/O cards common ground may be accepted.

  Each input shall be provided with filters to filter out any noise in the input line or noise because of input contract bouncing. The I/O cards pertinent to Electrical Inputs shall of fast scan time conforming to Sequence Of Event (SOE) type. The time stamping has to be done in CPU level and not in MMI Level. CPU, I/O and all related H/W shall be from same series.

  Hot Stand by Rack based Power Supplies shall be provided in each I/O rack. Analog Input cards should be able to accept Powered (4 wire instrument) & Non powered Input (Two wire instrument).

  Output contacts from the PLC shall be potential free / Dry contacts with contact ratings 220 V AC, 5 Amps. For HT Sw. Gr. / Feeder etc. the contact rating of the Interposing Relay shall be 110 V DC 10 Amps.

  It is recommended that all I/O shall be fused. Each output shall be short circuit proof and protected by fuse. Visual indication of fuse blown indication must be provided for each output.

  The communication of I/O system with central process shall be Hot Stand by with complete error checking.

For Analog I/O's there shall be Optical Isolation. For Digital I/O Free Wheel Diode is recommended.

Hot replacement of any module (CPU Module, Power Supply Module, and Communication Module) shall be provided. No output shall be affected while replacing these modules.

- Processor System

Hot Stand by Processor i.e. Hardware based switch over is envisaged, so that the switching over time from Primary Processor to Secondary Processor does not take more than 100 Milli Sec.

The offered system shall have battery backup RAM and non-volatile reprogrammable Flash ROM OR EEPROM having sufficient capacity to store the logic program along with the tag/symbol name. However, in case volatile memory is provided, battery backup shall be provided for a minimum of 3 months to keep the program storage intact. A battery drain indication shall be provided at least one week before the battery gets drained. A potential free contact shall be provided for hardwired annunciation in the New Control Room.

Watchdog timer shall be a software device. Watchdog timer shall continuously monitor the healthiness of processor. Any hardware or software problem in the processor sub-system, which shall include CPU, memory, power supply, communication interface etc. shall cause the watchdog timer to report processor failure.

2.06.09 PLC Console

The PLC console shall be used for programming, program storing, fault diagnostics, event logging and alarm monitoring. It shall also be possible to use this for plant operation, whenever specified. History management, reporting etc. to be included.

It shall consist of a single color 24″ size LED MONITOR screen unless otherwise specified, one programming keyboard and operating keyboard whenever specified.

PLC console when used for plant operation shall be supplied with dedicated operating keyboard.

All illegal entries shall be rejected by console and shall be identified by warning signal on LED Monitor.

Manual operation / forcing of any element connected to PLC shall be possible from keyboard.

It shall be possible to modify, add or delete the application program on line without effecting the outputs.

It shall be possible to printout the logic diagram on the PLC printer. In addition printer shall also be able to print the following.

a) Diagnostic messages, as and when they appear.

b) Diagnostic report when called for

c) Processor alarms connected to PLC as and when they appear and alarm report whenever initiated.

d) Shut down report as and when initiated.

e) I/O map showing status of all inputs and corresponding outputs in a user defined format.

PC shall be latest processor i7 10th Gen or higher, 8 GB DDR4 RAM (min.), 1 TB HDD (Two Nos.), Digital Versatile Disk (DVD) + CD Read Write (CDRW) or better, Gigabit LAN, USB 3.0 port (4 Nos. Min) loaded with all licensed OS and softwares.

PLC system shall have properly navigated Graphics for the entire system, in all the work stations.

2.06.10 Communication Sub-system

The communication sub-system between the processor sub-system & I/O sub-system shall be Dual Redundant with a minimum speed of 100 MBPS or more.

The mechanism used by the system for error checks and control shall be transparent to the application information /program. Error checking shall be done on all data transfers by suitable codes.

Programmable logic controller shall operate on uninterrupted power supply with following specifications.

Voltage	:	240 V AC
Frequency	:	50 Hz
Switchover time	:	5 Millie second

2.06.11 Self Diagnostics

The system shall have an extensive set of self-diagnostic routines which shall be able to identify the system failure at least up to module level including redundant components and power supplies through detailed LED MONITOR displays and report print out.

At the local level, an individual LED shall identify failure of a module in any sub-system.

Diagnostic software shall have the capability to provide information about the failed module / system either in the form of a system configuration display or provide information in the form of ‘statement’.

2.06.12 System Software

The PLC programming language for implementation of logic operations shall be based on Boolean Representation(i.e. ladder logic only).

Bidder must supply the off-line software package to enable the owner to modify/add/delete any part of program. Simulation Software shall be provided for the off line logic simulation without CPU Unit.

All the hardware covering 100% components shall be checked through elaborate self-test features every 10/20 ms. This shall ensure timely isolation of faults and sending appropriate message at the PLC console. This self-test shall consist of but not limited to the following:

- Minimum 2 copies of licensed software.
- Agreement for system updates on later time.
- Antivirus/firewall.

In Processor

a) Self checking of microprocessor
b) Self checking of each data bus
c) Self checking of each memory module
d) Self checking of I/O card diagnostic circuit
e) Self checking of I/O card addressing circuit
f) Self checking of software by watch dog timer
g) Self checking of power supply levels
h) Self checking of command outputs
i) Self checking of each component

In Input Card

a) Self-checking of addressing of inputs
b) Self-checking of all channel for high and low
c) Self-checking of inputs by reading
d) Send to controller identification codes
e) Send to controller power supply status

2.06.13 Earthing

Each cabinet, console and other equipment supplied as a part of PLC system shall be provided with an earthing lug. All these lugs shall be properly secured to the AC mains earthing bus.

All circuit grounds, shields and drain wires of control cables shall be connected to the system ground bus which is electrically isolated from AC mains earthing bus. This bus shall be typically of 25 mm wide and 6 mm thick of copper.

2.07.00 TECHNICAL SPECIFICATION PLC HARDWARE SPECIFICATION

- LED Monitor
- Controller PLC
- Input / Output Devices
- Computer
- Interposing Relay
- Ethernet Switch
- Colored Printer
- ELECTRICAL METERS AND ACCESSORIES
  - Pushbutton
  - Indicative Lamp

- Control Switch
- Auxiliary Relay
- Selector Switch

Certain minimum parameters for various items are included below. However the final Parameters shall be as per system requirement, and shall be finalized during detail engineering.

2.07.01 LED MONITOR

Qty.	:	As required
Type	:	LED Colored
Size	:	24" (Minimum), Flat Type
Mounting	:	Desk mounted
No. of pixels	:	Full HD Standard
Radiation level limitation at max. brightness	:	To be safe for continuous exposure at 0.5 Mt. Distance
Write up speed full page	:	One second
Character / Line	:	Mfg. Standard
Lines / Display	:	Mfg. Standard
Anti-glare screen	:	Required
No. of Hours of life	:	120,000 Hrs. continuous or more
Power supply	:	220 V AC
Isolation (High Volt)	:	Required
Scanning	:	Manufacturer Std.
Refresh Rate	:	25 frames per sec. (minimum)
Touch Screen	:	Manufacturer Std.

2.07.02 CONTROLLER (PLC)

Purpose	:	To provide Process with continuous control to analog input, sequencing, timing, integration, logical operations, digital inputs, pulse inputs, digital outputs, self-tuning, limitation, rationing etc. Redundant Processor with hardwired redundancy is envisaged.
Loading of the processor	:	The % loading of the processor should be such that the scan time remains unchanged. Preferably loading should not exceed 50%.
No. of AI/AO per control module	:	8 or Manufacturer Std.
No. of DI/DO per control module	:	32 or Manufacturer Std.

Processor Capacity	:	32 bit or better
Scan time for closed loop/open loop on full load	:	a) 250 M Sec for closed Loops & Interlock b) 2 Sec for Temperature signal related to monitoring only c) 1 Sec for all other Analog & Digital Open Loop.
Temp.Limits Operating/Storing	:	Manufacturer Std.
Power Supply	:	220 V 50 Hz ± 10% voltage
Accuracy output	:	± 0.5% or better
Output load R / L / C	:	Manufacturer Std.
Functions	:	Filtering, linearization including extraction for orifice type flow meter trending alarm, limits checking switch, integrating from average flow transmitter, inputs, ratio system, special systems, PID action with auto-tuning of PID parameters and values settable by key board auto-manual bump less transfer manual to auto bump less transfer output reversal block self-tuning.
Alarm	:	The Time Stamping for Alarm Registration shall be done in CPU level & not in HMI Level. Resolution of time stamping to be indicated.
Processor Intelligence	:	Confirm if controller can act independently with its own processor fully when console fails (Display may not be possible) or controller is dependent on console with intelligence and process at console.
Alarm and diagnostics	:	Are diagnostics alarm available at controller. List all functions Mode of display. Facility to have diagnostic alarm in console.
Localized Highway	:	Confirm communications within controller is through main highway or dedicated highway within system.
A/D & D/A Conversion	:	Please give details No. of bits, time resolution, clock resolution, error detection, etc.
Special feature	:	Procedure less hot swapping of the card

2.07.03 INPUT / OUTPUT DEVICES (RACK MOUNTED)

Purpose	:	To have conditioning effect on low voltage signal and resistance input along with standard 4-20 mA (Powered & Non Powered) Input and

		contact Input.
Capacity	:	AI – Maximum 8/16 Input AO – Maximum 8 Output DI/DO – Maximum 32 Input/ Output
Scope	:	Process related I/O shall be ordinary. Bidder shall clearly indicate if these devices are included in the offer.
Digital Output Cards Feature.	:	Some of the Digital Output cards shall have Built in relays along with 24 V DC power supply to Operate SOV's.
Isolation	:	Analog, I/O cards shall be optically isolated. Digital, I/O cards shall have Free Wheel Diode. Ground of each Channel should be separate in case of Analog I/O cards.
Special feature	:	Procedure less hot swapping of the card.

2.07.04 COMPUTER

Type	:	Core i7 3.6 G Hz 10th Gen or better
Drive	:	Digital Versatile Disk+ CD Read Write.
RAM	:	8GB DDR4 (Min)
Hard Disk	:	1 TB 7200 rpm (Min)-2 nos Gigabit LAN
USB ports	:	USB 3.0 (4 Min)

2.07.05 INTERPOSING RELAY

Type	:	Base Mounted
No of Contact	:	2 NO + 2 NC
Power Supply	:	24 V DC
Contact Rating	:	230 V AC, 5 Amps.

2.07.06 ETHERNET SWITCH

Type	:	Industrial grade , Managed Type
Power Supply	:	Dual power supply in redundant mode
Switching	:	Switching fabric of at least 32Gbps
Configurable Address	:	Configurable up to 8000 MAC addresses
Frames	:	Configurable maximum transmission unit (MTU) of up to 9000 bytes, with a maximum Ethernet frame size of 9018 bytes (Jumbo frames) for

			bridging on Gigabit Ethernet ports, and up to 1998 bytes for bridging of Multiprotocol Label Switching (MPLS) tagged frames on both 10/100 and 10/100/1000 ports
	Ports	:	Should have Ethernet 10/100/1000 ports and dual-purpose uplink port(OFC Port)
	Protocol	:	Should be able to support Dynamic Trunking Protocol, Port Aggregation Protocol and Link Aggregation Control Protocol
	Casting	:	Should be able to support Per-port broadcast, multicast, and unicast storm control prevents faulty end stations from degrading overall systems performance
	WTD	:	Should be able to support weighted tail drop (WTD) which provides congestion avoidance at the ingress and egress queues before a disruption occurs.
	Traffic	:	Should be able to support Strict priority queuing which guarantees that the highest-priority packets are serviced ahead of all other traffic
	User Authentication &Security	:	Should be able to support IEEE 802.1x which allows dynamic, port-based security
		:	IEEE 802.3ah (100BASE-X single/multimode fiber only)
			IEEE 802.3x full duplex on 10BASE-T, 100BASE-TX, and 1000BASE-T ports
			IEEE 802.1D Spanning Tree Protocol.

2.07.07 COLOURED PRINTER

Purpose	:	i) Alarm printing +Log Printer
		ii) PSCF (print , Scan , Copy & Fax)
Speed	:	220 CPS NLD/400 Draft Model, CPS or better
Line Length	:	14” Adjustable
Characters per inch	:	18 CPI
Printing Mech.	:	Laser
Print style	:	Draft mode and Near Letter Quality (NLQ)
Voltage		220 V AC 50 Hz
Power consumption		Manufacturer Std.
Memory	:	Manufacturer Std.
Resolution graphics	:	144 x 144 dots or better

Communication	:	RS 232
Communication speed	:	Mfg. Std.
Storage temp.	:	0 - 60°C
Operating temp.	:	0 - 40°C
Paper type	:	Ordinary / Perforated / A4 or A3 Size
Mounting	:	Self standing
Make / Model	:	
Paper included with offer	:	1000 folds ordinary perforated paper
Special keys and function	:	Manufacturer Std.
Alarm print/ Event print	:	Colored

2.07.08 ELECTRICAL METERS AND ACCESSORIES

2.07.08.1 Pushbutton

Type	:	Shrouded (mushroom head for important trips/illuminated push button/stay put type/ key operated PB, as required.
Construction	:	Modular.
Enclosure	:	Dust-proof type.
Contact configuration	:	4 stacks (2 NO + 2 NC in general).
Contact element	:	Nickel-silver alloy.
Gasket	:	Rubber gasket between actuator and panel.
Cable connection	:	Rear with screws for accepting full ring lug (6 Sq. mm cable).
Legend plate	:	Start-stop, forward, reverse, fast, slow, on, off, raise lower, accept reset, test enable.
Colors	:	To be decided after award of contract.
Body material	:	Chrome plated zinc alloy.
Contact housing	:	Moulded melamine.
MTBF of pushbutton	:	10^7 operations or more.
Frequency of operations	:	10 times / minute or better.
Voltage rating	:	500V AC / 250V DC.
Breaking capacity (unless otherwise	:	40A AC up to 500V.

	specified)		10A –24V DC non-inductive. 3.5A – 110V DC non-inductive. 1.0A -220V DC non-inductive.
	Overall size	:	Mosaic compacts (24x24mm, preferred).
	Fixing on panel	:	Single cut out on panel with locknut.
2.07.08.2	Indicative Lamp		
	Type	:	LED Type
	Wattage	:	2.0 watts (approx.)
	Lens	:	Screw on glass.
	Bulb replacement	:	From front.
	Wire connection	:	Rear.
	Color of lamps	:	Green, Amber, Red & White, Yellow (as required).
	Legend plate	:	Black anodized aluminium.
	Standard legends	:	Close, running, open, ready.
	Lamp fixing	:	Screwed type.
	Lamp size	:	24 x 24 mm to suit mosaic compact.
	MTBF of lamp	:	5000 glowing hours.
2.07.08.3	Control Switch		
	Type	:	Miniaturized stay put / spring return type with operating knob (as applicable).
	Construction	:	Series of individual base of fixed contact support, operating shaft, end plate covers, operating knob and escutcheon plate.
	Contact rating arrangements	:	10 Amp. AC at 240V AC.
	Contact material	:	Silver (gold plated).
	Housing	:	Dust-proof type.
2.07.08.4	Auxiliary Relay		
	Type	:	Plug in type / flag relay as required.

	Power supply	:	240V AC, 1 phase, 50 Hz.
	Operating principle	:	Electro-mechanically operated.
	Contact configuration	:	4 nos. SPDT contacts.
	Contact rating	:	a) 5 Amp. At 240V AC. b) 0.5 Amp. At 220V DC
	Body material	:	Heavy duty material.
	Connection	:	a) Fork type lug connection for contact. b) Ring type lug connection for relay coil connection.
	Circuit application	:	Normally in energized condition; de-energizes on interlock or fault actuation.
	Special features	:	i) Fork flag type relay, flag should drop down for display on de-energisation. The relay shall be hand reset type. ii) Plug in type relays shall be compact and dustproof. The transparent plastic cover should be easily removable. iii) For plug in type relays also status display will be preferred.
	Mounting	:	Flag relay - Flush mounting. Plug in relay - Base mounted inside panel.
	Accessories	:	Mounting bases and other necessary items.
2.07.08.5	Selector Switch		
	No. of poles	:	Two / Three.
	No. of points	:	Four / Six / Twelve as required along with neutral position.
	Mounting	:	Flush panel type.
	Contact material	:	Silver / Gold plated.
	Bezel dimension	:	48 x 48 mm as required.

2.08.00 TESTING AND INSPECTION

The testing and acceptance of the system shall be carried out on the mutually agreed procedures and criteria based on these guidelines and Bidder standard procedures.

Factory Acceptance Testing (FAT) and Acceptance

Bidder shall demonstrate functional integrity of the system hardware and software. No material or equipment shall be transported until all required tests are successfully completed and certified 'Ready for Shipment' by owner/ consultant.

It shall be Bidder's responsibility to modify and / or replace any hardware or software if the specified functions are not completely achieved satisfactorily during FAT.

It shall be Bidder's responsibility to modify and /or replace any hardware or software if the specified functions are not completely achieved satisfactorily during FAT.

Schedule of FAT shall be included in the proposal by Bidder. The Bidder shall produce detailed installation, test and commissioning procedures and operating instructions 4 weeks prior to the FAT for review and comment by Owner

Under first phase, Bidder shall perform following tests:

a) Quality control test which shall be carried out to assure quality of all components and modules.

b) System pre-test which shall be of physical check of all modules, racks, cabinets etc.

c) System power-up test which shall test functionality of all hardware and software.

The LSTK Vendor shall carry-out all pre-commissioning field tests which shall include verification of all the features of hardware and software and also conduct trial-run before commissioning. The LSTK Vendor shall furnish a procedure including list of field tests to be carried-out to the Owner for approval.

Second phase of testing shall systematically, fully and functionally test all hardware and software in the presence of owner/consultant. All sub-system shall be interconnected to simulate, as close as possible, the total integrated system. Following minimum testing shall be carried out:

a) Visual and mechanical testing

b) High voltage and insulation testing

c) Functional testing

2.09.00 INSTALLATION AND COMMISSIONING

Installation

The Bidder shall

- Carry out the laying of system communication network cables and fabricate and install all splices, connections and accessories necessary to provide a complete interconnection between all equipment.
- Test the hardware, power supplies, cabling and connection
- Install and pre-test the software programs and data

- Termination of all field cables in Bidder's marshalling cabinets, ferruling of cables, loop checking from field sensor to PLC

Commissioning / Pre-commissioning

The Bidder shall

- Simulate, test and commission all input functions from the incoming terminals at the marshalling cabinets through to the operator interface.
- Test and commission all output and control functions from the operator interface through to the outgoing terminals at the marshalling cabinets.
- Test and commission all maintenance and diagnostic facilities.

The Bidder shall assist in commissioning all field input and output devices to the system including:

- Reconfiguration and rewriting of the system where necessary
- Start-up and shut-down of the system
- The PLC system is to be hooked up to instruments and its dedicated PLC's offered by the Package LSTK Vendor. It shall be the responsibility of the Bidder to realize this total integration.

3.00.00 CCTV SYSTEM

3.01.00 SCOPE OF WORK

Design, Engineering, Planning, Procurement, Manufacturing, fabrication, Supply, Testing at site & Work delivery at site, Receiving Unloading Storage, Insurance, Erection, Final Checkup, Final Testing, Trial run Commissioning of CCTV System.

The function of viewing through CCTV is to aid the operator in achieving safe operation of the plant. This package consists of Closed Circuit Television System & allied accessories, but not limited to them. The gadgets shall be such that they will assist in the attainment of maximum plant availability to be implemented as follows.

- Use of equipment whose design, performance and high availability have been demonstrated by a considerable record of successful operation in identical plants.
- Use of proven designs.

Scope of Supply

Scope of supply by Bidder grossly includes the following.

- Minimum 10 nos. of IP based Fixed Camera and 10 nos. of PTZ (Pan Tilt & Zoom) type rugged industrial grade camera for strategic location of Entire Alumina Unloading & Conveying System. For successful operation of plant more nos. of Camera may please be provided.

- Associated Cables for connecting Power & Signal from the camera to the New Control Room. Control Cables for PTZ cameras. Fiber Optic Cable as needed.
- Associated Hardware for any type of signal converter etc.
- 2 nos. of Camera Server cum operator station with 24" LED Type Monitor & 1 no. of 74" Large Video Screen.
- Video Storage Device
- PTZ Controller.
- Network Switch
- Licensed software.
- Insurance Spare for CCTV
- Erection Hardware like MS Channel / Angle / Clamp etc.

Bidder is to supply CCTV Architecture Drawing along with supporting detail drawings.

Monitors for CCTV in the New Control Room are to be placed on the operators console physically adjacent to Monitors of relevant process segments.

SCOPE OF SERVICE

- Bidder to suggest the location of the CCTV Cameras and the location of the hardware like server LVS Network Switch etc.
- The Grounding of the entire system is the responsibility of the Bidder. There shall be discrete System / Electrical Grounding & Safety / Power Grounding.
- All Signal, Control, Fiber optic, UTP (Cat-6) & Power cable to be supplied / laid / terminated by the Bidder.
- Outdoor cable shall be laid through proper cable Tray & Trench.
- All outdoor cable shall be armored.
- UPS output power distribution to the Cameras or to the electronics of CCTV is under the scope of the Bidder.
- All components mentioned in the scope of supply is the scope of services of the Bidder

Erection & Installation

Installation of all items covered under scope of supply is under the scope of services of this package. Laying & Termination of Signal & Power Cable from Camera is under the scope of supply of this package.

Commissioning

Individual testing & commissioning of all erected Cameras & Monitors under the scope of services.

Bidder to furnish the Architecture Drawing along with the data sheet of every individual equipment for review & approval. Ensuring of proper grounding is in the purview of the Bidder.

CONTROL ROOM

All monitor & LVS shall be placed at New Control Room along with Camera controller.

3.02.00 DESIGN CRITERIA & PHILOSOPHY

DESIGN CRITERIA

It is envisaged that each CCTV signals shall be connected to network switch through TCP/IP to FO converter so that video signal can all be brought into the New Control Room for monitoring and control of CCTV. (Refer CCTV System architecture drawing: 14L08-DWG-I-CCTV-001, Rev-0) .

Application of sound maintainability principles and techniques including Modular Replacement, Easy Removal, Full Proof design to be followed. Auto wiper shall be envisaged to avoid dust.

There should be proper grounding facility for the video signals & power lines.

The System shall be as follows:

Every camera shall have TCP/IP port. There will be a media converter (TCP/IP to FO) near to camera. FO cable shall be connected to media converter & Network Switch (Refer CCTV System architecture drawing: 14L08-DWG-I-CCTV-001, Rev-0) through light interface unit. Network Switch will be placed at New Control Room or Air Conditioned environment. Camera Server will be connected to same Network Switch with redundant communication.

Universal key board as a single unit is used to control the PTZ Operation, video switching and programming purpose. They will be located at New Control Room.

The IP CCTV hardware & IP CCTV application software shall be from same manufacturer for better compatibility and better long term support.

Location of Camera shall be finalized during detail engineering.

All the Cameras will be Day/Night colored fixed with auto IRIS facility.

Protection from Lightening at Signal & Power end is required for all cameras.

Housing of all the field mounted devices like camera etc. shall be conforming to Out Door housing type.
All software shall be licensed in the name of NALCO.

SPARE PHILOSOPHY

The system shall have following minimum spare capability:

Network switches and other electronic shall have a capacity to accommodate 20% camera in future.

20% spare Fiber Optic Cables.

3.03.00 CCTV CONFIGURATION

It shall consist of a 2 no. of color 24″ size LED with Flat screen of Camera Server which can perform the video display also for new CR. 1 no. of 74" Video screen is also envisaged for New CR.

Manual operation shall be there to zoom any specific process area.

PTZ operation shall be done from New CR.

3.04.00 EARTHING

Each cabinet, console and other equipment supplied as a part of CCTV system shall be provided with an earthing lug. All these lugs shall be properly secured to the AC mains earthing bus.

All circuit grounds, shields and drain wires of control cables shall be connected to the system ground bus which is electrically isolated from AC mains earthing bus. This bus shall be typically of 25 mm wide and 6 mm thick of copper.

3.05.00 TECHNICAL SPECIFICATION

3.05.01 VIDEO MONITOR 24", 74" (LED):

Type	:	LED
Resolution	:	Flat LED monitor with 1920x1080 resolution
Aspect Ratio	:	16:9 with on screen display
Synchronization Format	:	PAL
Contrast Ratio	:	5000000 : 1
Input	:	1. Analogue VGA input 2. Video – 2 Nos.
Input selection	:	By selection key
Viewing option	:	Single channel / Both Channel
Viewing angle	:	170 degree (H) & 170 degree (V)
Mounting	:	Table mounted
Operating Temperature	:	0 Degto 40 Deg C

3.05.02 IP COMPATIBLE FIXED COLOUR (NIGHT SENSING CAPABILITY) CAMERA :

Type	:	Latest Color camera
Operating Resolution	:	Latest1/ 3 " CCD Imager Chip in Color format with night sensing capability (540 TVL or better) for Color in PAL format
Very Low light sensitivity	:	0.5 Lx(Color Full Video)
Signal Processing	:	Advance Digital Signal Processing. (DSP)

Signal to Noise Ratio	:	50 dB or better
Electronics Shutter	:	Automatic 1/10000 sec (PAL / CCIR)
Compatible Fixed Lens	:	Manual Zoom Lens of 5 – 100 mm with Auto Iris, 30X optical zoom, 16x digital zoom.
Back light	:	Back light Compensation for better picture quality
Operating Temperature	:	- 10 Deg Cto+ 50 Deg C
Operating Humidity	:	5%to 93% , non condensing
Safety& Quality standard	:	As per UL& EN certification
Auto Wiper	:	Required

3.05.03 IPCOMPATIBLE OUTDOOR DOME CAMERA WITH PTZ FACILITY :

Type	:	Latest colour camera
CCD	:	1/4” format CCD Imager Chip
Operating Mode	:	Operates both in Day & Night Mode (Night sensing capability).
Resolution	:	OperatingResolution625 TVL or better in PAL Format
Protection	:	IP 65 Grade of Weather Protection or better and auto wiper Rugged weather – resistant Design
Focus	:	Auto focus with 35 X Optical Zoom Lens (3.4 – 122 mm)
	:	Field of View2.3 – 55 Degree (or better)
	:	Digital Zoom of16 x
Control Function	:	Remotely Configurable from Control room for all functions
Pan Speed	:	Variable between 0.2 Deg / still120 Deg / Sec
Shutter Speed	:	1/10000
Accuracy	:	99 minimum preposition with 360 Deg/ Sec with +/- 0.2 Deg accuracy
Signal to Noise Ratio	:	50 dB or better
Operating Temperature	:	(- 20 Deg C to + 50 Deg C)
Safety& Quality standard	:	As per UL& EN certification

3.05.04 MANUAL LENSE FOR FIXED CAMERA :

Type	:	Verifocal Camera lense
Focal Length	:	LSTK Vendor to suggest size for different cases
Wide Angle	:	LSTK Vendor to suggest
Object distance	:	0.3 Mtr to Infinity
Codes & Standards	:	IS / ISO 9000 / EN 29001/UL

3.05.05 PC BASED WORK STATION:

CPU	:	Intel Quad Core i7 10 Gen 3.6 GHz or better
RAM	:	8 GB DDR4 (Minimum)
Hard Disk Drive	:	1 TB
Graphic Card	:	Intel / NVIDIA (512 MB)
Ethernet card	:	Intel 10/100/1000 Mbps / Gigabit – Ethernet Network on board
Operating System	:	latest O/S
Free Memory for OS	:	120 GB

3.05.06 Hardware Specification of NVR

CPU	:	Dual Core Intel Xeon, 4 G Hz
HDD Interface	:	IDE or better
RAM	:	4 GB or better
OS	:	Windows Server
Ethernet Card	:	Dual on board Intel Gigabit Ethernet with load balancing & failover support
CD	:	24 x EIDE , CD ROM
Free Memory for OS	:	120 GB
Hard Disk for video recording	:	4 TB

3.05.07 INDUSTRIAL CAMERA HOUSING

Type	:	Suitable for all type Camera & Lenses.
Enclosure	:	IP 66
Operating Temperature	:	5 ° C to 50 ° C
Material of Construction	:	Light Aluminum & polymer construction.
Codes of standard	:	IS / ISO 9000 / EN 29001

Certification	:	UL Listed
Accessories	:	Mounting Bracket etc. for completion.

3.05.08 ETHERNET SWITCH

Type	:	Industrial grade , Managed Type
Power Supply	:	Dual power supply in redundant mode
Switching	:	Switching fabric of at least 32Gbps
Configurable Address	:	Configurable up to 8000 MAC Media Access Control.
Frames	:	Configurable maximum transmission unit (MTU) of up to 9000 bytes, with a maximum Ethernet frame size of 9018 bytes (Jumbo frames) for bridging on Gigabit Ethernet ports, and up to 1998 bytes for bridging of Multiprotocol Label Switching (MPLS) tagged frames on both 10/100 and 10/100/1000 ports
Ports	:	Should have Ethernet 10/100/1000 ports and dual-purpose uplink port(OFC Port)
Protocol	:	Should be able to support Dynamic Trunking Protocol, Port Aggregation Protocol and Link Aggregation Control Protocol
Casting	:	Should be able to support Per-port broadcast, multicast, and unicast storm control prevents faulty end stations from degrading overall systems performance
WTD	:	Should be able to support weighted tail drop (WTD) which provides congestion avoidance at the ingress and egress queues before a disruption occurs.
Traffic	:	Should be able to support Strict priority queuing which guarantees that the highest-priority packets are serviced ahead of all other traffic
User Authentication & Security	:	Should be able to support IEEE 802.1x which allows dynamic, port-based security
	:	IEEE 802.3ah (100BASE-X single/multimode fiber only)
		IEEE 802.3x full duplex on 10BASE-T, 100BASE-TX, and 1000BASE-T ports
		IEEE 802.1D Spanning Tree Protocol .

3.05.09 VIDEO SIGNAL CABLE (Co Axial Cable)

Type	:	Armoured Co-Axial Cable (RG-II)

Conductor	:	Copper Conductor
Characteristic Impedance (Ω)	:	75
Weight(g/m)	:	140
Conductance Resistance (Ω /Km)	:	20.3
Capacitance (pf / m)	:	67.3
HV Test (KV)	:	10
Attenuation (dB / 100 m)	:	
At 400 MHz	:	17.1
At 3000 MHz	:	60.7
Inner sheath	:	Extruded PVC
Mode of wrapping layers	:	Mylar tape and filler chord
Mode of overall shielding	:	Aluminised mylar tape wrapped with 25% overlapping.
Overall sheath of cable	:	FRLS PVC/Fluropolymer insulation
Continuous operating temperature	:	90^0C
Voltage grade	:	600 Volt
Essential Features	:	(i) G.I. wire/strip armouring
		(ii) Annealed tinning through electrolysis process.
Accessories	:	(i) Lockable – unlockable type PVC/nylon cable straps..
		(ii) Fork-type termination lugs for all terminal points.

3.05.10 CONTROL CABLE

Type	:	Single pair, Twisted (Armored)Screened
Conductor	:	1.0 mm^2 multi-strand annealed tinned copper
Inner sheath	:	Extruded PVC
Continuous operating temperature	:	150^0C
Voltage grade	:	100V
Armouring	:	Rounded GI wire/strip with overlapping
By standard colors as well as numbering at frequent intervals.	:	By standard colors as well as numbering at frequent intervals.
Accessories	:	(i) Lockable - unlockable type PVC/ nylon cable straps (ii) Fork-type termination lugs for all termination points

3.05.11 POWERCABLE

Type	:	3 Core
Conductor	:	1.6mm^2 multi-strand annealed tinned copper
Inner sheath	:	Extruded PVC
Continuous operating temperature	:	150^{0}C
Voltage grade	:	1 KV
Armouring	:	Rounded GI wire/strip with overlapping
Overall seathing	:	FRIS PVC/Fluropolymer insulation.
By standard colours as well as numbering at frequent intervals.	:	By standard colours as well as numbering at frequent intervals.
Accessories	:	(i) Lockable - unlockable type PVC/ nylon cable straps (ii) Fork-type termination lugs for all termination points.

3.05.12 FIBER OPTIC CABLE (armored)

Nominal outer diameter	:	2 – 16 fibers: 8.5 mm
Nominal Weight	:	2 – 16 fibers: 60 kg/km
Tensile strength (dynamic)	:	1000 N
Tensile strength (permanent)	:	500 N
Compressive strength (crush)	:	2000 N
Impact	:	10 Nm
Torsion	:	5 cycles E 1 turn
Kink	:	The cables do not form a kink when a loop is drawn together to a diameter of 100mm
Minimum bending radius, unloaded	:	R = 55 mm
Minimum bending radius, Loaded	:	R = 110 mm
Temperature range	:	Storage and installation: -40 to 70 deg C
Operation	:	-40 to 70 deg C
Maximum attenuation variation in the operational temperature range	:	For M6 & M5 fibers: 0.5 dB/km For SM fibers: 0.2 dB/km.

3.05.13 Cat 6 / UTP CABLE

Cable Type	:	UTP
Conductor material	:	Bare Copper
Jacket Material	:	PVC
Pairs	:	4

Conductor gauge, singles	:	23 AWG
Conductor Type, Singles	:	Solid
Conductors quantity	:	8
ANSI/ITA Category	:	6
dc Resistance Unbalance, maximum	:	5%
dc Resistance, maximum	:	7.16ohm/100m
Mutual capacitance	:	5.6nF/100m @ 1 kHz
Nominal Velocity of propagation (NVP)	:	69%
Operating Frequency, maximum	:	300 MHz
Transmission Standards	:	ANSI/TIA-568-C.2
Safety Voltage Rating	:	300V

4.00.00 ERECTION PRACTICES AND HARDWARE

4.01.00 ERECTION PRACTICES

Panels

a) The LSTK Vendor shall arrange for the transportation and handling of the panels from stores to work site. Prior to installation of the panels, the LSTK Vendor shall inspect the foundation. The LSTK Vendor shall carry out retouching of painted surface of panels wherever required.

b) The main earthing strip provided in the panels shall do earthing of the panels suitably and technical earth with insulated multi strand copper wire of suitable thickness from earth pit to panels.

Field Mounted Instruments

a) The LSTK Vendor shall arrange for the transportation and handling of the field instruments from stores to the place of installation without any damage.

b) The field mounted instruments shall not be installed by the LSTK Vendor at such time when the same are likely to be damaged due to work of others, unless the Owner's / Consultant's engineer asks the LSTK Vendor to do so. The LSTK Vendor shall install no field-mounted instruments without simultaneously taking up impulse line work connected with the instrument. The LSTK Vendor shall also supply and fix all valves, fittings, flanges etc. Fabrication and connection of drain lines / manifolds to the nearest drain point complete with valve and fittings are also included in the LSTK Vendor's scope.

c) All field mounted instruments such as transmitters, local indicators / controllers, gauges etc. shall be lifted in position, leveled, plumbed and secured firmly.

d) No field mounted instruments shall be installed such that it depends for support or rigidity on the impulse piping or on the electrical / pneumatic connections to it.

e) Transmitters shall be grouped whenever possible in the transmitter enclosure mounted on the nearest suitable location as per Owner's requirement.

f) Indicating type field mounted instruments shall be installed in such a way that center of the indicating dial shall be about 1200 to 1500 mm from operating floor level.

g) All field mounted instruments and other process control / instruments shall be installed and erected along with all their accessories complete in all respects, by the instrument erector and to the fullest satisfaction of the Owner and Consultants.

h) There should be enough approach and space to carry out future maintenance activity on field instruments and control valves and ensure easy removal/ dismantle, calibration of instrument.

Impulse Tubing

a) The impulse tubing shall be installed from the isolation valve after the tapping points on the pipeline or on the vessels / equipment to the respective field instruments as per the typical installation drawings.Impulse tubing shall always be installed with a slope of 1:12 on horizontal runs and shall run with the minimum of changes in direction consistent with good practice and neat appearance. The impulse tubing should avoid sharp bends and piping should be of adequate size to avoid choking.

b) Impulse tubes shall be adequately supported and fixed. If additional structures are required for proper supporting of tubes, the LSTK Vendor shall arrange the same. Process piping shall not be used for supporting impulse tubing. Required no. of isolation valves and provision of drain valves should be there.

Testing of Impulse Tubing

Testing shall be carried out after the installation of instrument with primary tubing complete in all respects.Primary tubing shall be tested hydrostatically to 1:5 times
the design pressure for at least 30 minutes, after thorough flushing.

Instrument Air Supply Piping

a) All piping and sub-headers shall be thoroughly cleaned before installation by means of instrument air at 6 kg/sq.cm and shall be supported properly. The distance between any two supports shall not exceed 1 m unless otherwise required to suit condition.

b) GI pipes and fittings shall not be welded or brazed.

Instrument air supply to all the pneumatic instrument shall be routed through MS pipe of suitable dia and provided with isolation valve (1/2 inch SS ball valve with handle) about 1 to 2 meters away from the instrument location. Copper tubing of suitable size and proper fittings to be routed after the valve to connect air supply to the instrument.

Testing of Air Supply Piping

After supplying 7 kg/sq.cm air pressure, all connections shall be checked for possible leaks with soap solution and all leaks shall be rectified.

4.02.00 Sub-Trays

Main pre-fabricated perforated cable trays shall be made available by the LSTK Vendor up to marshalling cabinet. All sub-trays and branch trays shall also be perforated type and supplied and erected by the LSTK Vendor.

4.03.00 Instrument Cables

a) This shall include laying and termination of all instrument cables and special cables such as shielded cable etc.

b) Cables shall terminate in the panels / enclosures through proper sized cable glands cable markers/cable ferrules lugs. Supply and installation of all cable glands and suitable cable accessories for termination and support of cables are included in the scope of the LSTK Vendor. Cable or conduits should be properly glanded and sealed

c) All the cable runs shall be properly identified by number tags which shall be provided at both field ends and panel ends.

d) All cables shall be tested for continuity and insulation as per the latest Indian Electricity Rules before connecting to the instruments.

e) There should be no intermittent joints in the cables.

f) The cables must be protected either by rigid conduits or flexible hoses. The length of flexible hoses should be minimum as far as possible.

g) The cables must be tagged to enable easy identification.

4.04.00 Junction Boxes

a) Junction boxes shall be provided for multi-core cables. Entry of cables must be properly glanded and sealed. Supply and installation of all cable glands and suitable cable accessories for termination and support of cables are included in the scope of the LSTK Vendor

b) The junction boxes shall be fixed suitably to the nearest available structures and at an accessible place.

c) The junction boxes shall have at least IP-54 protection.

4.05.00 Earthing

a) A proper Earthing Scheme for Electronic devices is to be made and approved by the owner / consultant and earthing / grounding shall be done as per the scheme to avoid the damage to the devices and for safety of personnel.

The main earthing strip provided in the panels shall do earthing of the panels suitably and technical earth with insulated multi strand copper wire of suitable thickness from earth pit to panels/ boxes where needed.

b) Grounding must be done at only one point. Separate earth pits for the control system is in the scope of LSTK Vendor.

4.06.00 Calibration & Functional Checking Of Instruments

Prior to the installation of the instruments, the LSTK Vendor shall arrange for calibration and functional checking of all instruments and instrument accessories with the aid of standard testing instruments, arranged by him. Calibration and functional checking of the instruments shall be carried out as per the respective manufacturer's instructions and the procedures approved by the Engineer-In-Charge of Owner / Consultant.

If damage is caused to any instrument during calibration and functional checking due to negligence of the LSTK Vendor, the LSTK Vendor shall be liable to whatever action the Owner deems fit to take against him, as per the General & Special Conditions of Contract.

Calibration & Functional Checking Procedures

a) Control Valves

All control valves shall be lubricated (if required), stroked and checked for free movement of the stem. Alignment of valve positioners shall be checked. Connection and operation of solenoid valve, limit switches shall be checked. Action of the actuator shall be checked. The control valve along with positioner shall then be calibrated for the rated stroke and checked for linearity and hysteresis, as per manufacturer's specifications.

b) Other Instruments

All the other instruments shall be calibrated and checked strictly as per the procedure recommended by the manufacturers and approved by the Engineer-In-Charge.

4.07.00 Loop Checking

Loop test shall be performed after calibration and installation of all instruments. It is carried out to check the functional performance of all elements comprising the loop, thereby ensuring proper connection. This shall include but not limited to the following.

a) D/P transmitters with receiver indicator / controllers shall be loop tested as follows.

Impulses to the primary shall be applied by means of a squeeze bulb or regulator and U-tube manometer at the field end and performance of the associated receiver instrument in the control panel at 0%, 25%, 50%, 75% and 100% of full scale inputs.

b) Pressure transmitters with receiver indicators / controllers shall be simulated using comparator / dead weight tester and a standard gauge with accuracy better than ± 0.5 % and performance of receiver instrument checked for 0%, 25%, 50%, 75% and 100% of full scale inputs.

4.08.00 Special Tools and Tackles

Any special tools/instrument required for communicating / parameter setting /viewing /diagnostics viz. HART communicator, IR cable (if any), special cable etc.. Shall be supplied along with the instrument.

5.00.00 TESTING AND INSPECTION

5.01.00 GENERAL REQUIREMENTS

All equipment furnished under this specification shall be subjected to test by authorized quality assurance personnel of the LSTK Vendor and representatives of the Owner and / or Engineers during manufacture.

The offer shall furnish details of shop and site tests proposed to be conducted by him at various stages to meet the specification requirements for each type of instrument / system along with his proposal.

Shop Tests

Shop tests shall include all tests to be carried out at LSTK Vendor's works, at woks of his sub-LSTK Vendors and at works where components used for manufacture of equipment are produced.

Test at Manufacturer's Works

Works' tests shall include electrical, mechanical performance tests in accordance with relevant standard or any other tests called for by the Owner under these specifications to ensure that the equipment being supplied full fills the requirements of the specification. For equipment not covered by approved standards, the tests to be carried out shall be in accordance with LSTK Vendor's quality assurance program approved by the Owner.

6.00.00 DRAWINGS, DATA AND MANUALS

6.01.00 GENERAL

The following drawings, data and information shall be submitted by the Bidder / LSTK Vendor at various stages of the project to enable Owner / Engineer to evaluate, comprehend and successfully erect and commission the system and equipment offered.

6.02.00 Drawings / Data To Be Submitted With Tender

The following drawings / data shall form a part of the tender document.

a) List of bought out items and the list of reference for the same.

b) Proposed delivery schedule for all equipment supplied.

c) Manufacturer's catalogue for all instruments / equipment included in the tender.

d) Bill of materials of all Instruments, Control Valves, Solenoid valves.

e) Safety and protection interlock write up for the systems offered by the LSTK Vendor.

f) Preliminary I/O count.

g) List of commissioning spares.

h) List of operating spares.

i) List of tools & tackle.

j) List of proposed control loop and the details of the control loop.

k) Process / system-wise Instrument Summary List.

l) Proposed Hook-Up drawings with main C&I package for special instrument / system like Belt Weigher, VFD, Air Compressor, Air Blower etc.

m) Detailed catalogue of Belt Weigher etc.

n) No & size of cable entering into C.R.

o) UPS Power requirement.

p) Instrument Air requirement.

q) System Architecture Drawing showing all third party system.

6.03.00 Drawings / Data to be furnished by the LSTK Vendor

The following drawings / data are to be submitted progressively by the successful LSTK Vendor during the engineering stage for approval (A) / Reference (R) of Owner. All drawings shall be system / process wise.

a) Instrument Summary List.

b) Block logic diagram for safety and interlock system.

c) I/O list and annunciation list.

d) General arrangement drawings for panels showing internals & exterior.

e) Graphics

f) Foundation and installation details of panels and instruments.

g) Instrument Loop diagram showing JB/LCP/ Marshalling Cabinet terminal details.

h) Instrument Power supply Drawings

i) Cable schedule & Junction Box Schedule, cable routing etc.

j) Panel external wiring termination details.

k) Proposed earthing scheme.

l) Instrument layout, cable layout, pneumatic layout

m) Quality assurance plan for each system / instrument.

n) Inspection and testing procedure.

o) Ladder Logic diagram.

p) P&ID of entire plant

q) Control system architecture of the plant along with a write up mentioning the basic features like scan time, protocol, handshaking with 3rd party etc. along with special features like hot swapping fault diagnostics etc.

r) GA drawings of control room

s) Lay out drawings of instrument items installed in the control room

t) Data Sheet and Specification sheet of all field instruments, final control element, cables etc.

u) Junction box installation details

v) Control & Operational philosophy write up

w) Specification sheet of system related hardware like monitor, printer, network switch panel etc.

x) All field instrument setting.

6.04.00 Drawings / Data to be furnished during Delivery Stage

The following drawings / data are to be furnished by the LSTK Vendor during delivery stage.

a) Installation guidelines for each equipment.
b) Operation and maintenance manual for the I&C system supplied.
c) Original equipment manufacturer test certificate etc.
d) Calibration Report of all Instruments.

All drawings submitted and finalized during engineering stage i.e. As-Built Drawing. As built drawing shall be submitted by the LSTK Vendor within a month after commissioning and startup of the plant.

SECTION – III/4 :CIVIL & STRUCTURAL

SECTION III/4- CIVIL & STRUCTURAL

I N D E X

CLAUSE NO.	DESCRIPTION
1.00.00	PROJECT INFORMATION
2.00.00	SCOPE OF WORKS
3.00.00	SITE AND SOIL CONDITIONS
4.00.00	CIVIL AND STRUCTURAL CODES & STANDARDS
5.00.00	GENERAL REQUIREMENT
6.00.00	MATERIALS
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8.00.00	TYPICAL DESIGN PRINCIPLE OF SOME STRUCTURES
9.00.00	CONSTRUCTION
10.00.00	TESTS AND ACCEPTANCE CRITERIA
11.00.00	DRAWINGS AND DOCUMENTS TO BE SUBMITTED
12.00.00	ADDITIONAL REQUIREMENT
ANNEXURE-1	LIST OF ACCEPTABLE BRANDS AND MANUFACTURERS

1.00.00 PROJECT INFORMATION

1.01.00 Project : Alumina Unloading and Transportation System.

1.02.00 Executing Agency : National Aluminum Company Limited.
Nalco Bhavan, P/1, Nayapalli, Bhubaneswar – 751013
Odisha, India

1.03.00 Project Site : Angul,Odisha,India

1.04.00 Location : Approximately 5 KM from the nearest town of Angul in the state of Orissa. The district is situated in the central part of Orissa. The district finds its circumferential limits within 20031" and 21.21^{0}North Latitude and 86.11^{0}East Longitude. It is surrounded on the North by Keonjhar and Sundargarh, East by Cuttack and Dhenkanal, South by Boudh and West by Sambalpur and Deogarh district.

1.05.00 General Topography : Topographically the district can be divided in to three natural tracks. First is a chain of hills running along the northeastern boundary of the district covering Pallahara. Another chain of hills runs along with south-west boundary covering Athamallik and Angul. The third natural division is a valley of river Brahmani running along with boundary of Talcher through Kaniha touching Pallahara.

1.06.00 Site Conditions and Climatic Condition

i)	Record max. temperature	: 50.9 °C
ii)	Average daily max. temperature	: 30 °C
iii)	Average daily minimum. Temperature	: 18 °C
iv)	Record minimum. Temperature	: 5 °C
v)	Annual Average rainfall	: 1421 mm
vi)	Maximum rainfall recorded in one hour	: 100mm
vii)	Maximum relative humidity	: 68.3 %
viii)	Prevalent direction of wind from	: southwest and northwest
ix)	Prevalent wind speed	: 50 m/s
x)	Seismic Zone	: Zone III

2.00.00 SCOPE OF WORKS

2.01.00 GENERAL SCOPE

Following are the systems/plants, which constitute the total scope and define the battery limits for the subject namely **"ALUMINA UNLOADING AND TRANSPORTATION SYSTEM"**:

- Pneumatic Conveying system for unloading of Alumina from BTAP wagons and its transfer to an underground pit.
- Air slides with blowers for alumina unloading and transportation
- Pipe conveyors
- Dedusting System for dust suppression and evacuation of additional air.
- Compressed Air supply system located within the unloading area with compressors and blowers, all accessories including pipes & piping support.
- Rope winch systems for hauling wagons.
- Power Distribution System
- Control & Instrumentation System including Control Room
- Transformer & VFD Room near Silo-1&2 and Silo-5&6 including receiving power from nearest substation 11kv switch gear.

The scope of work of the LSTK Vendor under this package shall be as described hereunder basically pertaining to all the equipment and facilities with respect to Process/Mechanical, Environmental, Electrical, Instrumentation, Architectural, Civil& Structural, finishes, sanitary and plumbing for the above mentioned systems:

Design, manufacture, planning, fabrication, assembly, shop testing and shop painting including procurement and supply of all materials, labour, supervision and necessary quality assurance testing.

- Receiving/unloading, storage at site, handling at site including insurance till take over.
- Site fabrication, construction and final assembly.
- Layout and Civil & Structural construction
- Erection and Final painting.
- Maintenance till handing over.
- All such relevant work and services as are necessary for successful commissioning and handing over to the total satisfaction of the Purchaser, of the subject complete with all systems, sub-systems equipment, accessories, auxiliaries and ancillaries materials and facilities, buildings, foundations and all other related civil and structural work as

required on EPC basis within the battery limits as broadly described in the following clause no. 2.02.00.

2.02.00 CIVIL & STRUCTURAL SCOPE

The detailed Scope of work under the purview of this project shall be as per the list given below:

A] Removal of shrubs & trees.

B] Topographical Survey.

C] Route survey of both underground & over ground structures.

D] Geotechnical Investigation including soil resistivity.

E] Area Grading

F] RCC Building, Steel Structures, Brick Masonry Work with Fly Ash Brick, Cement Plaster, Painting (Internal & External) , Door, Windows & Roof Sheeting etc. :

1) MCC, VVVFD & CONTROL Building– (Two storied)
2) PLC Building- (Single storied)
3) COMPRESSOR & BLOWER Room- (Single storied)
4) Watchtower with operators cabin to control the placement of rake in the unloading system.
5) Drive Winch & Auto Rope House.

G] Transfer Points / Junction Houses

H] Passenger cum good lift at transfer point

I] Pipe Conveyor galleries (About 1400m long) along with supporting Structure and underground tunnel (About 100m long) and Pent House.

J] Unloading Station (Underground RCC structure with sump): air slides etc.

K] Blower and other machine Foundations as required.

L] Pits and misc. underground structure as required.

M] Misc. supporting structure as required.

N] RCC Approach Road (7.5 m width) with concrete drains on both sides.

O] Pipe & Cable Supporting Structure

P] Paving as per plot plan.

Q] Sewerage system

R] Storm Water collection & disposal System.

S] Drinking Water Supply Distribution System.

T] All ladder, stairs and their foundations.

U] All equipment supporting foundations inside and outside buildings.

V] Dismantling of Miscellaneous structures & Foundations and their rerouting where required.

W] Septic Tank and soak pit to be considered for individual buildings.

X] Cement lining of Internal plant drains are to be considered.

Y] Please ignore clause no 2.8.03 of Civil & Structural DBR regarding wall post.

Z] Water retaining structure shall be M30 grade.

AA] Area drainage of unloading area and silo area connection to the existing system

AB] Maintenance of access road during construction period.

AC] All mobile equipment and special handling equipment, such as fork lift truck, hydra, and crane etc. for construction shall be arranged by successful bidder. The owner shall provide the equipment if available on chargeable basis as per NALCO guidelines.

AD] GA of Pile Cap & Tunnel for Silo-1 & Silo-2 Dwg No. 10532029021 included for reference.

AE] Cement punning shall be laid on plastered surface of drain.

AF] Thickness of chequered plate shall be 8 mm o/p. Floor washing has not been envisaged.

AG] Storm water drainage system in radius of 100 meters nearby wagon unloading area

AH] Following Civil & Structural work in and around rail track and railway siding area shall also be included in the scope of this package :

1. Removal of railway line/track and sleepers for the proposed Alumina unloading area and proper storage.
2. Removal of ballast, stones etc from the proposed Alumina unloading area for construction of underground/over ground structures.
3. Taking permission from the railway Authority for the necessary construction of underground structures below railway line for the proposed Alumina unloading area.
4. Submission of design calculations and execution drawings including scheme and procedures of construction for all underground structures, if required, below railway line and structures/shed over railway line for the proposed Alumina unloading area to the Railway Authority and getting approval from railway Authority before commencement of construction work.

5. Construction of underground structures below Railway line/track and structures/shed over Railway line/track, as required, for the proposed Alumina unloading area
6. Placement of ballast, railway line/track and sleepers in the proposed Alumina unloading area with proper alignment with the existing system.
7. Supply of railway line/track and sleepers , if required to complete the laying of railway line/track
8. Facilitation of checking of the railway line/track, underground structures below railway line and structures/shed over Railway track by Railway Authority, if required.
9. Co-ordination with Railway Authority for smooth execution of project as and when required.
10. Dismantling of underground rock layer, as required, by rock breaker (blasting or Controlled Blasting are strictly prohibited).

AJ] Design and construction of roads and storm water drainage system within battery limit of this package and connecting the same to existing road and drainage network within plant.AK] All other items not covered above but required for completion and successful operation of the plant and requirement for which has been described elsewhere in this specification shall form part of the scope.

AL] Architectural finishing including flooring, paving, side cladding with sheeting or brick masonry, walls, plastering, painting, false ceiling, doors & windows, plumbing, roof treatment, etc., for all buildings covered under this package.

The scope shall also include setting up by the Contractor a complete testing laboratory in the field to carry out all relevant tests required for the civil works for the project.

Water will be supplied by the Owner free of charge at a mutually agreed single point & the Bidder shall arrange distribution of the same beyond the above point at their own cost.

The scope of work covers complete Civil, Structural and Architectural Work including supply of all materials, labour, tools and plants as required for successful execution of the turnkey package.

The scope shall also include setting up by the Contractor a complete testing laboratory in the field to carry out all relevant tests required for the civil works for the project.

The Bidder shall visit the site and assess the involvement of demolition and site clearance, if required, within the plant area to construct the project & accordingly the cost is to be considered in his offer.

The scope shall also include setting up by the Contractor a complete testing laboratory in the field to carry out all relevant tests required for the civil works for the project.

All necessary statutory clearances shall be obtained by the Bidder prior to execution of work under scope of this specification.

All the quality standards, tolerances, welding standards and other technical requirements shall be strictly adhered to by the Contractor.

3.00.00 SITE AND SOIL CONDITIONS

The present site is full of vegetation & small trees. The site is slightly undulated in nature. The subsoil in general is a loose to medium dense silty sand mixed with gravels followed by weathered sand stone layer. The weathered sand stone layer is underlain by hard rock (sandstone) stratum which exists at variable depth.

Soil Survey and testing at site and its Report shall be carried out by the LSTK Vendor after award of contract. Moreover, routine tests (where required) for the important structures on design documents to cross check the safe bearing capacity. The LSTK Vendor shall also investigate and determine the water table, including any temporary rise of the water table during the rainy season. However, for design purpose, water table at site shall be considered at finished ground level irrespective of the results obtained during soil investigation by LSTK Vendor.

Nature of subsoil as described above is given for guidance and preliminary assessment only. However, for soil characteristics and design parameters to be adopted in final design, the LSTK Vendor is required to do detail geotechnical investigation work as part of the contract to verify/generate data so required. The cost of such work shall be deemed to have been included in the contractor's quoted price.

It should be noted that nothing extra whatsoever on account of variation between soil data described above and that found by detailed geotechnical investigation to be carried out by LSTK Vendor shall be payable.

4.00.00 CIVIL AND STRUCTURAL CODES & STANDARDS

4.01.00 Codes and Standards

4.01.01 Loads

IS 875	:	Code of Practice for design loads (other than earthquake) for buildings and structure.
IS 1893	:	Criteria for earthquake resistant design of structure Foundations

IS: 1080	:	Code of Practice for design and construction of shallow foundations in soils (other than raft, ring and shell).
IS : 1904	:	Code of Practice for design and construction of foundations in soils: General requirement loads (other than earthquake) for buildings and structure.
IS : 2950	:	Code of practice for design and construction of raft foundations; Part-1 : Design.
IS : 2974 (Part 1)	:	Code of Practice for design and construction of machine foundations for Reciprocating Type Machine.
IS : 2974 (Part 2)	:	Code of Practice for design and construction of machine foundationfor Impact Type Machine (Hammer Foundations).
IS : 2974 (Part 3)	:	Code of Practice for design and construction of machine foundations for Rotary Type Machine (Medium & High Frequency).
IS : 2974 (Part 4)	:	Code of Practice for design and construction of machinefoundations for Rotary Type Machine of Low Frequency.
IS : 2974 (Part 5)	:	Code of Practice for design and construction of machine foundations for Impact Machines other than Hammer.
IS : 8009 (Part 1)	:	Code of Practice for calculation of settlement of foundations : Shallow foundations subject to symmetrical static vertical Loads.
IS : 8009 (Part 2)	:	Code of Practice for Deep foundations subjected to symmetrical static vertical loading.
IS : 11089	:	Code of Practice for design and construction of ring Foundations.
IS 13301	:	Guidelines for vibration isolation for machine foundations

4.01.02 Reinforced Cement Concrete

IS : 456-2000	:	Code of Practice for Plain and Reinforced Concrete
IS : 3370	:	Code of Practice for Concrete Structures for the storage of liquids
IS : 3414	:	Code of Practice for design and installation of joints in buildings
IS : 4326	:	Code of Practice for earthquake resistant design and construction of buildings
IS : 5525	:	Recommendation for detailing of Reinforcement in reinforced concrete works
IS : 13920	:	Code of Practice for Ductile Detailing of RCC structures subjected to Seismic Forces

4.01.03 Structural Steel

IS : 800	:	Code of Practice for General construction in steel
IS : 808	:	Dimensions for hot rolled steel beam, column channel and angle sections
IS : 813	:	Scheme of symbols for welding
IS : 816	:	Code of Practice for use of metal arc welding for general construction in mild steel
IS : 9595	:	Recommendation for metal arc welding of carbon and carbon manganese steel
IS : 3502	:	Specification for steel chequered plates

4.01.04 Handbook and Special Publications

SP:6 (Part 1)	:	Handbook for Structural Engineering- Structural Steel Section
SP:6 (Part 2)	:	Handbook for Structural Engineering- Steel Beams and Plate Girders
SP:6 (Part 3)	:	Handbook for Structural Engineering- Steel Columns & Struts
SP:6 (Part 4)	:	Handbook for Structural Engineering- Use of High Strength Friction Grip Bolts
SP:6 (Part 5)	:	Handbook for Structural Engineering- Cold formed light gauge steel structure
SP:6 (Part 6)	:	Handbook for Structural Engineering- Application of Plastic theory in steel structure
SP:6 (Part 7)	:	Handbook for Structural Engineering- Simple welded girders
SP-7	:	National Building Code of India
SP-16	:	Design Aids for reinforced concrete to IS : 456
SP-20	:	Handbook on masonry design and construction
SP-22	:	Explanatory handbook on codes for earthquake engineering
SP-24	:	Explanatory handbook on Indian Standard Code of Practice for plain and reinforced concrete
SP-25	:	Handbook on causes and prevention of cracks in buildings
SP-32	:	Handbook on functional requirements of industrial buildings (lighting and Ventilation)
SP-34	:	Handbook of concrete reinforcement and detailing

5.00.00 GENERAL REQUIREMENT

5.01.00 Buildings

Different types of buildings shall have roofing, side walls finishes, Pavements and drains etc. The buildings shall have enough natural lighting and ventilation and should be aesthetically pleasant. Proper sealing arrangement with flashings, mastic or sealants to make the building waterproof and to prevent leakage of water at down comers, junctions, openings etc. shall be provided as directed by the Engineer. LSTK vendor shall Guarantee a period of minimum five years for water proofing treatment.

Roofed buildings shall have water proofed roofs with drainage outlets and discharge pipes. Concrete roof shall be cast with 1% slope.

The following general philosophy should be maintained while designing the buildings and structures:

a) Maximum use of day lighting by using translucent/polycarbonate sheets and natural air ventilation systems for buildings.
b) Insulation of office/building roofs.
c) Efficient air distribution for adequate cooling and heating in well-designed structural works.

5.02.00 Access for Operation and Maintenance

Each building and structure shall be designed so as to provide enough space with emergency exit for easy operation and maintenance and to give the workers good and safe environment. All working, maintenance and access areas shall be covered and protected from weather unless otherwise accepted by the Engineer.

5.03.00 Structures

5.03.01 Pipe Conveyor Gallery and its Supporting Structures

Conveyor gallery will be supported on trestles that are to be placed at approximately 20 m center to center. Height of all trestles is more or less constant and it is approximately 50 m height.

Plate bearings with elongated holes may be accepted only for short span and small lengths of conveyor bridges. In other cases, roller or rocker and roller bearings shall be provided, unless otherwise approved by the Engineer.

5.03.02 Transfer Points / Junction Houses:

Transfer Points shall be of steel over ground structures. These structures are required for transferring discharged alumina from unloading area to silos through pipe conveyors. Its sizes will be considered by the LSTK Vendor so as to accommodate enough space for easy operation of the pipe conveyor. All Working, maintenance and access areas shall be covered and protected from weather unless otherwise accepted by the Engineer.

5.03.03 Foundation

All foundations shall rest on sound virgin soil. Foundations on filled-up soils shall not be permitted. Concrete shall not be laid directly on ground but shall be laid over lean concrete.

Machine foundations shall be structurally isolated from adjacent foundations and structures by bituminous boards or other means, to prevent transmission of vibrations unless otherwise approved by the Engineer. The minimum weight of foundation shall not be less than three times the machine weight unless otherwise approved by the Engineer. Anti-vibration mountings shall be provided and dynamic analysis of Compressor foundations shall be made if required.

5.03.04 Hoppers

In general hopper shall be of steel construction with 12 mm thick liner plate [Tiscral/ Sailma / Sail hard or equivalent liners]. ROM ore bins for storage of alumina ore shall be of steel construction with 16mm thick Tiscral/SAIL Hard liner plate. General data sheet specification shall also be satisfied.

Bins and hoppers shall be designed considering these to be full. Over-pressure and dynamic effect shall be considered based on flow, height of fall, size of ore and other factors. Alternate and adjacent bins shall be considered as empty or full, as applicable, to determine the worst loading condition.

For this IS: 9178-1979 [Part-I, II & III] covering Criteria for Design of Steel Bins for Storage of Bulk Materials shall be followed.

5.03.05 Water Retaining Structures

Water retaining structures shall be designed as per IS:3370. The structures shall be so designed and constructed as to make these completely water proof. Water proofing admixtures like Plastocrete – N or equivalent shall be used as per manufacturer's recommendation. The degree of fixity of wall with the foundation slab shall be determined considering elasticity of structure and soil. Minimum thickness of walls/slabs including slabs not subjected to any significant stress shall not be less than 200mm. Water stoppers shall be provided at all construction and expansion joints unless otherwise accepted by the Engineer. Water stoppers shall be of PVC/rubber, minimum 250mm wide and 5mm thick. Tests shall be made for water tightness of the structures before backfilling. LSTK vendor shall Guarantee a period of minimum five years for water retaining structures.

5.03.06 Underground Pits, Basements and Tunnels

Underground structures below water table shall be designed as water retaining structures unless full waterproof treatment by suitable water proofing treatment is provided. Water stoppers shall be provided at all construction and at expansion joints below water table. Adequate slope (minimum 1 in 200) on floors and sumps shall be provided for proper drainage. Drainage from sumps shall be generally by gravity. Sump pumps shall be provided where required.

5.03.07 Drainage

Down comers and lined drains with perforated covers around the buildings shall be provided. Concrete plinth protection, 1.0m wide, shall be provided around the buildings. The finished ground floor levels shall be minimum 300mm above the adjacent finished grade. Arrangement for floor washing shall be provided where required.

5.03.08 Sanitary Sewage System

Sanitary Sewage drainage system is required for all RCC buildings. This shall comprise of local septic tank and soak pit close to the building. It must be connected to existing nearby sewerage network of plant.

5.03.09 Storm Water System

The storm water runoff generated around unpaved areas inside the plant is considered to be uncontaminated water. This water runoff shall flow overland facilitated by grading of the plant area to the peripheral sloped Reinforced Concrete U-ditches. The runoff from U ditches will be discharged /connected to the existing drainage system. It must be connected to existing underground storm water drainage system of plant.

5.03.10 Anti-termite Treatment

Full protection shall be provided against action of termites. Anti-termite pre-construction chemical treatment shall be provided where required.

6.00.00 MATERIALS

6.01.00 General

Unless specified otherwise, only best quality commercially available materials shall be used.

6.02.00 Bricks and Mortar

Bricks shall be of class designation 7.5 with average crushing strength not less than 7.5 N/sq.mm. Fly ash bricks shall be used provided it's designated class shall conform to Class-10 of IS: 13757-1993 (Burnt clay fly ash building bricks-Specification). The bricks shall be machine molded with requisite dimensional tolerance as per the above Code.

6.03.00 Concrete

Concrete shall be of following grades or nominal mix , unless otherwise specified :-

Lean concrete	:	1:4:8
All Structural Concrete	:	M25
Structural Concrete for Machine Foundation	:	M30
Structural Concrete for Concrete Roads	:	M35

The LSTK Vendor may use higher grades of concrete and design accordingly.

Minimum cover to main reinforcement

The following minimum clear cover shall be provided for RCC works:

- Slab (Roof & Floors), canopy, cantilever, waist slabs	25 mm or diameter of the bar whichever is greater
- Beam (Roof, Floor & Tie), Lintel	Do
- Column	40 mm
- Column Pedestal	50 mm
- Retaining Wall, Basement Wall, Pit Wall	
a) Face in contact with Earth/Water	50 mm
b) Free face	25 mm or the diameter of the bar whichever is greater
- Foundation Slab, Base Slab and Plinth Beam	50 mm

Minimum thickness of the structural concrete

The following minimum thickness shall be as followed:

- Footings	250 mm
- Slab thickness in raft foundation with beam and slab construction	300 mm

-	Floor / Roof Slab, Walk Way, Canopy Slab resting on beams	125mm
-	Cable / Pipe Trench / Launder Walls and Base Slab	150 mm
-	Cantilevered Canopy Slab	150 mm
-	Parapet	100 mm
-	Underground Pit Reservoir	
-	Walls	150 mm
-	Base Slab with Beams	200 mm
-	Base Slab without Beams	300 mm

Minimum height of Pedestals

The minimum projection of Pedestal supporting any steel structure / stanchion base shall be 300 / 150 mm above the high point of pavement / finished grade / finished floor level whichever is higher, for outdoor and indoor located pedestals respectively. The maximum projection of pedestal for stair case / ladder shall be 200 mm.

Minimum cover to foundation bolts

Minimum distance from the center line of foundation / anchor bolt to edge of pedestal shall be the minimum of the following:

i) Clear distance from the edge of the base plate / base frame to the outer edge of pedestal shall be minimum 75 mm.
ii) Clear distance from the face of the pocket to the outer edge of the pedestal shall be 100 mm.
iii) Clear distance from the edge of shear or anchor plate to the edge of the pedestal shall be 100 mm.

6.04.00 Reinforcement:

High strength deformed bars conforming to IS 1786 (f_y =500) shall be used. If reinforcement of grade f_y = 500 N/m^2 is used, it should be of ductile nature.

6.05.00 Structural Steel

The material for structural steel work shall conform to IS:2062-Gr-A except for Dynamic Loaded structures which shall conform to Gr-B only. High strength bolts of class 8.8 shall be used for bolted field connection.

Purlins, girts may be connected by bolts of class 4.6. Chequered plates shall be 6 mm o/p thick. Concentrated load more than 1.5 kN shall not be provided on chequered plates.

6.06.00 Grouting

Unless otherwise approved, only free flowing non-shrink cementitious grout shall be used. Epoxy grout shall be used for machine foundation.

Chemical injection or grouting method will be used to make the walls & base slab waterproof.

6.07.00 Doors and Rolling Shutters

Sizes and location of rolling shutters shall be indicated in Basic Engg. Drawing based on technological requirements. All external doors and where required from fire protection shall be steel doors. Internal doors shall be solid core flush doors with kicking plates except in toilets where FRP paneled doors shall be provided. Sizes of doors shall be adequate for erection and maintenance of equipment but neither less than the width of walkways and corridors nor less than 1.0m wide and 2.1m high. For toilet doors sizes may be reduced to 0.9m wide for the main entry and 0.75m wide for entry to units. All windows and louvers shall be of Aluminium standard section with toughen glass. For MCC & PLC all doors shall be provided with Aluminium door frames and panels.

7.00.00 LOADS AND STRESSES

7.01.00 Dead Loads

The loads shall comprise all loads of permanent nature.

7.02.00 Imposed Loads

Minimum imposed loads shall be considered as follows:

	Type of floor / roof	**Imposed Load**
i)	All Roofs including roof of conveyor galleries (except Roof Supporting Control Room and Cooling Tower Deck)	As per IS:875 (Part-II); dust load on inaccessible roof @ 25 Kg/ sq.m (extra) shall be considered.
ii)	MCC, Control Room Roof etc.,	250 Kg/Sq.m.
iii)	Cooling Tower Deck	250 Kg/Sq.m. for the free portion and equipment load in the occupied portion.
iv)	Floor of conveyor galleries	Apart from equipment loads 300 Kg/Sq.m on entire length of walk ways & 500 Kg/Sq.m on individual panels of walkways.
v)	Steel floors in platforms	300 Kg/Sq.m plus equipment load.
vi)	Stairs, landings, corridors & floor of cable spreader rooms	500 Kg/Sq.m.
vii)	Electrical MCC & Control Room, Ventilation Room and other concrete floors	750 Kg/Sq.m.
viii)	Trench covers except those subjected to crossing of vehicles.	500 Kg/Sq.m.
ix)	Trench & Tunnel below roads.	IRC Class-A loading or actual Vehicle weight whichever is higher. Impact factor to be taken as 25%.

	Type of floor / roof	**Imposed Load**
x)	Surcharge pressure on ground (e.g. beside trench)	1500 Kg/Sq. m minimum.

The above live loads shall be increased to take care of erection loads and actual equipment loads as necessary.

xi) Characteristics of Alumina

Type	:	Sandy
Maximum Density	:	1.1
Angle of repose during reclaiming	:	35 degree
Angle of repose during loading	:	23 degree
Internal angle of friction	:	27 degree to 35 degree
Angle of friction on steel	:	25 degree

7.03.00 Wind Load

Wind Load shall be considered as per IS: 875 (Part-3) – Latest. The basic wind speed shall be taken as 50 m/s. The terrain shall be considered as of Category -3. Design life shall be considered as 50 years. Topography factor shall be taken as 1.0.

7.04.00 Seismic Load

For Seismic load, the area shall be considered to be in Zone-III as per IS: 1893-2002 and the importance factor shall be taken as 1.0. Response reduction factor shall be considered as stipulated in IS: 1893-2002.

7.05.00 Temperature Effect

Temperature stresses due to variation of plus minus T^0C shall be considered for exposed structures. This temperature variation T shall be calculated from Site Climatic Temperature Data. However, if permitted by the Consultant, temperature effect need not be considered for buildings less than 75m in length.

7.06.00 Combination of Loads

Loads shall be combined for the worst condition for design. Various design loads considered shall be combined in accordance with clause 8.0 of IS: 875 [Part-5] to give the most severe loading condition for design of structures. However, wind and seismic loads need not be considered simultaneously.

7.07.00 Stability

Stability of the structures shall be ensured as per the provisions of IS: 456 and IS: 800, considering also the conditions stated under design criteria in this document.

7.08.00 Deflections

The maximum deflections shall be within the limits specified by the relevant standards

8.00.00 TYPICAL DESIGN PRINCIPLE OF SOME STRUCTURES

Some typical design methodology of structures are given below.

I : DESIGN OF BUILDING STRUCTURES

1.0.00 DESIGN CONSIDERATIONS

1.1.00 GENERAL

1.1.01 Structures shall be designed such that they are economical and safe and meet the functional and service requirement of the technological process for which they are designed. The architectural planning of the building shall be based on the guidelines and requirements given in the tender drawing and specification.

1.1.02 The structures shall be designed conforming to relevant safety regulations, factories acts, electricity rules and stipulations of statutory bodies as applicable to the project.

1.1.03 Natural ventilation shall be provided ensuring that it prevents rainwater entry into the building.

1.1.04 Mild steel gutters and down pipes with gutter outlets and grating shall be provided to carry rainwater from roofs of buildings to the drainage system for such building at ground level. In case access is provided to roof, gutters shall be designed walkable and painted with Epoxy paint.

1.1.05 Adequate facilities in the form of monorails, hoists, platforms etc. shall be provided to facilitate repair and maintenance of overhead cranes equipment etc. Access to this platform shall be provided by stairs from the nearest accessible floor or platform. Transverse runway platform shall be provided at the gable end for crane maintenance.

1.1.06 Access to all floors, gangways and landings shall be by staircases. Access to roof and landing of secondary importance or where such access is used only rarely, shall be by vertical ladders with safety caging.

1.1.07 Access to roof shall be generally located at gable ends and if required also at intermediate locations, so that for every 150 meters length of the building at least one access to roof is available.

1.1.08 Platforms for access to crane cabin shall be provided and shall preferably be located at the gable end i.e. crane maintenance bay.

1.1.09 Edges of floors, gangways, stairs and landings shall be provided with safety hand railings.

1.1.10 Roof with access shall be provided with safety hand railings along the periphery of the roof.

1.1.11 All gable ends of buildings, platforms shall be provided connecting the walkways at crane gantry level.

1.1.12 Floors, gangways and landings shall be covered as follows:

[a] Gangways and landings shall have chequered plate with a minimum thickness of 6mm o/p suitably stiffened to meet design load requirements.

[b] Repair and operating platforms other than the above shall have chequered plate flooring with minimum thickness of 8 mm o/p suitably stiffened to meet design load requirements.

[c] Where there is a possibility of gas and dust collection, hot dip galvanized open gratings shall be used.

1.1.13 Protective metal heat shields shall be provided for steel structures exposed to continuous heat radiation or splashing on structures is likely to occur.

1.1.14 All buildings and their foundations shall be designed so that it shall be possible to extend them in the longitudinal direction at a later date without further strengthening of gable structures.

1.1.15 Sheeting on sides and gables shall generally terminate 3.5m above floor level, sides below this level shall be generally screened by brick walls allowing sufficient air inlet to achieve natural ventilation, unless otherwise required from technological and ventilation requirements.

1.1.16 Connection by permanent bolts to structural elements subjected to vibration loads shall be provided with lock nuts.

2.0.00 ELEMENTS OF STRUCTURES

2.1.00 COLUMNS& BEAMS

2.1.01 At the location of passage/ opening through columns, web shall be suitably strengthened by vierendal panel or modified lattice system.

2.1.02 Shear force at the column base shall be resisted either by shear keys shop welded to the underside of the column base plates or by welding base plate to inserts provided in foundation.

2.1.03 The level of underside of column base shall be so chosen such that the complete anchor table lies below the finished floor level, thus keeping the shop floor free from projection of anchor tables.

2.2.00 CRANE GIRDERS

2.2.01 Crane girders shall generally be of simply supported design, unless continuous crane girder is specifically required.

2.2.02 The flange plate shall be welded to web plate with full penetration butt weld with fully automatic submerged arc welding. Bottom flange plate shall be welded to web plate by continuous fillet welds with automatic/ semi-automatic welding.

2.2.03 All intermediate stiffeners shall be fitted against top flange and welded to it by fillet welds / partial penetration butt welds. These stiffeners shall terminate short of bottom flange with at least 25mm gap. The stiffeners shall be fillet welded to web plate and corners shall be cut suitably to clear thermally affected area of web to top flange connection.

2.2.04 End bearing stiffener plates of crane girder shall be capable of transmitting the maximum reactions to the columns. The bearing surface of the bearing plate shall be planned / machined to ensure full tract.

2.2.05 Tension flange of crane girders shall be stabilized by horizontal latticed bracings, where required in order to limit the slenderness ratio of the flange.

2.2.06 Generally for girder having span more than 12 meter, vertical auxiliary girder and horizontal girder at crane girder bottom flange level shall be provided.

2.3.00 SURGE GIRDER WALKWAY

2.3.01 Continuous maintenance walkways with safety hand railings shall be provided along each column row adjacent to each crane gantry girder. These walkways shall be of non-slip plate construction connected to crane girder top flange by continuous fillet weld.

2.3.02 Connections between surge girder and the main columns shall be designed to resist load due to lateral breaking of crane trolley.

2.3.03 On the periphery of the building, full length hand rails shall be provided along the edge of the maintenance walkway at crane girder level.

2.3.04 Hand rail and its clearance from crane end carriage shall conform to provisions of relevant safety regulation.

2.4.00 CRANE STOP

2.4.01 Crane stops shall be provided at the ends of each crane girder system or as required to limit the movement of crane as per technological requirements.

2.4.02 Crane stop shall be bolted to crane gantry girder.

2.5.00 ROOF STRUCTURES

2.5.01 The main supporting element shall be roof trusses provided at uniform spacing to suit shop layout. Roof shall be provided with adequately sized roof monitor for natural ventilation, wherever required.

2.5.02 Roof shall have suitable slope to meet technological as well as rain water drainage requirements.

2.5.03 System of bracing shall be provided in the roof top chord and bottom chord levels along with longitudinal ties to ensure stability and rigidity of the roof structures. Vertical bracings between trusses shall also be provided wherever required.

2.5.04 Wind tie [50 x6 mm flat] shall be provided at eaves and ridge end of roof sheeting.

2.6.00 ROOF LIGHTING WALKWAYS

2.6.01 Full length roof lighting walkways, generally 800mm wide, shall be provided in each bay as required to match the number of rows of roof light provided in the building.

2.6.02 These walkways shall span between roof truss members and will be decked with chequered plate floor. Walkways shall be provided with hand railings on both the sides.

2.7.00 ROOF DRAINAGE SYSTEM

2.7.01 Roof drainage system shall be designed for maximum precipitation for 5 minutes based on local meteorological data. A factor of safety of 1.3 shall be kept in the design.

2.7.02 All valley and eaves gutters shall be of pressed plate construction with a minimum sole width of 600mm so as to function as walkway.

2.7.03 Eaves gutter shall be provided for eaves height ranging between 10m to 25m above apron/ground level.

2.7.04 The gutters shall be laid to slope towards down pipes with welded outlets and having grills fitted flush with gutter sole. Slope of gutters and collector pipes shall not be flatter than the following limits:

[a] Longitudinal slope of gutter 1: 500

[b] Longitudinal slope of collector pipe 1: 300

2.7.05 Poking holes with cover shall be provided in the down pipes at suitable intervals as well as accessible levels, to clean the down pipes.

2.7.06 Collector pipes shall be provided with covered manholes at 6m interval.

2.7.07 Eaves gutter shall be provided with safety hand railing.

2.7.08 When rain water falls from higher to lower roof, double layer of sheets shall be provided for the portion of roof sheeting on which rain water falls, provided the drop of roof is in the range of 3m to 6m. In case the drop is more than 6m, independent gutter shall be provided.

2.7.09 Down pipes shall be spaced preferably at 24m centers. Down pipes shall be connected to the gutter with suitably designed hoppers with gratings at sole level of gutter, made of 8 mm dia. rounds at 50 mm centers.

2.7.10 Joints of gutter and collector pipes shall be by welding in order to achieve leak-proof.

2.8.00 WALL STRUCTURES

2.8.01 Wall runners with necessary sag rod arrangements shall be provided to support wall and gable sheeting, including internal partition wall, wherever required.

2.8.02 The wall posts shall generally terminate at 3.5m above roof level.

2.8.03 Gables of buildings shall have wall post spaced at intervals to suit bay width.

2.8.04 Walls shall be provided with louvers and glazing at appropriate levels, to provide natural ventilation and lighting.

2.9.00 FLOOR FRAMEWORK

2.9.01 Floor beams supporting vibrating equipment's shall be designed to avoid resonant frequencies.

2.9.02 Beams along with framework, shall be provided with horizontal and vertical bracings [wherever permissible] to achieve overall rigidity.

2.10.00 VERTICAL BRACINGS

2.10.01 Vertical bracings shall be provided on all column rows for each expansion block.

2.10.02 Vertical bracings shall extend from ground level to roof level and shall be designed to transmit longitudinal forces i.e. wind forces, crane tractive forces, seismic forces etc. to the foundation.

2.10.03 Below crane girder level, the bracings shall be of twin system in the plane of each column leg, suitably tied or laced together.

2.11.00 ACCESS STAIRCASE, WALKWAYS, PLATFORMS AND LADDERS

a) Wherever possible access shall be provided by means of stairs.

b) All walkways and stairs leading to working platforms shall have minimum 1000 mm width of walkways/flight of stair.

c) All other walkways and stairs leading to areas for maintenance purpose, or due to restriction of space, shall have a minimum width of 800 mm of walkway/flight of stair, unless required otherwise.

d) Staircase shall be generally designed with slope of approximate 37.5° with the horizontal (in no case slope shall exceed 40° with the horizontal). Intermediate landings shall be provided wherever required such that vertical rise of each flight does not exceed 3000 mm. Risers in one flight shall be equally spaced.

e) Walkway floors and stair treads shall be designed with chequered plate (or non-slip type plates). Ribbed floor/treads may be provided wherever the possibility of accumulation of dust exists, taking care that such provisions do not create a nuisance to the operating personnel on the shop floor.

f) Rise of treads in staircase shall not exceed 200 mm.

g) A minimum headroom of 2200 mm shall be provided over operating platforms, visitors galleries, or other areas with possibility of public gathering. In all other platforms, walkways and stairs, minimum headroom of 2000 mm shall be provided. Only in special cases, local headroom of 1800 mm may be allowed (i.e. at intersection with structural members etc.).

h) Cat ladders shall be provided for access, wherever provision of staircase is impracticable due to limitations of space, or the access is required very infrequently.

i) Wherever the height of cat ladder exceeds 2.5 m, safety cage shall be provided. Intermediate landing shall be provided to cat ladders such that vertical height of single rise does not exceed 8.0 m.

a. Cat ladders shall be designed with following provisions:

i) Width of rung = 700 mm
Minimum width of rung at locations of space constraints = 500 mm
Minimum rise of rung = 250 mm
Maximum rise of rung = 300 mm

iii) Minimum clearance from rung of ladder to back of cage

(in case of caged ladders) = 700 mm

iv) Minimum clearance from the center of cage all round = 350 mm

v) Slope of cat ladders:

g) For normal cat ladders, slope shall be within the range of 75°-90° with the horizontal.

h) For ship-type ladders (i.e. cat ladders with short side handrail) the slope shall be within the range of 65°-75° with the horizontal.

i) All walkways, platforms and stairs shall be provided with safety handrails. All handrails shall be constructed with steel tubes/angles for posts, top and middle rail and plates/sheets for toe plates. In case of stairs, the toe guards need not be provided.

j) The vertical height of hand railings on walkways and stairs shall be minimum 1000 mm above floor level.

k) Hand railing along edge of roof and gutters shall have a minimum height of 600 mm over top edge of gutters/sheets. In such hand railings toe guards need not be provided. (only top hand rail and mid rail shall be provided).

2.12.00 DESIGN

2.12.01 DESIGN OF STRUCTURES

2.12.01.01 Design of steel structures shall be done in accordance with IS: 800 latest.

2.12.01.02 Structures subjected to fluctuating / reversal of stresses [e.g. Crane girders] shall be designed in accordance with IS: 1024 -1979.

2.12.01.03 Resonance in structures- structures supporting vibratory/reciprocating equipment's shall be designed so as to obviate occurrence of resonance. The ratio of applied frequency to natural frequency shall be beyond the limits of 0.7 to 1.5 [preferably less than 0.7]

2.13.00 DESCRIPTION OF DESIGN LOADS

2.13.01 Loads considered in design shall allow fully for all aspects of:

[a] Dead weight of structures, walls, floors, equipment's, wiring, machinery, pipe work, cabling and any item of permanent nature.

[b] Superimposed loads for roofs and floors plus any temporary machinery not allowed within the general superimposed loads.

[c] Crane loads.

[d] Temperature loads from process requirements because of the position of the structure relative to the heat source or from support of mains, pipes etc. subjected to heat.

[e] Maximum range of temperature variation for climatic condition is to be calculated from Max/Min. Temperature data.

[f] Dust load.

[g] Dynamic loads from screens and other such reciprocating machinery.

[h] Maintenance Hoists.

[i] Wind loads.

[j] Seismic loads.

[k] From future expansion.

[l] Any special erection requirements.

2.13.02 For Loading codes, Load combinations etc. refer Cl. No.5.00.00 in LOADS AND STRESSES.

2.14.00 LIMITING DEFLECTION

2.14.01 The deflection shall be limited in various elements of structures in accordance with IS: 800-1984 [Clause-3.13]

2.14.02 In addition, the following limitations in deflection shall be observed in the design:

Vertical deflection		
[a]	Monorail Track beam	Span/ 400
[b]	Main roof trusses, roof girders, main floor beams in operating platform	Span/ 400
Horizontal direction		
[a]	Crane girders due to surge force [from one crane only]	Span/ 2000
[b]	Main column at crane rail level due to action of crane [for surge force consider one crane for single bay and one crane on adjacent aisles for multi-bay]	H / 2500
[c]	Open gantry for condition [b] above where H is the height of column from bottom of base plate to crane rail level.	H / 4000
[d]	All deflections shall be calculated without dynamic factor.	

2.15.00 CAMBER

Wherever excessive deformation is likely to cause operational problem or is aesthetically not agreeable, camber shall be provided to neutralize the effect of deformation due to dead load plus 50% of imposed loads.

2.16.00 EXPANSION JOINT

2.16.01 Longitudinal and transverse expansion joints shall be provided in buildings and structures in accordance with IS:800.

2.16.02 Expansion joints shall be formed by providing double rows of columns, with interconnecting gantry girders, secondary roof and wall framing being detailed to allow the maximum calculated movement for the specified temperature variation.

II : DESIGN OF PIPE CONVEYOR GALLERIES AND TRANSFER POINT/JUNCTION HOUSES

1.0.00 DESIGN CONSIDERATION

1.0.01 The pipe conveyor galleries shall be designed so as to meet functional requirements and shall provide space for operation, maintenance and removal of machinery and give the workers good and safe environment.

1.0.02 Gallery floors shall be of chequered plates supported on steel beams.

1.0.03 Steps shall be provided [rise not exceeding 130 mm] along the walkway if the gallery slope exceeds 12 degree. In case the slope of gallery is between 6 to 12 degree, suitable ribs shall be provided on floor [without any sharp edges] at 250 to 300 mm intervals.

1.0.04 Provisions shall be made for emergency exit from galleries to ground level and also for cross over above conveyor at 150 m intervals [maximum].

1.0.05 Roof of conveyor galleries shall be covered with Pre coated colored Aluminium toughened sheets.

1.0.06 Roof of pipe conveyor galleries shall be flat type with a mild slope in two directions.

1.0.07 The level of underside of the base plate of gallery supporting trestles shall be 300 mm above the average ground level of the surrounding area.

1.0.08 Protective hand railing shall be provided along gallery walkways, open platform, stairways, landings, edges of walkways when the gallery is not enclosed, and around erection openings, if any, to ensure safety of operation personnel.

1.0.09 Conveyor galleries longer than 150 m shall be provided with expansion joints with twin trestles/ supports. Each expansion block shall have fixed support/ rigid trestle with adequate arrangement [provision of top chord and bottom chord bracing to gallery girder etc.] for transferring the transverse and longitudinal forces to the foundation.

1.0.10 Gallery girder near Transfer Point shall be preferably supported on trestle located as close to the Transfer Point as possible with part of gallery girder between junction house and trestle cantilevered from the trestle. Supporting gallery girder on junction house shall be generally avoided.

1.0.11 When conveyor gallery crosses above or below H.T. Cables, a clear distance of 1.0 m between the structural elements /cladding and H.T. Cables shall be maintained.

1.0.12 When the conveyor bridge passes over plant roads, clearance between the road surface and the lowest point of the bridge shall not be less than 4.5 m or the height needed for the passage of the largest individual components of the plant equipment, whichever is the larger.

1.0.13 The Transfer Point shall be designed to suit the technological requirements. Number of floors, height of building etc. shall be decided accordingly.

1.0.14 In general Transfer Point shall be designed as framed structures on short span side and vertically braced on longer side to achieve stability.

1.0.15 Floors of Transfer Points shall be of steel cheq. plate floor (min. 8 mm o/p) supported on steel beams, unless required otherwise from technological consideration.

1.0.16 Roof and side covering of Transfer Points shall be with colored Aluminium toughened sheets. Roof slope shall be 1:3 [1vertical, 3 horizontal]

1.0.17 Suitable access staircase and safety hand railing shall be provided to all floors of junction house.

1.0.18 When hydro-washing of floor of Transfer Points / junction house is envisaged, the floor beam supporting RCC slab shall be laid to a suitable slope to achieve the same, wherever the same is not practicable to achieve, screed concrete shall be laid to a min. slope of 1.5%.

1.0.19 Wall sheeting shall generally start from the lowest working floor and extend up to roof level with louvers at each floor level to ensure adequate natural ventilation.

1.0.20 Monorails of maintenance hoists shall be provided for maintenance and repair of various equipment's located on the floors.

1.1.00 COMPONENTS OF STRUCTURES

1.1.01 Gallery trusses

[a] Gallery truss shall be of latticed type construction and shall support roof as well as floor deck supporting conveyor system.

[b] The trusses shall be adequately braced at top and bottom chord level to transfer the horizontal wind forces to end portals.

1.1.02 Stringer beam

These beams shall be suitably placed to support the conveyor stringer post and shall deliver load to gallery trusses. Walkways on either sides of the conveyor shall also be supported on these stringer beams.

1.1.03 Supporting trestles

Intermediate trestles shall be two-legged and shall deliver loads from gallery trusses to the foundations. In addition four legged trestles shall be provided which will act as fixed support to transmit all longitudinal forces between expansion block, in addition to other forces.

1.1.04 Junction houses

[a] Floors- Floor beam layout shall be arranged to suit equipment layout as well as equipment anchoring system.

[b] Columns- In addition to loads from floor and roof, columns shall be designed to transmit horizontal load due to belt tension /snapping of belts to the foundation.

1.1.05 Belt Tension devices

Suitable structures shall be provided to accommodate belt-tensioning device which may be located either under the conveyor gallery or in the junction house itself.

1.1.06 Design of structure

[a] Design of steel structures shall be done in accordance with IS: 800 -1984.
[b] In absence of specific dynamic factor to be considered for the load from the pipe conveyor, a dynamic factor of not less than1.3 shall be considered for the design of floor beams and gallery girders.
[c] Gallery trusses and stringers as well as floor beams of junction house shall be checked for obviating occurrence of resonance and shall be designed accordingly.

1.1.07 Description of loads and loading codes

[a] Unless specified otherwise, all loading codes and loads shall be as per Cl. No.5.00.00 under LOADS AND STRESSES.
[b] Live loads from conveyor on the gallery floor shall be as per conveyor suppliers load data.
[c] While designing fixed support/ rigid in an expansion block of conveyor gallery the following loads [in addition to wind load] shall be considered :

i) Forces due to difference in frictional resistance of top and return idle rollers of conveyor.
ii) Forces due to inertia of rollers at the time of starting of conveyor belt.
iii) Break down load caused by snapping of belt [in case of multiple conveyors, snapping of one belt at a time] shall be considered.

[d] As per technological requirements, provision of supporting the following and load arising thereof shall be considered in the design of conveyor gallery:

i) Ventilation duct.
ii) Electrical cables / cable rack.
iii) Firefighting equipment's.

[e] Junction house floor shall be designed for the following loads:

i) Live load on floor.
ii) Tension from conveyor belt.
iii) Loads due to equipment's located on the floor.
iv) Load due to jamming of chutes.
v) Erection loads anywhere on the floor

1.1.08 Limiting Deflection

[a] The deflection shall be limited in various elements of structures in accordance with IS: 800.

[b] In addition, the following limitation in deflection shall be observed in the design :

i) Gallery trusses ……..... Span/ 400

ii) Top of end portal of gallery truss…… H / 1000 where
H = Height of portal above beam.

iii) Transverse deflection of top of supporting trestle, H / 1000 where

H = Height of trestle above FDN.

iv) Stringer supporting conveyor structural member directly

supporting with tripper… … … … … … Span/900

v) Member supporting the tripper… … … .. Span/325

III : SPECIFICATION FOR DESIGN OF MACHINE FOUNDATION

1.0.00 GENERAL

Design guidelines for Loads, Load combinations, Materials & Analysis which shall be used for various Equipment Foundations including air compressor.

1.0.01 EQUIPMENT FOUNDATION

Equipment foundation like air compressor, pump foundation shall be block type foundation. Generally dynamic analysis shall not be required if the rotation mass is comparatively less. But pockets of anchor bolts and cut outs shall be provided as per approved mechanical GA drawing.

1.0.02 FEEDING CONVEYOR SUPPORT FOUNDATION

Feeding conveyor with drive system are generally supported on steel structures having steel floors with chequered plates at various levels. Steel staircase shall be provided to access all the floors. This vibrating screen are floor mounted type and shall be supported on steel floor beam through bolts by using anti-vibration pads. This screen supporting structures shall preferably be independent of building structures with adequate bracing system up to ground level and its foundation shall be rigid enough to withstand the vibrating shock loads.

1.0.03 REFERENCE BOOKS FOR GUIDELINES:

[a] Handbook of Machine Foundation –by P. Srinivasalu & C.V. Vaidyanathan.

[b] Design of Structure and Foundation for Vibrating Machines-by Suresh Arya, Michael , O'Neill & George Pincus.

1.2.00 DESIGN PHILOSOPHY

1.2.01 MACHINE FOUNDATION

The machine foundation shall be designed to satisfy the following requirements:

[a] The natural frequency criteria of the foundation- machine unit.

[b] Vibration limits under steady state operation.

[c] Strength requirements under normal and abnormal condition.

1.2.02 ANALYSIS

Foundation at fundamental modes of vibration are at least +- 20% away from the operating The Eigen solution for the foundation shall be calculated to ensure the natural frequencies of the frequency of the crusher. The sizing of the foundation shall be arrived such that the mass of foundation shall be at least 2.5 times the mass of the whole machine.

The dynamic vibration amplitudes shall be calculated by applying the unbalanced loads of the crusher as the time varying loads at their loading points with the frequency of the forcing

function equal to the natural frequency of the foundation or the operating frequency / first critical speed of the crusher. The vibration amplitudes shall be checked whether they are within the permissible limits as per manufacturer's requirement or the design codes.

The static analysis of the foundation shall be done for different load cases. The dead load. Live load and machine load on the foundation shall be calculated and shall be given as input. Then the different combined loads expected on the structure shall be calculated as per IS:2974 and the structure shall be designed for the worst of the above load combination.

1.2.03 LOADINGS

[a] DEAD LOAD: Dead load shall include the following loads:

(i) Mass of the foundation and crusher house structure if supported on it.

(ii) Mass of the crusher, driving motor and ancillaries.

[b] LIVE LOAD : Live load shall be considered as 5 kN/ sq.m applied on the area of Deck slab.

[c] MACHINE LOAD

(i) Unbalanced force in normal operating condition:
It shall be furnished by the crusher supplier. The same shall be multiplied by four [4] and shall be applied at the supporting points.

(ii) Maximum Unbalanced force due to considerable wear & tear:
It shall be calculated by considering the eccentricity 'e' as 1 mm.

(iii) Maximum Unbalanced force in failure [or] abnormal condition:
It shall be due to breakage of one hammer. It shall be taken as 5 times the operating unbalanced load.

1.2.04 VIBRATION AMPLITUDE

In the absence of any limits of vibration amplitude by manufacturer, permissible amplitude shall be considered as below [Ref: IS: 2974-Part-4]

[a] Permissible vibration amplitude is 300 microns for machine with operating frequency up to 300 c/s.

[b] Permissible Vibration amplitude is 100 microns for machine with operating frequency above 300 c/s.

1.2.05 EQUIPMENT FOUNDATION

The block foundation consisting of equipment, Gearbox and motor shall be designed as single block subjected to static and dynamic loads at respective application points as given in the equipment GA drawing.

Eccentricity in foundation block in X and Y direction due to the self weight of foundation and machine with respect to self weight of foundation system shall not be greater than 5% of the length and breadth of the foundation block in X and Y direction respectively.

Natural frequency and the amplitude of foundation shall be calculated using Barkan's method as described in Hand book of Machine foundation by P. Srinivashalu and C.V. Vaidyanathan.

Damping effect of foundation shall not be considered for dynamic analysis.

The sizing of the foundation shall be arrived such that the mass of the foundation shall be at least 2.5 times the mass of the whole machine. The weight of the base slab shall not be less than the combined weight of the structure and the machine.

Natural frequency of the foundation in the following modes shall be calculated:

[a] Vertical mode.

[b] Sliding and rocking mode in XZ plane.

[c] Sliding and pitching mode in YZ plane.

[d] Torsion mode.

Amplitude in three directions viz. X, Y & Z directions shall be calculated.

Dynamic forces and moments shall be calculated with dynamic factor [or] fatigue co-efficient as 2.0. Dynamic loads due to the amplitude shall also be calculated to arrive the total load on the foundation.

1.2.06 LOADS & LOAD COMBINATIONS

The following load cases shall be considered:

DL Dead Load of Foundation and Machine.

SSL Steady State Loads with fatigue factor-2.

1.2.07 LIMITING VALUES

Natural frequency of the block foundation shall be kept 20% away from the machine frequency.

Limiting horizontal amplitude at top of foundation shall be 0.2mm [200 microns]

Since dynamic factor 2.0 is applied for calculating the design forces for foundation design, seismic will not be critical.

IV : PIPE LINE SUPPORTING STRUCTURE

1.0.00 DESIGN CONSIDERATION

1.0.01 Bridges shall be provided to support pipelines of smaller diameters for which maximum permissible span is less than the distance between supporting trestles.

1.0.02 Trestles, which are designed to transmit longitudinal loads (along the length of pipeline) to the foundation, shall be four-legged construction. Other trestles, which transmit only the vertical load to the foundation, shall be two-legged construction.

1.0.03 Access stair and platforms shall be provided for maintenance of equipment installed in the pipeline (e.g. Valves etc.). Maintenance walkways with hand railing shall also be provided along the pipeline, wherever required. Provision of access stairs, walkways platforms, hand railing etc. shall conform to clause 1.2.12 of this specification.

1.1.00 DESIGN OF STRUCTURES

1.1.01 Design of steel structures shall be done in accordance with IS: 800.

1.2.00 DESCRIPTION OF LOADS AND LOADING CODES.

1.2.01 Unless otherwise specified hereinafter, all live loads shall be considered in accordance with IS: 875-1987 (Part-2).

1.2.02 Wind load shall be considered in accordance with IS: 875-1987 (Part-3).

1.2.03 Seismic loads shall be considered in accordance with IS: 1893.

1.2.04 In addition, pipeline, bridge and supporting trestle shall be designed for the following loads:

a) Weight of liquid or condensate, as is appropriate for pipeline.
b) Weight of valves, compensators, fittings etc. in addition of self-weight of pipe.
c) Load due to thermal expansion of pipeline.

1.02.05 Maintenance platforms shall be designed for a service load of 5 $KN/m^{2.}$

1.3.00 COMBINATION OF LOAD

1.3.01 The various loads specified shall be combined in accordance with clause 8.0 of IS: 875-1987(Part-5) to give the most severe loading condition for design of structures.

1.4.00 STRESS ENHANCEMENTS

1.4.01 Permissible limits of stress may be increased, wherever permissible, in accordance with IS: 800.

1.5.00 LIMITING DEFLECTION

a) Deflection of gallery bridge structure shall be limited to span / 400.

b) Transverse deformation of trestle shall be limited to H / 1000 where H = Height of trestle above foundation level.

c) The deflection of other elements of structures shall be limited in accordance with of IS: 800.

V : STANDARDIZATION AND UNIFORMITY

1.0.00 GENERAL

Every endeavour shall be made to achieve standardization and uniformity amongst the steel structures of different units of the plant.

1.0.01 The following items shall be kept in view in design of structures:

a) Uniform layout module shall be adopted to the extent possible consistent with economy. It is suggested to adopt a basic module of 3 m for building width and 6 m for column spacing along building length.

c) Uniform slopes of roofs matching with existing buildings unless specifically required otherwise for any particular unit.

d) Provision of expansion joints by using twin columns & expansion joint treatment.

e) Uniform adoption of clearance between structures and moving parts of equipment's.

f) Provision of adequate natural ventilation by using louvers (canopy like structures) at appropriate location.

VI : STRUCTURES ADJACENT TO RAILWAY TRACKS

All underground and overground structures across the Railway Tracks shall be designed as per Railway Bridge Rules and other Railway Standards.

Structures adjoining to railway track shall be designed for additional surcharge as per provisions of IRC and other railway Standards.

Design calculations, execution drawings and construction methologies shall be submitted by LSTK Vendor to Railway Authority for their Approval.

9.00.00 CONSTRUCTION

9.01.00 Technical Specifications

The following Standard technical specifications shall be followed for construction and these are furnished at the following Sub sections:

SUB-SECTION NO.		TECHNICAL SPECIFICATIONFOR
C1	-	Earthwork in excavation and backfilling.
C2	-	Cement Concrete (Plain and Reinforced).
C3	-	Fabrication of Structural Steel Work.
C4	-	Erection of structural Steel Work
C5	-	Sheeting work in Roof sides and Gable ends.
C6	-	Masonry and Allied Work.
C7	-	Finish to Masonry and Concrete.
C8	-	Floor finishes and Allied Works.
C9	-	Metal Doors, Windows, Ventilators, Louvres etc.
C10	-	Glass and Glazing.
C11	-	Painting, White Washing, Polishing etc.
C12	-	Roof Water-proofing, Insulation & Allied Works.
C13	-	Carpentry and Joinery.
C14	-	Miscellaneous Metal.
C15	-	Rolling Steel shutters/Grills
C16	-	Anti-termite treatment.
C17	-	Water supply

SUB-SECTION NO. **TECHNICAL SPECIFICATIONFOR**

C18 - Drainage and Sanitation

C19 - Area Grading

C20 - Concrete Roads

C21 - Geotechnical Investgation

C22 - Survey works

10.00.00 TESTS AND ACCEPTANCE CRITERIA

The tests and acceptance criteria shall be as per the General Specification and the Technical Specifications stated under C1 through C20, as mentioned in Cl. 6.01.00.

11.00.00 DRAWINGS AND DOCUMENTS TO BE SUBMITTED

11.01.00 Following design documents and drawings shall be submitted as per conditions of contract.

11.01.01 Detailed list of drawings/documents [Including design calculations, design drawings, bar bending schedules (For RCC works) and fabrication drawings (For structural works)] and structure-wise quantity statements (showing anticipated, released, balance quantities of concrete, structural steel) shall be prepared by the LSTK Vendor and submitted monthly for review by Owner/Owner's representative, list shall also indicate the document/drawing category (approval, review, information as applicable) together with the scheduled and actual date of submission of the documents.

11.01.02 Before proceeding with design and drawing preparation the LSTK Vendor shall submit general philosophy of design of various parts of all the structures, equipment foundations along with explanatory sketches for review by owner/owner's representative. Only after the review and incorporation of comments on the general philosophy, as offered during the review, the LSTK Vendor shall submit any design document and/or drawing for review or information and the same for construction. Design and detailing of the structures and foundation shall fulfill all functional requirements for which the same is intended and ensured that adequate accesses, clearances, clearing of cutouts, etc. have been provided to make the structure/foundation fully operational. The design and AFC drawings shall strictly adhere to the reviewed design basis and architectural/ structural general arrangement and shall incorporate all the comments/suggestions given by owner/owner's representative without any extra cost to the owner and any implication of time schedule for completion of works.

11.01.03 Design Calculations including STAAD input (.STD file) & output files for all superstructure RCC works e.g., Bldg. framework, roof Structures, columns, Pits etc. and all Steel works, e.g. Monorail beams, hopper, conveyor gallery supporting structure and misc. structures etc.

11.01.04 Design Calculations for foundation of all steelwork superstructures, RCC frame Bldgs. and other RCC structures under the scope.

11.01.05 Design calculations for Compressor foundations, including dynamic analysis, wherever applicable.

11.01.06 Detail drawings (Including AUTOCAD files) of all structures and miscellaneous steel work including material lists, DOD lists etc.

11.01.07 Detail drawings (Including AUTOCAD files)of all concrete work including embedded items, bar bending schedule, materials list etc.

Architectural and Miscellaneous drawings showing:

a) Plan, elevation and sections of all buildings

b) Door and Window Schedules.

c) Finish and Flooring Schedules.

d) Plumbing and Sanitary Installation details.

e) Details showing drainage around buildings and apron slab.

f) Miscellaneous detail drawings for false ceiling, roofing etc.

12.00.00 ADDITIONAL REQUIREMENT

12.01.00 Chequered Plates & Grating

The minimum thickness of chequered plates for flooring shall be 8mm o/p. Stiffeners shall be provided as required from strength/deflection considerations. Gratings shall be as approved by the Engineer.

If chequered plate is used in stairs, a minimum thickness of 8mm o/p is to be provided, unless otherwise approved by the Owner/ Consultant.

12.02.00 Staging

Staging for all work shall be done as per IS: 3696 (Part I & II) unless otherwise approved by the Engineer. The LSTK Vendorshall remove the same on completion and hand over the work and the surrounding in neat and clean conditions.

12.03.00 Additional Design guide lines

Additional design guide lines for some specific structures have been provided in Annexures furnished at the end after the Sub Sections.

SUB – SECTION NO.C1

TECHNICAL SPECIFICATIONFOREARTHWORK IN EXCAVATION AND BACKFILLING

EARTHWORK IN EXCAVATION AND BACKFILLING

CONTENTS

CLAUSE NO.	DESCRIPTION
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2.0.0	GENERAL
3.0.0	EXECUTION
4.0.0	TESTING AND ACCEPTANCE CRITERIA
5.0.0	INFORMATION TO BE SUBMITTED
6.0.0	RATES
7.0.0	MEASUREMENT

TECHNICAL SPECIFICATION FOR EARTHWORK IN EXCAVATION AND BACKFILLING

1.0.0 SCOPE

This specification covers excavation in all types of soil, soft and decomposed rock not requiring blasting and rocks requiring blasting, shoring, dewatering, filling around foundations and to grade, compaction of fills and approaches, protective fencing, lighting, etc. relevant to structures and locations covered under the scope of this contract.

2.0.0 GENERAL

2.1.0 Work to be provided for by the LSTK Vendor

The work to be provided for by the LSTK Vendor, unless specified otherwise, shall include but not be limited to the following :

a) Furnish all labour, supervision, services including facilities as required under statutory labour regulations, materials, scaffolds, equipment, tools and plants, transportation, etc. required for the work.

b) Prepare and submit working drawings showing the approaches, slopes, berms, shoring, sumps for dewatering, including drains and outfall for drainage, space for temporary stacking of spoils, disposal area, fencing, etc. and all other details as may be required by the Engineer.

c) To carry out sampling and testing and submit to the Engineer, results of soil compaction tests Whenever required by the Engineer to assess the degree of compaction.

d) Construction, maintenance and removal after completion of Magazine of proper capacity as well as design for storing of explosives required for blasting work to be carried out under the scope of this tender including procurement of necessary licenses from proper authorities.

2.2.0 Work To Be Provided For By Others

No work under this specification will be provided by any agency other than the LSTK Vendor unless specifically mentioned elsewhere in the Contract.

2.3.0 Codes And Standards

All works under this specification, unless specified otherwise, shall conform to the latest revision and/or replacement of the following or any other Indian Standard Specifications and Codes of Practice. In case any particular aspect of work is not covered specifically by Indian Standard Specification any other standard practice as may be specified by the Engineer shall be followed :-

IS:1200 (Part-I)	Method of Measurement of Building and Civil Engineering work; Part - I Earthwork.
IS:2720 (Part-II)	Determination of Moisture Content

IS:2720 (Part-VII)	Determination of Moisture content / Dry Relation using Light Compaction.
IS:2720 (Part-XIV)	Determination of Density Index (Relative Density) of cohesion's soils.
IS:2720 (Part-XXIX)	Determination of Dry Density, in place, by core cutter method.
IS:2720 (Part-XXVIII)	Determination of Dry Density of soils, in place, by sand replacement methods.
IS:3764	Safety code for Excavation work.
IS:4081	Blasting and Related Drilling Operations
IS:4701	Earthwork on canals

2.4.0 Conformity With Designs

The LSTK Vendor is to carry out the work as per the drawings issued to him and/or LSTK Vendor drawings, which are approved by the Engineer and/or the Engineer's instructions.

2.5.0 Materials To Be Used

2.5.1 General

All materials required for the work shall be of best commercial variety and approved by the Engineer.

2.5.2 Borrow Material

Borrow material required for back-filling shall be excavated from approved locations and levels and shall consist of material, approved by the Engineer, free from roots, vegetations, decayed organic matter, harmful salts and chemicals, free from lumps and clods. If specified, clean graded sand free from harmful and deleterious material from approved quarries, shall be used as fill material.

2.6.0 Quality Control

The LSTK Vendor shall establish and maintain quality control for the various aspects of the work, method, materials and equipment used. The quality control operation shall include but not be limited to the following items of work : -

a)	Lines, Levels and Grades	:	i) Periodic surveys
			ii) Establishment of markers, boards etc.
b)	Back-filling	:	i) Checking the quality of fill material
			ii) Checking moisture content of the backfill
			iii) Checking the degree of compaction

2.7.0 Information regarding site conditions

Surface and Sub-surface data regarding the nature of soil, rock, sub-soil water etc. shown on drawing or otherwise furnished to the LSTK Vendor shall be taken as a guidance only and variation there from shall not affect the terms of the contract. The LSTK Vendor must satisfy himself regarding the character and volume of all work under this contract and expected surface, Sub-surface and / or sub-soil water to be encountered. He must also satisfy himself about the general conditions of site and ascertain the existing and future construction likely to come up during the execution of the contract so that he may evolve a realistic program of execution.

3.0.0 EXECUTION

3.1.0 Setting Out

The LSTK Vendor will prepare and submit to the Engineer, detailed drawings of the excavation work as proposed to be executed by him showing the dimensions as per drawings and specification adding his Proposals of slopes, shoring, approaches, dewatering sumps, berms, etc. On receiving the approval from the Engineer with modifications and corrections, if necessary, the LSTK Vendor will set out the work from the control points furnished by the Engineer and fix permanent points and markers for ease of future checking. These permanent points and markers will be fixed at intervals prescribed by the Engineer and checked by the Engineer and certified by him after which the Contractor will proceed with the work. Engineer shall be provided with necessary men, material and instructions for such checking. It should be noted that this checking by the Engineer prior to start of the work will in no way absolve the LSTK Vendor of his responsibility of carrying out the work to true lines and levels and grades as per drawing and subsequent corrections, if necessary, free of cost to the Owner in case any errors are noticed in the Contractor's work at any stage.

3.2.0 Initial Levels

Initial levels of the ground either in a definite grid pattern or as directed by the Engineer will be taken by the LSTK Vendor jointly with the Engineer over the original ground prior to starting actual excavation work and after setting out. These initial levels will be used for preparing cross-sections for volume measurement or for cross-checking the depths obtained from tape measurements.

All records of levels, measurements etc. and also any drawing, cross section etc. made there from, shall be jointly signed by the authorized representative of the LSTK Vendor and the Engineer before the commencement of work and they shall form the basis of all payments in future.

3.3.0 Clearing and Grubbing, etc.

The area to be excavated or filled shall be cleared out of fences, trees, logs, stumps, bush, vegetation, rubbish, slush, etc. and level up. Trees up to 300 mm girth shall be uprooted. Trees above 300 mm girth to be cut, shall be approved by the Engineer and then marked. Felling of trees shall include taking out roots up to 600 mm below ground level or 150 mm below formation level whichever is lower. After the tree is cut and roots taken out the pot-holes formed shall be filled with good earth in 250 mm layers and consolidated unless directed by the Engineer otherwise. The trees shall be cut in suitable pieces as instructed by the Engineer.

Before earthwork is started, all the spoils and unserviceable materials and rubbish shall be burned or removed from the site to approved disposal areas as may be specified. Ash shall be

spread or removed. Useful materials, saleable timber, firewood, etc. shall be the property of the Owner and shall be stacked properly at the worksite in a manner as directed by the Engineer.

3.4.0 CLASSIFICATION

All earthwork shall be classified under the following categories :

No distinction will be made whether the material is dry or wet.

a) Ordinary Soil

This shall comprise vegetable or organic soil, turf, sand, silt, loam, clay, mud, peat, black cotton soil, soft shale or loose moorum, a mixture of these and similar material which yields to the ordinary application of pick and shovel, rake or other ordinary digging implement. Removal of gravel or any other nodular material having diameter in any one direction not exceeding 75 mm occurring in such strata shall be deemed to be covered under this category.

b) Hard Soil

This shall include:

i) Stiff heavy clay, hard shale, or compact moorum requiring grafting tool or pick or both and shovel, closely applied ;

ii) Gravel and cobble stone having maximum diameter in any one direction between 75 and 300 mm ;

iii) Soling of roads, paths, etc., and hard core ;

iv) Macadam surfaces such as water bound, and bitumen/tar bound;

v) Lime concrete, stone masonry in lime mortar and brick work in lime/cement mortar, below ground level ;

vi) Soft conglomerate, where the stones may be detached from the matrix with picks; and

vii) generally any material which requires the close application of picks, or scarifiers to loosen and not affording resistance to digging greater than the hardest of any soil mentioned in (i) and (vi) above.

c) Soft and Decomposed Rock

This shall include:

i) Limestone, sandstone, laterite, hard conglomerate or other soft or disintegrated rock which may be quarried or split with crowbars ;

ii) Un-reinforced cement concrete which may be broken up with crowbars or picks and stone masonry in cement mortar below ground level ;

iii) Boulders which do not require blasting having maximum diameter in any direction of more than 300 mm, found lying loose on the surface or embedded in river bed, soil, talus, slope wash and terrace material of dissimilar origin; and

iv) Any rock which in dry state may be hard, requiring blasting, but which when wet becomes soft and manageable by means other than blasting.

d) Hard Rock (requiring blasting)

This shall include:

i) any rock or cement concrete for the excavation of which the use of mechanical plant or blasting is required ;

ii) reinforced cement concrete (reinforcement cut through but not separated from the concrete) below ground level; and

iii) boulders requiring blasting.

e) Hard Rock (blasting prohibited)

Hard rock requiring blasting as described under (d) but where blasting is prohibited for any reason and excavation has to be carried out by chiseling, wedging or any other agreed method.

In case of any dispute regarding classification, the decision of the Engineer shall be final.

3.5.0 EXCAVATION FOR FOUNDATIONS AND TRENCHES

3.5.1 General

All excavations shall be done to the minimum dimensions as required for safety and working facility. Prior approval of the Engineer shall be obtained by the LSTK Vendor, in each individual case, for the method he proposes to adopt for the excavations including dimension, side slopes, shoring, dewatering, disposal, etc. This approval, however, shall not in any way make the Engineer responsible for any consequent loss or damage. The excavation must be carried out in the most expeditious and efficient manner.

All excavation in open cuts shall be made true to line, slopes and grades shown on the drawing or directed by the Engineer. No material shall project within the dimension of minimum excavation lines marked. Boulders projecting out of the excavated surfaces shall be removed, if in the opinion of the Engineer they are likely to be a hindrance to the workers.

Method of excavation shall be in every case subject to the approval of the Engineer and the LSTK Vendor shall ensure the stability and safety of the excavation, adjacent structures, services and works.

The LSTK Vendor shall have full responsibility of the stability of the excavation and safety of the workmen. If any slip occurs, the LSTK Vendor shall remove all slipped material from the excavated pit.

All loose boulders, semi-detached rocks, not directly in excavation but so close to the area to be excavated as to be liable, in the opinion of the Engineer, to fall or otherwise endanger the workmen, equipment of the work, etc., shall be stripped off and removed away from the areas of excavation. The method used shall be such as not to shatter or render unstable or unsafe the portion which was originally sound & safe. Any materials not requiring removal as contemplated in the work, but which, in the opinion of the Engineer, is later to become loose or unstable shall also be promptly and satisfactorily removed as directed by the Engineer.

Prior to starting the excavation, the ground level at the location shall be checked jointly with the Engineer.

The rough excavation may be carried up to a maximum depth of 150 mm above the final level. The balance shall be excavated with special care. If directed by the Engineer, soft and undesirable spots shall be removed even below the final level. The extra excavation shall be filled up as instructed by the Engineer and the LSTK Vendor shall not claim any payment for the extra excavation.

If the excavation is done to a depth greater than that shown on the drawing, or directed by the Engineer, due to the LSTK Vendor fault, the excess depth shall be filled up to the required level at the latter's cost (with cement concrete not leaner than 1:4:8 ordinary concrete or richer) as directed by the Engineer in each individual case.

In formation of rock requiring blasting, those over cuts which are unavoidable will be made up by ordinary cement concrete 1:2:4 which will be paid for under appropriate rate, provided this over cut is not due to negligence of the LSTK Vendor. The decision of the Engineer as to the admissibility of such over-cut for payment will be final. All excavated materials such as hard rock, boulders, bricks, dismantled concrete blocks, etc. shall be stacked separately as directed by the Engineer and shall be the property of the Owner.

3.5.2 Excavation in Ordinary Soil, Hard Soil and Soft and Decomposed Rock

The excavation in ordinary soil, hard soil, soft and decomposed rock will be carried out as per the approved proposal, modified and corrected where necessary by the Engineer. The work will be carried out in a workmanlike manner without endangering the safety of nearby structures/services or works and without causing hindrance to other activities in the area. As the excavation reaches the required dimensions, lines, levels and grades, the work will be checked by the Engineer thoroughly and the balance work will be carried out carefully to avoid any over-excavation. On completion, the work will be finally checked and approved by the Engineer. In certain cases, where deterioration of the ground, upheaval, slips, etc. are expected, the Engineer may order to suspend the work at any stage and instruct the LSTK Vendor to carry out the balance work just before the foundation work of the structure can be started. No extra will be paid to the LSTK Vendor for such unavoidable temporary suspension of work.

3.5.3 Excavation in Hard Rock

In case where excavation, both in ordinary soil and hard rock, are involved, the ordinary soil comprising of soft, hard and dense soils (including laterite formations) and rock including weathered rocks, lateritic rocks, etc. which can be excavated without blasting, shall be completely stripped off and the levels of the hard rock surface shall be taken to enable measurements. Further work in hard rock shall be resumed after clearance from the Engineer.

Personnel deployed for rock excavations shall be protected from all hazards such as loose rock/boulder rolling down and from general slips of excavated surfaces. Where the excavated surface is such that it is not stable against sliding, necessary supports, props, bracings or bulkheads shall be provided and maintained during the period of construction. Where danger exists of loose rock / boulder falling from the excavated surfaces deeper than 2 meters, steel mesh anchored to the lower edge of excavation and extending over and above the rock face, adequate to retain the dislodged material shall be provided and maintained.

In case where blasting, though otherwise required, is prohibited for any reasons, the excavation shall be carried out by chiseling, wedging or any other approved method and payment appropriate to blasting shall be made, unless otherwise mentioned in the Schedule.

3.5.4 BLASTING

3.5.4.1 General

Storage, handling and use of explosives shall be governed by the current explosive rules laid down by the Central and the State Governments. The LSTK Vendor shall ensure that these rules are strictly adhered to. The following instruction, wherever found in variance with the above rules, shall be considered as superseded by the above rules.

No child under the age of 16 and no person who is in a State of intoxication shall be allowed to enter the premises where explosives are stored nor they shall be allowed to handle the explosives.

3.5.4.2 Storage of Explosive

Storage of explosives shall be governed by the current Explosive Rules, Explosives shall be stored in a clean, dry, well ventilated magazine to be specially built for the purpose. Under no circumstances should a magazine be erected within 400 m of the actual work site or any source of fire. A space surrounding the magazine shall be fenced in. The ground inside the fence shall be kept clear and free from trees, bushes etc. The admission to this fenced space shall be by one gate only and no person shall be allowed inside this fence without permission of the Officer-in-charge. The clear space between the fence and the magazine shall not be less than 90m. The mezzanine shall be perfectly well drained.

Two lightning conductors shall be provided to the magazine, one at each end. The lightning conductors shall be tested once in every year.

Fuses and detonators shall be stored in separate magazines. However, detonators can be kept in an annexe adjoining the magazine provided that their number does not exceed 25,000 and that the annexe is so constructed that not less than 60 cm masonry and 100 cm of air space shall intervene between any detonators in such annexe and the interior of the main magazine. Cases containing explosives are not to be opened in a magazine. Explosive in open cases are not to be received into a magazine. Explosives which appear to be in a damaged or dangerous condition are not to be kept in any magazine, but must be removed without delay to a safe distance and destroyed.

Artificial light is not to be allowed in any magazine. No smoking shall be allowed within 100 m of a magazine.

Magazine shoes without nails shall be used while entering the magazine.

The mallets, levers, wedge etc. for opening barrels or cases are to be of wood. Inside a magazine the cases of explosives are to be carried by hand and shall not be rolled or dragged. Explosives which have been issued and returned to the magazine are to be issued first; otherwise those which have been longest in store are to be issued first.

Cases of explosives must be kept clear of the walls and floors for free circulation of air on all sides, special care is to be taken to keep the floor free from grains of powder or portions of explosive matter fallen on the floors due to leakage of cases etc.

The magazine shall not be opened during any dust-storm or thunderstorm nor shall any person be allowed in the vicinity of the magazine.

All magazines shall be officially inspected at definite intervals and a record kept of the results of such inspections.

3.5.4.3 Carriage of Explosives

Detonators and explosives shall be transported separately to the blast site. Explosives shall be kept dry and away from the direct rays of the sun, naked lights, steam pipes or heated metal and other sources of heat. Before explosives are removed, each cage or package is to be carefully examined to ascertain that it is properly closed and shows no sign of leakage.

No person except the driver shall be allowed to travel on a vehicle conveying explosives. No carriage or vessel shall be used for transporting explosives unless all iron or steel therein with which a package containing any explosive is likely to come in contact is effectually covered with lead, leather, wood, cloth or other suitable material. No lights shall be carried on the vehicle carrying explosives.

No operation connected with the loading, unloading and handling of explosives shall be conducted after sunset.

3.5.4.4 Use of Explosives

The LSTK Vendor shall appoint an agent who shall personally superintend the firing and all operations connected therewith. The LSTK Vendor shall satisfy himself that the person so appointed is fully acquainted with the responsibilities imposed on him.

Holes for charging explosives shall be drilled with Pneumatic drills, the drilling pattern being so planned that the rock pieces after blasting will be suitable for handling.

The hole diameter shall be of such a size that cartridges can easily pass down them and undue force is not required during charging. Charging operations shall be carried out by or under the personal supervision of the shot-firer. Wrappings shall never be removed from explosive cartridges. Only wooden rods shall be used for loading and stemming shot-holes. Only one cartridge at a time shall be inserted and gently passed home with the wooden tamping rod.

Only such quantities of explosives as are required for the particular amount of work to be done shall be brought to the works. Should any surplus remain when all the holes have been charged, it shall be carefully removed to a point at least 300 m from the firing point.

The explosives shall be fired by means of an electric detonator placed inside the cartridge. For simultaneous firing of a number of charges the electric detonators shall be connected with the exploder through the shot-firing cable in a simple series circuit. Due precautions shall be taken to keep the firing circuit insulated from the ground, bare wires, rails, pipes or any other path of stray current and to keep the lead wires short circuited until ready to fire. Any Kinks in detonator leading wire shall be avoided.

For simultaneous firing of a large number of shot-holes, use of cordtex may be done. Cordtex shall be initiated by an electric detonator attached to its side with adhesive tape, connecting wire or string.

All connections shall be made by the authorized shot-firer himself. The shot-firing cable shall not be dragged along the ground to avoid possible damage to the insulation. The shot-firing cable shall be tested for continuity and possible short-circuiting before it is used each time.

The shot-firer shall always carry the exploder handle on his person until he is ready to fire shots. The number of shots fired at a time shall not exceed the permissible limits.

Blasting shall only be carried out at certain specified times to be agreed jointly by the LSTK Vendor and the Engineer.

Before any blasting is carried out, it shall be ensured that all workmen, vehicles and equipment on the site are cleared from an area of minimum 300 meters radius from the firing point, or as required by statutory regulations, at least ten minutes before the time of firing by sounding a warning siren. The area shall be encircled by red flags.

At least five minutes after the blast has been fired in case of electric firing or as stipulated in the regulations the authorized shot-firer shall return to the blast area and inspect carefully the work and satisfy himself that all charged holes have exploded. Cases of misfired unexploded charges shall be exploded by drilling a parallel fresh hole not less than 600 mm from the misfired hole and by exploding a new charge. The authorized shot-firer shall be present during removal of the debris liable to contain unexploded explosives near the misfired hole. The workmen shall not return to the site of firing until at least half an hour after firing.

When blasting is conducted in the neighbor-hood of roads, structures, buildings etc. controlled blasting has to be carried out by drilling shallow shot-holes and filling the same with light charge of explosives.

Adequate safety precautions as per building byelaws, safety code, statutory regulations etc. shall be taken during blasting operations.

3.5.5 Disposal

The excavated spoils will be disposed of in any or all the following manners :-

a) By using it for backfilling straightway.

b) By stacking it temporarily for use in backfilling at a later date during execution of the Contract.

c) i) By either spreading, Or

ii) Spreading and compacting at designated filling areas and / or disposal areas.

d) By selecting the useful material & stacking it neatly in areas designated by the Engineer for use in backfilling by some other agency.

3.5.6 Disposal of Surplus

All surplus material from excavation shall be carried away from the excavation site to designated disposal area selected by the Engineer.

All good and sound rock excavated from the pits and all assorted materials of dismantled structures shall be the property of the Owner.

3.5.7 Protection

The Engineer shall be notified by the LSTK Vendor as soon as the excavation is expected to be completed within a day so that it may be inspected by him at the earliest. Immediately after approval of the Engineer, the excavation must be covered up in the shortest possible time. But, in no case the excavation shall be covered up or worked on before approval and measurement by the Engineer. Excavated material shall be placed beyond 1.5 meters from the edge of the pit or trench or half the depth of the pit or trench whichever is more or further away if directed by the Engineer.

Excavation shall not be carried out below the foundation level of structure close by until required precautions have been taken.

Adequate fencing is to be made enclosing the excavation.

The LSTK Vendor shall protect all under-ground services exposed by excavation. The LSTK Vendor shall also divert all surface drains, etc. affected by the excavation to maintain the working area neat and clean.

3.5.8 Dealing with Surface Water

All working areas shall be kept free of surface water as far as reasonably practicable. Works in the vicinity of cut areas shall be controlled to prevent the ingress of surface water.
No works shall commence until surface water streams have been properly intercepted, redirected or otherwise dealt with.

Where works are undertaken in the monsoon period, the LSTK Vendor may need to construct temporary drainage systems at his own cost to drain surface water from working areas.

3.5.9 Dewatering

All excavations shall be kept free of water and slush. Grading in the vicinity of excavations shall be controlled to prevent surface water running into excavated areas. The LSTK Vendor shall remove by pumping or other means approved by the Engineer any water inclusive of rain water and subsoil water accumulated in excavation and keeps the trench dewatered until the construction of foundation structure and backfilling are complete in all respects (except where such dewatering would need installation of well points or deep wells for which separate payment will be made). Sumps made for dewatering must be kept clear of the foundations. Method of pumping shall be approved by the Engineer but in any case, the pumping arrangement shall be such that there shall be no movement of subsoil or blowing in due to differential head of water during pumping.

3.5.10.1 Timber Shoring

Timber Shoring made out of approved quality of timber shall be 'close' or ‘open’ type, depending on the nature of soil and the depth of pit or trench and the type of timbering shall be determined by the Engineer. It shall be the responsibility of the LSTK Vendor to take all necessary steps to prevent the sides of trenches and pits from collapsing.

3.5.10.1 Close Timbering

Close timbering shall be done by completely covering the sides of the trenches and pits generally with short, upright members called ‘polling boards’. These shall be of minimum 250 x 40 mm sections as directed by the Engineer. The boards shall generally be placed in position vertically in pairs, one board on each side of cutting, and shall be kept apart by horizontal walrus of strong wood at maximum 1.2 meters spacing, cross strutted with ballies or as directed by the Engineer. The length of the bally struts shall depend on the width of the trench or pit.

In case where the soil is very soft and loose, the boards shall be placed horizontally against the sides of the excavation and supported by vertical wallers, which shall be strutted to similar timber pieces on the opposite face of the trench or pit. The lowest board supporting the sides shall be taken into the ground. No portion of the vertical side of the trench or pit shall remain exposed, so that the earth is not liable to slip out.

The withdrawal of the timber shall be done very carefully to prevent the collapse of the pit or trench. It shall be started at one end and proceed systematically to the other end. Concrete or masonry shall not be damaged during the removal of the timber. No claim shall be entertained for any timber which cannot be withdrawn and is lost or buried.

3.5.10.2 Open Timbering

In the case of open timbering, the entire surface of the side of trench pit is not required to be covered. The vertical board of minimum 250 mm width and minimum 40 mm depth shall be spaced sufficiently apart to leave unsupported strips of maximum 500 mm average width. The detailed arrangement, sizes of the timber and the distances apart shall be subject to the approval of the Engineer. In all other respects, specification for close timbering shall apply to open timbering.

3.6.0 Treatment of Slips

The LSTK Vendor will take all precaution to avoid high surcharges and provide proper surface drainage to prevent flow of water over the sides. These precautions along with proper slopes, berms, shoring and control of ground water should cause no slips to occur. If slips occur , the same shall be removed by the LSTK Vendor without any financial implication to the Owner.

3.7.0 BACK-FILLING

3.7.1 General

The material used for backfilling shall consist of material, approved by the Engineer obtained directly from nearby areas where excavation work by the same agency is in progress, from temporary stacks of excavated spoils or from borrow pits from selected areas designated by the

Engineer. The material shall be free from lumps and clods, roots and vegetations, harmful salts and chemicals, organic materials, etc.

In certain locations, the Engineer may direct sand fillings. The sand should be clean, well graded and be of quality normally acceptable for use in concrete.

3.7.2 Filling and Compaction in Pits and Trenches around Structures

As soon as the work in foundations has been accepted and measured, the spaces around the foundation structures in pits and trenches shall be cleared of all debris, brick bats, mortar droppings, etc., and filled with earth in layers not exceeding 250 mm in loose thickness each layer being watered, rammed and properly compacted to achieve a dry density of not less that 90% of proctor's dry density at optimum moisture content as per IS-2720 (Part-VII) where backfilling with cohesive soil and sandy silt containing high percentage of Silt. For back filling with sand having little or no silt, each layer shall be compacted to a relative density of 75% as per IS-2720 part XIV. Earth shall be rammed with approved mechanized compaction machine. Usually, no manual compaction shall be allowed unless specifically permitted by the Engineer. The final surface shall be trimmed and level to proper profile as shown in the drawing and as desired by the Engineer.

Since the degree of compaction depends on the moisture content of the soil, a close watch should be kept on it and corrections done to optimize the moisture content.

3.7.3 Plinth Filling

The plinth shall be filled with earth in layers not exceeding 250 mm in loose thickness, watered and compacted as stated under clause no. 3.7.2 with approved compaction machine or manually, if specifically permitted by the Engineer. When the filling reaches the finished level, the surface shall be flooded with water for at least 24 hours, allowed to dry and then rammed and compacted, in order to avoid any settlement at a later stage. The finished level of the filling shall be trimmed to the slope intended to be given to the floor.

3.7.4 Filling in Trenches for Water Pipes and Drains

Earth used for filling shall be free from salts, organic or other foreign matter. All clods of earth shall be broken or removed. Where excavated material is mostly rock, the boulders shall be broken into pieces not bigger than 150 mm size in any direction, mixed with fine material consisting of disintegrated rock, moorum or earth as available, so as to fill up the voids as far as possible and then the mixture used for filling. The types of bedding & pipe surround material shall be as specified in the drawings.

Filling in trenches for pipes and drains shall be commenced as soon as the joints of pipes and drains have been tested and passed.

Where the trenches are excavated in soil, the filling shall be done with earth on the sides and top of pipes in layers not exceeding 150 mm, watered, rammed and compacted taking care that no damage is caused to the pipe below. Filling of trenches shall be carried out simultaneously on both sides of the pipe in such a manner that unequal pressures do not occur.

In case of excavation of trenches in rock, the filling up to a depth of 300 mm or the diameter of the pipe whichever is more, above the crown of pipe or barrel shall be done with fine material such as earth, moorum, disintegrated rock or ash according to the availability at site. The remaining filling shall be done with rock filling of boulders of size not exceeding 150 mm mixed with fine material as available to fill up the voids, watered, rammed and compacted.

3.7.5 Filling in Disposal Area

Surplus material from excavation which is not required for backfilling will be disposed of in designated disposal areas. The spoils shall not be dumped haphazardly but should be spread in layers approximately 250 mm thick when loose and compacted with the help of compacting equipment. In wide areas rollers will be employed and compaction done to the satisfaction of the Engineer at the optimum moisture content which shall be checked and controlled by the LSTK Vendor.

In certain cases the Engineer may direct disposal without compaction which can be done by tipping the spoils from a high bench neatly maintaining always a proper level and grade of the bench.

3.8.0 Approaches and Fencing

The LSTK Vendor should provide and maintain proper approaches for workmen and for inspection. The roads and approaches around the excavated pits should be kept clear at all times so that there is no hindrance to the movement of men, material and equipment of various agencies connected with the Project. Sturdy and elegant fencing is to be provided around the top edge of the excavation as well as the bottom of the fill at the surplus disposal area where dumping from a high bench is in progress.

3.9.0 Lighting

Full scale area lighting is to be provided if night work is permitted or directed by the Engineer. If no night work is in progress, red warning lights should be provided at the corners of the excavated pit and the edges of the fill.

4.0.0 TESTING AND ACCEPTANCE CRITERIA

4.1.0 Excavation

On completion of excavation, the dimensions of the pits will be checked as per the drawings after the pits are completely dewatered the work will be accepted after all undercuts have been set right and all over excavations filled back to required lines, levels and grades by placing ordinary concrete of 1:4:8 proportion and / or richer and / or by compacted earth, as directed by the Engineer, at the LSTK Vendor's cost. The choice of grade of concrete will be a matter of unfettered discretion of the Engineer. Over excavation of the sides will be made good free of cost by the LSTK Vendor while carrying out the back filling. The excavation work will be accepted after the above requirements are fulfilled and all temporary approaches encroaching inside the required dimension of the excavation have been removed.

4.2.0 Back-filling

The degree of compaction shall be sufficient to achieve a dry density of not less than 90% of proctor's dry density at optimum moisture content as per IS-2720 (Part - VII) or a relative density of 75% as per IS-2720 (Part-XIV) as applicable depending on the nature of back filling material as stated in clause no. 3.7.2 of this specification. The work of back-filling will be accepted after the Engineer is satisfied with the degree of compaction achieved.

5.0.0 INFORMATION TO BE SUBMITTED

5.1.0 With Tender

Details of Equipment proposed to be used for excavation, back-filling and compaction have to be submitted along with the tender.

5.2.0 After Award

After award of the Contract the successful LSTK Vendor shall submit the following for approval and adoption:

a) Within 30 days of Award of the contract, the LSTK Vendor shall submit a detailed programme of the work as proposed to be executed giving completion dates of excavation of the various foundations and the time required for back-filling and compaction after completing the foundation for structures. In case the Earthwork LSTK Vendor is also the agency for the foundation work, the earthwork programme is to be connected with the foundation programme.

The programme should show how the excavation and back-filling quantities will be balanced, minimizing temporary stacking of spoils. It is to be noted that the Engineer even after initial approval of the programme, may instruct to enhance or retard the progress of work during the actual execution, in order to match with the progress of foundations without attracting any claims from the LSTK Vendor. The initial programme being submitted by the LSTK Vendor should have sufficient flexibility to take care of such reasonable variations.

b) Within 15 days of award, The LSTK Vendor shall submit drawings showing details of slopes, shorings, approaches, sump pits, dewatering lines, fencing etc. for approval of the Engineer for adoption.

6.0.0 RATES

Even though it may not be specifically mentioned in the Schedule of Items, the rates shall include all work to be provided by the LSTK Vendor in accordance with Sub-clause 2.1.0 of this Contract and cost of all materials and labour required to complete the work or incidental to it, hire charges of Constructional Plant and Equipment and erection tools, insurance, all necessary transport, taxes and royalties, making necessary arrangements for approaches, yard, security, safety and other facilities, power, fuel, lubricant, services, supervisions, overheads, profits etc. complete in all respects. It shall also include cost of all other work and supplies not specifically mentioned but reasonably implied as being necessary to complete the works in all respects in accordance with the Contract.

7.0.0 MEASUREMENT

7.1.0 Clearing and Grubbing

All measurement shall be in metric tonnes and based on the theoretical unit weights as per Indian Standard and on the following considerations:

i) All members, except plate work paid under rates for bunkers, tanks, etc. shall be measured square.

ii) All plate work paid at rates for bunkers, tanks, etc. shall be measured as actual.

iii) No deduction shall be made for bolt and / or holes and/or holes for other purposes up to 25 Sq.cm. in area.

iv) All allowance of 1.5% for welds extra over the calculated weights in respect of (I), (ii) & (iii) above shall be measured and paid at the respective rates.

7.2.0 Excavation

Actual quantity of excavation required and approved by the Engineer shall be measured in Cu.m. No extra shall be paid for keeping the excavations dewatered as required for completion of the structure to come in. Necessary disposal of the spoils at described in the schedule of items shall be included in the quoted rate.

7.3.0 Shoring

The actual effective area of shoring as approved by the Engineer, shall be measured in Sq.m. unless included in the rate for earthwork in excavation. All planks, waling, verticals, struts, props and all other materials as required for the shoring and subsequent safe dismantling and removal shall be included in the rates quoted.

7.4.0 Back-Filling

7.4.1 With Assorted Earth from Excavations for Foundations, Trenches etc**.**

Actual quantity of consolidated backfill shall be measured in Cu.m. The cost of load, lift, etc. shall be at per schedule of times and included in the rate quoted.

7.4.2 With Earth from Borrow pits and stacks

Actual quantity of consolidated back-filling or actual quantity of excavation in the borrow pits, of the excavated volume of the stack with a deduction of 30% for voids, in case filling is done by earth from stack, whichever is less, shall be paid in Cu.m. The lead, lift, etc. at mentioned in the Schedule of Items shall be included in the rates quoted.

7.4.3 Sand filling

Actual quantity of consolidated sand filling shall be measured in Cu.m. The rate shall include cost of sand and all necessary works for excavation of the items.

7.5.0 Leads and Lifts

The leads for excavation and/or back-filling will be measured between the centered of the actual disposal area and that of the plan of the pit. The distance between these two points will be measured along the shortest practicable haulage path as decided by the Engineer.

Lifts will be measured vertically between the average ground level from where the pit excavation was stated and the bottom level of the excavated pit. Level lines corresponding to the stages where lifts become payable will be drawn on the cross section of the pit and the volumes of excavation contained between these horizontal planes will be computed and paid according to the corresponding rates.

7.6.0 Dewatering

Dewatering for work beyond the contract period original of extended will be measured on the basis of horse power–hour which will be obtained by multiplying the estimated requirement of horse power required to run the pumps or actually employed, whichever is less, by the actual hours run, approximated to the nearest half hour.

SUB-SECTION NO. C2

TECHNICAL SPECIFICATIONFORCEMENT CONCRETE (PLAIN & REINFORCED)

TECHNICAL SPECIFICATION
FOR
CEMENT CONCRETE (PLAIN & REINFORCED)

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TECHNICAL SPECIFICATION FOR CEMENT CONCRETE (PLAIN & REINFORCED)

1.0 SCOPE

1.1 General

This specification covers all the requirements, described hereinafter for general use of Plain and Reinforced Cement Concrete work in Structures and locations, cast-in-situ or precast, and shall include all incidental items of work not shown or specified but reasonably implied or necessary for the completion of the work.

1.2 This specification shall also apply to the extent it has been referred to or applicable with the special requirements of structures covered in SCOPE of IS: 456.

1.3 IS: 456 shall form a part of this specification and shall be complied with unless permitted otherwise. For any particular aspect not covered by this Code, appropriate IS Code, specifications and/or replacement by any International Code of practice as may be specified by the Engineer shall be followed. All codes and Standards shall conform to its latest revisions. A list of IS codes and Standards is enclosed hereinafter for reference.

2.0 GENERAL

2.1 Work to be provided for by the LSTK Vendor

The work to be provided for by the LSTK Vendor, unless otherwise specified shall include but not be limited to the following:-

a) Furnish all labour, supervision, services including facilities as may be required under statutory labour regulations, materials, forms, templates, supports, scaffolds, approaches, aids, construction equipment, tools and plants, transportations, etc. required for the work.

b) Except where it is excluded from the Scope of Contract, LSTK Vendor shall prepare progressively and submit for approval detailed drawings and Bar Bending Schedules for reinforcement bars showing the positions and details of spacers, supports, chairs, hangers etc.

c) Design and prepare working drawings of formworks, scaffolds, supports, etc. and submit for approval.

d) Submit for approval detailed drawings of supports, templates, hangers, etc. required for installation of various embedments like inserts, anchor bolts, pipe sleeves, frames, joint seals, frames, openings etc.

e) Submit for approval detailed schemes of all operations required for executing the work, e.g. Material handling, Concrete mixing, Placement of concrete, Compaction, curing, services, Approaches, etc.

f) Design and submit for approval concrete mix designs required to be adopted on the job.

g) Furnish samples and submit for approval results of tests of various properties of the following:-

i) The various ingredients of concrete

ii) Concrete

iii) Embedments

iv) Joint seals

h) Provide all incidental items not shown or specified in particular but reasonably implied or necessary for successful completion of the work in accordance with the drawings and specifications.

i) For supply of certain materials normally manufactured by specialist firms, the LSTK Vendor may have to produce, if directed by the Engineer, a guarantee in approved proforma for satisfactory performance for a reasonable period as may be specified, binding both the manufacturers and the LSTK Vendor, jointly and severally.

2.2 Work by Others

No work under this specification will be provided by any agency other than the LSTK Vendor unless specifically mentioned elsewhere in the contract.

2.3 Information to be submitted by the Bidder:

2.3.1 With Tender

The following technical information are required to be furnished by the tender :

a) Source and arrangement of processing of aggregates proposed to be adopted.

b) Type of plant and equipment proposed to be used.

c) Names of firms, if any, with which association is sought for to execute the special items of work in the contract.

d) Types of formwork proposed to be used.

2.3.2 After Award

The following information and data including samples where necessary shall be submitted by the LSTK Vendor progressively during the execution of the contract.

a) Programme of Execution and Requirement of Materials

The LSTK Vendor will submit a Master Programme for completion of the work giving monthwise requirements of materials for the procurement.

This Master Programme may have to be reviewed and updated by the LSTK Vendor, quarterly or at more frequent intervals as may be directed by the Engineer depending on the exigencies of the work.

Detailed day-to-day programme of every month is to be submitted by the LSTK Vendor before the end of the previous month.

b) Samples

Samples of the following materials and any other materials proposed to be used, shall be submitted as directed by the Engineer, in sufficient quantities free of cost, for approval. Approved samples will be preserved by the Engineer for future reference. The approval of the Engineer shall not, in any way, relieve the LSTK Vendor of his responsibility of supplying materials of specified qualities:-

i) Coarse and fine aggregates.

ii) Admixtures.

iii) Plywood/Steelwork for Formwork.

iv) Embedded and anchorage materials as may be desired by the Engineer.

v) Joint sealing strips and other waterproofing materials.

vi) Joint filling compounds.

vii) Foundation quality Rubber Pads.

c) Design Mix

Design mix as per Clauses 2.1 (f) & 3.4 of this specification giving proportions of the ingredients, sources of aggregates and cement, along with accompanying test results of trial mixes as per relevant I.S., is to be submitted to the Engineer for his approval before it can be used on the works.

d) Detail Drawings and Bar Bending Schedules

Detailed working drawings and Bar Bending Schedules in accordance with Clause 2.1(b) and 3.16.1 of this specification.

e) Detailed Drawings and Designs of Formworks to be used

Detailed design data and drawings of standard formworks to be used as per clause 2.1 (c).

f) Detailed Drawings for Templates & Temporary Supports for Embedment as per Clause 2.1 (e).

g) Mill Test Reports for Cement & Reinforcing Steel

h) Inspection Reports

Inspection Reports in respect of Formwork and Reinforcement and any other item of work as may be desired by the Engineer in accordance with Clause 2.4 of this specification.

i) Test Reports

Reports of tests of various materials and concrete as required under Clause 4.0: SAMPLING & TESTING of this specification.

j) Any other data which may be required as per this specification.

2.4 Conformity with Design

The LSTK Vendor will prepare check lists in approved proforma which will be called 'Pour Cards'. These Pour Cards will list out all items of work involved. The LSTK Vendor will inform the Engineer, sufficiently in advance, whenever any particular pour is ready for concreting. He shall accord all necessary help and assistance to the Engineer for all checking required in the pour. On satisfying himself that all details are in accordance to the drawings and specifications, the Engineer will give written permission on the same 'Pour Card' allowing the LSTK Vendor to commence placement of concrete. Details of all instructions issued by the Engineer and the records of compliance by the LSTK Vendor, deviations allowed by the Engineer and any other relevant information will be written on accompanying sheets attached to the Pour Cards. These sheets, termed as 'Progress Cards', will be prepared by the LSTK Vendor on approved proforma. The Pour Cards along with accompaniments will be handed over to the Engineer before starting placement of concrete. One of the mix designs developed by the LSTK Vendor as per the I.S. Specifications and established to the satisfaction of the Engineer by trial mixes shall be permitted to be used by the Engineer, the choice being dictated by the requirements of designs and workability. The methods of mixing, conveyance, placement, vibration, finishing, curing, protection and testing of concrete will be as approved or directed by the Engineer.

2.5 Materials to be used

2.5.1 General Requirement

All materials whether to be incorporated in the work or used temporarily for the construction shall conform to the relevant IS Specifications unless stated otherwise and be of best approved quality.

2.5.2 Cement

Generally cement shall be 53 grade Portland Slag Cement conforming to IS-455. In special cases any of the following type of cement may be permitted or directed to be used with prior approval by the Engineer:

a) 43 Grade ordinary Portland Cement conforming to IS-8112

b) 53 Grade ordinary Portland Cement conforming to IS-12269

c) Rapid hardening Portland Cement conforming to IS-8041

d) Portland slag cement conforming to IS-455

e) Portland Pozzolona Cement (flyash based) Conforming to IS- 1489 (Part-1)

f) Portland pozzolona Cement (calcined clay based) conforming to IS-1489 (Part-2)

g) Hydrophobic Cement conforming to IS-8043

h) Low heat Portland Cement conforming to IS: 12600

i) Sulphate Resisting Portland Cement conforming to IS-12330

2.5.3 Aggregate

Aggregates shall be natural or crushed gravel or crushed rock and free from deleterious material. It shall comply with the requirements of IS-383.

a) Coarse Aggregate

Aggregate of sizes ranging between 4.75 mm and 150 mm will be termed as Coarse Aggregate. Only Coarse Aggregate from approved quarries and conforming to IS:383 will be allowed to be used on the works. Aggregates shall be washed to make it free from deleterious materials, if necessary. The grading of coarse aggregates by seive analysis shall be as per IS:383.

b) Fine Aggregate

Aggregate smaller than 4.75 mm and within the grading limits and other requirements set in IS:383 is termed as Fine Aggregate or Sand. Only

Fine Aggregate from approved sources and conforming to the above IS Specification will be allowed to be used on works.

2.5.4 Water

Water for use in concrete shall be clear and free from injurious oils, acids, alkalis, organic matter, salt, silts or other impurities. Normally potable water is found to be suitable. Generally, IS: 3550 will be followed for routine tests. In case of doubt the acceptance test for water shall be as per IS:3025, and Table-1 of IS:456.

2.5.5 Admixture

Only admixtures of approved quality will be used when directed or permitted by the Engineer. The different types of admixtures which may be necessary to satisfy the concrete mix and the design requirement shall be as per the following I.S. Standards :

IS : 2645 - Integral cement water proofing compound

IS : 9103 - Indian standard specification for Admixtures for Concrete or equivalent American Codes (ASTM C494 and ASTM C260) or British Codes (BS 5075, Part 1 to 3) and may be one of the following :

a) Accelerating admixtures :

Set accelerating admixtures like "Sigunit Powder" or "Sigunit LN10" or approved equivalent.

b) Retarding admixtures :

Modified lignosulphonate based set retarding concrete admixture like, "Plastiment R" or approved equivalent.

c) Water reducing admixtures:

Modified sulphonated melamine formaldehyde based water reducing concrete admixture like, "Sikament" or approved equivalent.

d) Air entraining admixtures :

Modified lignosulphonate based air entraining concrete admixture like "FLOMO AEP " or surface - active agents like "Sika AER" or approved equivalent.

e) Water proofing admixtures :

Modified ligno-sulphonate based waterproofing admixture like "Plastocrete Super" or approved equivalent.

The LSTK Vendor shall furnish following technical information about the admixtures (alongwith the manufacturer's Catalogue) which he is planning to use in different areas within the scope of work for the approval of the Engineer :

i) Type of admixture

ii) Mix proportion & mode of application in concrete/mortar

iii) Manufacturer's specification & necessary quality assurance certificates (mainly on chloride & suphate content, PH value, infra-red analysis & solid content.)

2.5.6 Reinforcement

Reinforcement shall be as per relevant IS Specification as mentioned in the Contract/Drawing/Instructions. All bars shall be of tested quality.

2.6.0 Storage of Materials

2.6.1 General

All materials shall be so stored as to prevent deterioration or intrusion of foreign matter and to ensure the preservation of their quality and fitness for the work. Any material, which has deteriorated or has been damaged or is otherwise considered defective by the Engineer, shall not be used for concrete and shall be removed from site immediately, failing which, the Engineer shall be at liberty to get the materials removed and the cost incurred thereof shall be realised from the LSTK Vendor's dues. The LSTK Vendor shall maintain up to-date accounts of receipt, issue and balance (stackwise) of all materials. Storage of materials shall conform to IS:4082.

2.6.2 Cement

Sufficient space for storage, with open passages between stacks, shall be arranged by the LSTK Vendor to the satisfaction of the Engineer.

Cement shall be stored off the ground in dry, leak proof, well-ventillated ware-houses at the works in such a manner as to prevent deterioration due to moisture or intrusion of foreign matter.

Cement shall be stored in easily countable stacks with consignment identification marks. Consignments shall be used in the order of their receipts at site. Sub-standard or partly set cement shall not be used and shall be removed from the site, with the knowledge of the Engineer, as soon as it is detected.

Different types of cement shall be clearly marked for easy identification and different types of cement shall not be intermixed.

2.6.3 Aggregate

Aggregates shall be stored on planks or steel plates or on concrete or masonry surface. Each size shall be kept separated with wooden or steel or concrete or masonry bulk-heads or in separate stacks and sufficient care shall be taken to prevent the material at the edges of the stock piles from getting intermixed.

Stacks of fine and coarse aggregates shall be kept sufficiently apart with proper arrangement of drainage. The aggregates shall be stored in easily measurable stacks of suitable depths as may be directed by the Engineer.

2.6.4 Reinforcement

Reinforcing steel shall be stored consignment-wise and size wise off the ground and under cover, if desired by the Engineer. It shall be protected from rusting, oil, grease and distortions. If necessary, the reinforcing steel may be coated with cement wash before stacking to prevent scale and rust at no extra cost to the Owner. The stacks shall be easily measurable. Steel needed for immediate use shall only be removed from storage.

2.7 Quality Control

LSTK Vendor shall establish and maintain quality control for different items of work and materials as may be directed by the Engineer to assure compliance with contract requirements and maintain and submit to the Engineer records of the same.

The quality control operation shall include but not be limited to the following items of work :-

a)	Admixture	:	Type, quantity, physical & chemical properties that affect strength, workability and durability of concrete. For air entraining admixtures, dosage to be adjusted to maintain air contents within desirable limits.
b)	Aggregate	:	Physical, chemical & mineralogical qualities. Grading, moisture content and impurities.
c)	Water	:	Impurities tests.
d)	Cement	:	Tests to satisfy relevant IS Specifications (only association with Owner's tests, if the supply is made by Owner).
e)	Formwork	:	Material, shapes, dimensions, lines, elevations, surface finish, adequacy of form, ties, bracing and shoring and coating.
f)	Reinforcement	:	Shapes, dimensions, length of plices, clearances, ties and supports. Quality & requirement of welded splices. Material tests or certificates to satisfy relevant IS Specification (If LSTK Vendor supply).
g)	Grades of concrete	:	Usage & mix design, testing of all properties.
h)	Batching & Mixing	:	Types and capacity of plant, concrete mixers and transportation equipment.
i)	Joints	:	Locations of joints, water stops and filler materials. Dimension of joints, quality and shape of joint material and splices.

j)	Embedded and Anchorage Items	:	Material, shape, location, setting.
k)	Placing	:	Preparation, rate of pouring, weather limitations, time intervals between mixing and placing and between two successive lifts, covering over dry or wet surfaces, cleaning and preparation of surfaces on which concrete is to be placed, application of mortar/slurry for proper bond, prevention of cold joint, types of chutes or conveyors.
l)	Compaction	:	Number of vibrators, their prime mover, frequency and amplitude of vibration, diameter and weight of vibrators, duration of vibration, hand-spreading, roding& tamping.
m)	Setting of base &	:	Lines, elevations and bedding mortar. Beaming plates.
n)	Concrete Finishes	:	Repairs of surface defects, screening, floating, steel trowelling &brooming, special finishes.
o)	Curing	:	Methods and length of time.

Copies of records and tests for the items noted above, as well as, records of corrective action taken shall be submitted to the Engineer for approval as may be desired.

3.0 INSTALLATION

All installation requirements shall be in accordance with IS:456 and as supplemented or modified herein or by other best possible standards where the specific requirements mentioned in this section of the specification do not cover all the aspects to the full satisfaction of the Engineer.

3.1 Washing and Screening of Aggregates

Washing and Screening of coarse aggregate shall be carried out to remove fines, dirts or other deleterious materials.
Washing of fine aggregate shall not be allowed, Fine aggregates shall be screened only to remove dirt or other deleterious materials.

However, all washing & screening of aggregates shall be carried out by approved means to ensure compliance with the aggregate specification.

3.2 Admixture

All concrete shall be designed for normal rate of setting and hardening at normal temperature. Variations in temperature and humidity under different climatic conditions will affect the rate of setting and hardening, which will, in turn, affect the workability and quality of the concrete.

Admixtures may be permitted to be used in accordance with IS:456 to modify the rate of hardening, to improve workability or as an aid to control concrete quality. The Engineer reserves the right to require laboratory test or use test data, or other satisfactory reference before granting approval. The admixture shall be

used strictly in accordance with the manufacturer's directions and/or as directed by the Engineer.

3.3 Grades of Concrete

Concrete shall be in any of the grades designated in IS:456. Grade of concrete to be used in different parts of work shall be as shown on the drawing or as per the Engineer's instructions. In case of liquid retaining structures, IS:3370 will be followed.

3.4 PROPORTIONING AND WORKS CONTROL

3.4.1 General

Proportioning of ingredients of concrete shall be made by any of the two following methods as directed by the Engineer.

a) With preliminary tests by designing the concrete mix. Such concrete shall be called 'Design Mix Concrete'.

b) Without preliminary tests adopting nominal concrete mix. Such concrete shall be called 'Nominal Mix Concrete'.

As far as possible, design mix concrete shall be used on all concrete works. Nominal mix concrete, in grades permitted in accordance with IS:456, may be used if shown on drawings or approved by the Engineer. In all cases the proportioning of ingredients and works control shall be in accordance with IS:456 and shall be adopted for use after the Engineer is satisfied regarding its adequacy and after obtaining his approval in writing.

3.4.2 Mix Design Criteria

Concrete mixes will be designed by the LSTK Vendor to achieve the strength, durability and workability necessary for the job, by the most economical use of the various ingredients. In general, the design will keep in view the following considerations:-

a) Consistent with the various other requirements of the mix, the quantity of water should be kept at the lowest possible level.

b) The nominal maximum size of coarse aggregate shall be as large as possible within the limits specified.

c) The various fractions of coarse and fine aggregates should be mixed in such a proportion as to produce the best possible combined internal grading giving the densest and most workable mix.

d) Chemical admixtures may be used to modify the rate of hardening, to improve workability (maintaining low water - cement ratio) or as an aid to control concrete quality.

e) The finished concrete should have adequate durability in all conditions, to withstand satisfactorily the weather and other destructive agencies which it is expected to be subjected to in actual service.

The requirement of adequate structural strength is catered for by the choice of proper grade of concrete by the Engineer. The LSTK Vendor shall strictly abide by the same in his design of concrete mix.

Notwithstanding anything mentioned in various tables given in IS:456 giving specific values and degrees of workability for different condition of concrete placing, minimum cement content and maximum water-cement ratio for concrete exposed to sulphate attack and for concrete to ensure durability under different conditions of exposure, strength requirement for different grades of concrete, proportion for nominal mix concrete, the following tables in the specification are included. For identical condition if values given in the tables shown herein below are different from those mentioned in IS:456, the values as indicated in the tables shown herein below shall prevail.

Various trials shall be given by the LSTK Vendor with specific cement content on each trial. In some cases, plasticizer and other admixtures may be necessary to achieve the desired results.

TABLE - I

STRENGTH REQUIREMENT OF CONCRETE

Grade of concrete	Specified Characteristic Compressive strength of 15cm Cubes at 28 days conducted in accordance with IS:516 (All values in N/Sq.mm)
M - 10	10
M - 15	15
M - 20	20
M - 25	25
M - 30	30
M - 35	35
M - 40	40

Note -1: Nominal mix concrete of proportions 1:4:8 or 1:3:6 may be used as lean concrete for simple foundations for masonry walls, below the reinforced concrete foundations and mass filling. These mixes need not be designed.

Note-2: Grades of concrete leaner than M-20 shall not be used in reinforced concrete.

TABLE - II

MIX PROPORTIONS (BY WEIGHT) EXPECTED TO GIVE DIFFERENT DEGREES OF WORKABILITY WITH DIFFERENT VALUES OF WATER -CEMENT RATIO

(FOR GUIDANCE)

CEMENT/TOTAL AGGREGATE RATIOS

WORKABILITY	WATER/ CEMENT RATIO	RATIO BY WEIGHT OF CEMENT OF GRAVEL AGGREGATE		RATIO BY WEIGHT OF CEMENT TO CRUSHED STONE AGGREGATE	
		20 mm size	38 mm size	20 mm size	38 mm size
Very low	0.4	1:4.8	1:5.3	1:4.5	1:5.0
Slump	0.5	1:7.2	1:7.7	1:6.5	1:7.4
0-25 mm	0.6	1:9.4	1:10	1:7.8	1:9.6
	0.7	1:10	1:12	1:8.7	1:10.6
Low	0.4	1:3.9	1:4.5	1:3.5	1:4.0
Slump	0.5	1:5.5	1:6.7	1:5.0	1:5.5
25-50 mm	0.6	1:6.8	1:7.4	1:6.3	1:7.0
	0.7	1:8.0	1:8.5	1:7.4	1:8.0
Medium	0.4	1:3.5	1:3.8	1:3.1	1:3.6
Slump	0.5	1:4.8	1:5.7	1:4.2	1:5.0
50-100 mm	0.6	1:6.0	1:7.3	1:5.2	1:6.2
High	0.4	1:3.2	1:3.5	1:2.9	1:3.3
Slump	0.5	1:4.4	1:5.2	1:3.9	1:4.6
100-175 mm	0.6	1:5.4	1:6.7	1:4.7	1:5.7
	0.7	1:6.2	1:7.4	1:5.5	1:6.5

NOTE: 1 - Notwithstanding anything mentioned above, the cement/Total aggregate ratio is not to be increased beyond 1:9.0 without specific permission of the Engineer.

NOTE: 2 - It should be noted that such high aggregate cement ratios will be required for concrete of very low slump and high water-cement ratios which may be required to be used in mass concrete work only.

NOTE: 3 - The above figures are for guidance only. The actual cement/aggregate ratios are to be worked out from the specific gravities of coarse aggregates and sand being used and from trial mixes.

3.5 Strength Requirements

The strength requirements of both design mix and nominal mix concrete where ordinary Portland Cement or Portland slag cement is used, shall be as per Table-2 of IS:456. All other relevant clauses of IS:456 shall also apply.

3.6 Minimum Cement Content

The minimum cement content for each grade of concrete shall be as per Table-5 of IS: 456.

3.7 Water-Cement Ratio

The choice of water-cement ratio in designing a concrete mix will depend on the following:-

a) The requirement of strength.

b) The requirement of durability.

3.7.1 Strength Requirement

In case of 'Design Mix Concrete', the water-cement ratio of such value as to give acceptable test results as per IS:456, will be selected by trial and error. The values of water-cement ratios for different grade and mix designs will have to be established after conducting sufficiently large number of preliminary tests in the laboratory to the satisfaction of the Engineer. Frequent checks on test will have to be carried out and the water-cement ratios will be revised if the tests produce unsatisfactory results. Notwithstanding anything stated above the LSTK Vendor responsibility to produce satisfactory test results and to bear all the consequences in case of default remains unaltered.

In case of nominal mix concrete Table-9 of IS:456 may be followed. The acceptance criteria for nominal mix concrete shall be as per IS:456.

3.7.2 Durability Requirement

Table-5 of IS:456 gives the maximum water-cement ratio permissible from the point of view of durability of concrete subjected to adverse exposure to weather, sulphate attacks, and contact with harmful a suitable plasticizer / super-plasticizer. However the LSTK Vendor has to propose specifically along with field trials in the event of lower cement content if found suitable along with a plasticizer. It will be preferable to use Melamine based plasticizer.

3.8 Workability

The degree of workability necessary to allow the concrete to be well consolidated and to be worked into the corners of formwork and around the reinforcement and embedment and to give the required surface finish shall depend on the type and nature of structure and shall be based on experience and tests. The usual limits of consistency for various types of structures are given below:-

TABLE - III

LIMITS OF CONSISTENCY

Degree of workability	**Slump in mm with Standard Cone as per IS:1199**		**Use for which concrete is suitable.**
	Min.	Max.	
Very low	0	25	Large Mass concrete structure with heavy compaction equipment, roads and like.
Low	25	50	Uncongested wide & shallow R.C.C. structures.
Medium	50	100	Deep but wide RCC structures with congestion of reinforcement and inserts.
High	100	150	Very narrow & deep RCC structures with congestion due to reinforcement and inserts.

NOTE:

Notwithstanding anything mentioned above, the slump to be obtained for work in progress shall be as per direction of the Engineer.

With the permission of the Engineer, for any grade of concrete, if the water has to be increased in special cases, cement shall also be increased proportionately to keep the ratio of water to cement same as adopted in trial mix design for each grade of concrete. No extra payment will be made for this additional cement. The workability of concrete shall be checked at frequent intervals by slump tests. Alternatively where facilities exist or if required by the Engineer, the compacting factor test in accordance with IS:1199.

3.9 Size of Coarse Aggregates

The maximum size of coarse aggregates for different locations shall be as follows unless otherwise directed by the Engineer:-

Very narrow space	-	12 mm
Reinforced concrete except foundation	-	20 mm
Ordinary Plain concrete and Reinforced concrete foundations	-	40 mm
Mass concrete	-	80 mm
Mass concrete in very large structure	-	150 mm

Grading of coarse aggregates for a particular size shall conform to relevant I.S. Codes and shall also be such as to produce a dense concrete of the specified proportions, strength and consistency that will work readily into position without segregation.

Coarse aggregate will normally be separated into the following sizes and stacked separately in properly designed stock piles:

150 mm to 80 mm, 80 mm to 40 mm, 40 mm to 20 mm and 20 mm to 5 mm. In certain cases it may be necessary to further split the 20 mm to 5 mm fraction into 20 mm to 10 mm and 10 mm to 5 mm fractions.

This separation of aggregates in different size fractions is necessary so that they may be remixed in the desired proportion to arrive at a correct internal grading to produce the best mix.

3.10 Mixing of Concrete

Concrete shall always be mixed in mechanical mixer unless specifically approved by the Engineer for concrete to be used in unimportant out of the way locations in small quantities. Water shall not normally be charged into the drum of the mixer until all the cement and aggregates constituting the batch are already in the drum and mixed for at least one minute. Mixing of each batch shall be continued until there is a uniform distribution of the materials and the mass is uniform in colour and consistency, but in no case shall mixing be done for less than 2 (two) minutes and at least 40 (forty) revolutions after all the materials and water are in the drum. When absorbent aggregates are used or when the mix is very dry, the mixing time shall be extended as may be directed by the Engineer. Mixers shall not be loaded above their rated capacity as this prevents thorough mixing.

The entire contents of the drum shall be discharged before the ingredients for the next batch are fed into the drum. No partly set or remixed or excessively wet concrete shall be used. Such concrete shall be immediately removed from site. Each time the work stops, the mixer shall be thoroughly cleaned & when the next mixing commences, the first batch shall have 10% additional cement at no extra cost to the Owner to allow for loss in the drum.

Regular checks on mixer efficiency shall be carried out as directed by the Engineer as per IS: 4634 on all mixers employed at site. Only those mixers whose efficiencies are within the tolerances specified in IS: 1791 will be allowed to be employed.

Ingredients for design mix concrete shall be measured by weight. For small jobs portable swing weigh Bachers conforming to IS:2722 may be used.

Batching plant conforming to IS:4925 shall be used for large jobs. The accuracy of the measuring equipment shall be within + 2% of the quantity of Cement, water or total aggregates being measured and within + 5% of the quantity of any admixture being used. The batching equipment shall be fitted with an accurate mechanism for weighing separately the cement, fine aggregate and coarse aggregate. Water may be measured by volume or by weight. All measuring equipment should be maintained in a clean serviceable condition, and their accuracy shall be checked periodically.

Mechanical / electrical control shall be provided on the mixing equipment to ensure the batch cannot be discharged until approved mixing time has elapsed and the entire batch shall be discharged before the mixer is recharged.

Where admixtures are employed, separate containers & measuring devices shall be used.

For minor concreting works, batching by volume according to specific weight may be permitted by the Engineer. In that case the whole bags of cement shall be used and gauge boxes used for measuring aggregates.

When hand mixing is permitted by the Engineer, it shall be carried out on a water-tight platform and care shall be taken to ensure that mixing is continued until the mass is uniform in colour and consistency. In case of hand-mixing, 10% extra cement shall be added to each batch at no extra cost to the Owner.

3.11 Conveying Concrete

Concrete shall be handled and conveyed from the place of mixing to the place of laying as rapidly as practicable by approved means and placed and compacted in the final position before the initial setting of the cement starts. Concrete should be conveyed in such a way as will prevent segregation or loss of any of the ingredients. For long distance haulage, agitator cars of approved design will be used. If, in spite of all precautions, segregation does occur during transport, the concrete shall be properly re-mixed before placement. During very hot or cold weather, if directed by the Engineer, concrete shall be transported in deep containers which will reduce the rate of loss of water by evaporation or loss of heat. If necessary, the container may have to be covered and insulated. Conveying equipment's for concrete shall be well maintained and thoroughly cleaned before commencement of concrete mixing. Such equipment's shall be kept free from set concrete.

3.12 Placing and Compacting Concrete

Where specifically covered, the relevant I.S. Code will be followed for the procedure of surface preparation, placement, consolidation, curing, finishes, repairs and maintenance of concrete. If, however, there is no specific provision in the relevant I.S. Code for any particular aspect of work, any other standard Code of practice, as may be specified by the Engineer, will be adopted. Concrete may have to be placed against the following types of surfaces:-

a) Earth foundation

b) Rock foundation

c) Formwork

d) Construction joint in concrete or masonry

The surface on or against which concrete is to be placed has to be cleaned thoroughly. Rock or old construction joint has to be roughened by wire brushing, chipping, sand blasting or any other approved means for proper bond. All cuttings, dirt, oil, foreign and deleterious material, laitance, etc. are to be removed by air water jetting or water at high pressure. All excavated areas for foundations, ring beams, plinths, pile caps etc. shall be rammed & consolidated properly before blinding with nominal mix plain concrete, as per drawing and / or direction of the Engineer and shall be allowed to cure prior to setting out steel fixing, shuttering and concrete pouring for the main structural element.

Formwork, reinforcement, preparation of surface, embedments, joint seals etc., shall be approved in writing by the Engineer before concrete is placed. As far as possible, concrete shall be placed in the formwork by means approved by the Engineer and shall not be dropped from a height or handled in a manner which may cause segregation. Any drop over 1500 mm shall have to be approved by the Engineer. Rock foundation or construction joint will be kept moist for at least 72 hours prior to placement. Concrete will be placed always against moist surface but never on pools of water. In case the foundation cannot be dewatered completely, special procedure and precaution, as directed by the Engineer will have to be adopted.

Formwork will be cleaned thoroughly and smeared lightly with form oil or grease of approved quality just prior to placement.

A layer of mortar of thickness 12 mm of the same or less w/c ratio and the same proportion as that of the concrete being placed and cement slurry will be spread thoroughly on the rock foundation or construction joint just prior to placement of concrete. The cost of application of such cement slurry and mortar will be deemed to be included in the unit rate of concrete.

After concrete has been placed, it shall be spread, if necessary and thoroughly compacted by approved mechanical vibration to maximum subsidence without segregation and thoroughly worked around shape. Vibrators shall not be used for pushing concrete into adjoining areas. Vibrators must be operated by experienced workmen and the work carried out as per relevant IS Code of

Practice. In thin members with heavy congestion of reinforcement or other embedments, where effective use of internal vibrator is, in the opinion of the Engineer, doubtful, in addition to immersion vibrators the LSTK Vendormay have to employ form vibrators conforming to IS:4656. For slabs and other similar structures, the LSTK Vendor will additionally employ screed vibrator as per IS:2506. Hand tamping may be allowed in rare cases, subject to the approval of the Engineer. Care must be taken to ensure that the inserts, fixtures, reinforcement and formwork are not displaced or distorted during placing and consolidation of concrete.

The rate of placement of concrete shall be such that no cold joint is formed and fresh concrete is placed always against green concrete which is still plastic and workable. No concrete shall be placed in open, during rains. During rainy season, no placement in the open is to be attempted unless sufficient tarpaulins or other similar protective arrangement for completely covering the still green concrete from rain is kept at the site of placement. If there has been any sign of washing of cement and sand, the entire affected concrete shall be removed immediately. Suitable precautions shall be taken in advance to guard against rains before leaving the fresh concrete unattended. No accumulation of water shall be permitted on or around freshly laid concrete.

The size of the concrete pours must be carefully considered prior to commencement to ensure the structural elements are poured in on continuous shift to avoid cold joints.

Slabs, beams and similar members shall be poured in one operation, unless otherwise instructed by the Engineer. Moulding, throating, drip course, etc., shall be poured as shown on the drawings or as directed by the Engineer. Holes shall be provided and bolts, sleeves, anchors, fastenings or other fixtures shall be embedded in concrete as shown on the drawings or as directed by the Engineer. Any deviation there from shall be set right by the LSTK Vendor at his own expense as instructed by the Engineer.

In case the forms or supports get displaced during or immediately after the placement and bring the concrete surface out of alignment beyond tolerance limits, the Engineer may direct to remove the portion and reconstruct or repair the same at the LSTK Vendor's expense. The Engineer shall decide upon the time interval between two placements of concrete of different ages coming in contact with each other, taking in consideration the degree of maturity of the older concrete, shrinkage, heat dissipation and the ability of the older concrete to withstand the load imposed upon it by the fresh placement.

Once the concrete is deposited, consolidated and finished in its final position, it shall not be distributed.

3.13 Construction Joints and Cold Joints

3.13.1 Construction Joints

It is always desirable to complete any concrete structure by continuous pouring in one operation. However, due to practical limitation of methods and equipment and certain design considerations, construction joints are formed by discontinuing concrete at certain predetermined stages. These joints will be formed in a manner specified in the drawings/Instruction. Vertical construction

joints will be made with rigid stop-board forms having slots for allowing passage of reinforcement rods and any other embedments and fixtures that may be shown. Next stage concrete shall be placed against construction joint as per clause 3.12. For water retaining structures and leak-proof buildings suitable approved water bars will be installed at the construction joints.
Where the location of the joints are not specified, it will be in accordance with the following:-

a) In a column, the joint shall be formed 75 mm below the lowest soffit of the beam framing into it.

b) Concrete in a beam shall preferably be placed without a joint, but if provision of a joint is unavoidable, the joint shall be vertical and within the middle third of the span.

c) A joint in a suspended floor slab shall be vertical and within the middle third of the span and at right angles to the principal reinforcement.

d) Feather-edges in concrete shall be avoided while forming a joint.

e) A construction joint should preferably be placed in a low-stress zone and at right angles to the direction of the principal stress.

f) In case the LSTK Vendor proposes to have a construction joint anywhere to facilitate his work, the proposal should be submitted well in advance to the Engineer for study and approval without which no construction joint will be allowed.

3.13.2 Cold Joint

An advancing face of a concrete pour, which could not be covered by fresh concrete before expiry of initial setting time (due to an unscheduled stoppage or delay on account of breakdown in plant, inclement weather, low rate of placement or any other reason), is called a cold joint. The LSTK Vendor should always remain vigilant to avoid cold joints.

If, however, a cold joint is formed due to unavoidable reasons, the following procedure shall be adopted for treating it:-

a) If the concrete is so green that it can be removed manually and if vibrators can penetrate the surface without much effort, fresh concrete can be placed directly against the old surface. The old concrete should be covered by fresh concrete as quickly as possible and the joint thoroughly and systematically vibrated.

b) In case concrete has hardened a bit more than (a) but can still be easily removed by a light hand pick, the surface will be raked thoroughly and the loose concrete removed completely without disturbing the rest of the concrete in depth. A rich mortar layer 12 mm in thickness, will be placed on the cold joint fresh concrete shall be placed on the mortar layer and the joint will be thoroughly and systematically vibrated penetrating the vibrator deep into the old layer of concrete.

c) In case the concrete at the joint has become so stiff that it cannot be remoulded and mortar or slurry does not rise in spite of extensive vibration, the joint will be left to harden for at least 12 - 24 hrs. It will then be treated as a regular construction joint, after cutting the concrete to required shape and preparing the surface as described under clause 3.12.

3. 14 Repairs, Finishes and Treatment of Concrete surfaces

3. 14.1 Adequate and sound concrete surfaces, whether formed or unformed, can be obtained by employing a concrete mix of proper design, competent formwork, appropriate methods of handling, placing and consolidation by experienced workmen.

Unsound concrete resulting from improper mix design, incompetent methods, equipment and formwork, poor workmanship and protection will not be accepted and will have to be dismantled, removed and replaced by sound concrete at the LSTK Vendor's cost. The Engineer may, at his sole discretion, allow retaining concrete with minor defects provided the LSTK Vendor is able to repair it by approved methods at no extra cost to the Owner. All concrete work shall be inspected by the LSTK Vendor immediately after the forms are removed and he will promptly report occurrence of any defects to the Engineer. All repair work will be carried out as per the instructions and in the presence of the Engineer or his representative. Generally, repair work will consist of any or all of the following operations:-

a) Sack rubbing with mortar and stoning with carborundum stone.

b) Cutting away the defective concrete to the required depth and shape.

c) Cleaning of reinforcement and embedments. It may be necessary to provide an anti-corrosive coating on the reinforcement.

d) Roughening by sand blasting or chipping.

e) Installing additional reinforcement / welded mesh fabric.

f) Dry packing with stiff mortar.

g) Plastering, guniting, shotcreting etc.

h) Placing and compacting concrete in the void left by cutting out defective concrete.

i) Grouting with cement sand slurry of 1:1 mix.

j) Repairing with a suitable mortar either cement or resin modified mortar.

k) Polymer modified patching and adhesive repair mortar for beams & columns.

3.14.2 Finishing Unformed Surface

A few typical and common cases of treatment of unformed concrete surface are cited below:-

a) Floor

Whenever a non-integral floor finish is indicated, the surface of reinforced concrete slab shall be struck off at the specified levels and slopes and shall be finished with a wooden float fairly smooth removing all laitance. No over trowelling, to obtain a very smooth surface, shall be done as it will prevent adequate bond with the subsequent finish. If desired by the Engineer, the surface shall be scored and marked without any extra cost to the Owner to provide better bond.

Where monolithic finish is specified or required, concrete shall be compacted and struck off at the specified levels and slopes with a screed, preferably a vibrating type and then floated with a wooden float. Steel trowelling by hand or by rotary power float is then started after the moisture film and shine have disappeared from the surface and after the concrete has hardened enough to prevent excess of fines and water to rise to the surface but not hard enough to prevent proper finishing of aberrations. Steel trowelling properly done will flatten and smoothen sandy surface left by wooden floats and produce a dense surface free from blemishes, ripples and trowel marks. A fine textured surface that is not slick and can be used where there is likelihood of spillage of oil or water can be obtained by trowelling the surface lightly with a circular motion after initial trowelling keeping the steel trowel flat on the surface.

To provide a better grip the Engineer may instruct marking the floor in a regular geometric pattern after initial trowelling.

b) Beams, Columns & Walls

If on such or any other concrete structure it is intended to apply plaster or such concrete surfaces against which brickwork or other allied works are to be built, the LSTK Vendor shall hack the surface adequately as soon as the form is stripped off so that proper bond can develop. Pattern, adequacy and details of such hacking shall meet with the approval of the Engineer, who shall be informed to inspect such surfaces before they are covered up.

3.15 Protection and Curing of concrete

Newly placed concrete shall be protected by approved means from rain, sun and wind. Concrete placed below the ground level shall be protected against contamination from falling earth during and after placing. Concrete placed in ground containing deleterious substances, shall be protected from contact with such ground, or with water draining from such ground, during placing of concrete and for a period of at least three days or as otherwise instructed by the Engineer. The ground water around newly poured concrete shall be kept to an approved level by pumping out or other adequate means of drainage to prevent

floatation or flooding. Steps, as approved by the Engineer, shall be taken to protect immature concrete from damage by debris, excessive loadings, vibration, abrasion, mixing with earth or other deleterious materials, etc. that may impair the strength and durability of the concrete.

As soon as the concrete has hardened sufficiently, it shall be covered either with sand, polythene sheet, hessian, canvas or similar materials and kept continuously wet for at least 14 (fourteen) days after final setting. Curing by continuous sprinkling of water will be allowed if the Engineer is satisfied with the adequacy of the arrangements made by the LSTK Vendor.

If permitted by the Engineer, curing compound like "ANTISOLE (WP)" or approved equivalent may be used for prevention of premature water loss in concrete and thereby effecting curing of concrete. This type of curing compound shall be sprayed on newly laid concrete surfaces to form thin film barrier against premature water loss without disturbances to normal setting action. The curing compound shall comply with ASTM requirements for acceptance.

The curing compound shall be applied following the final finishing operation and immediately after disappearance of water sheen from concrete surface.

It is important not to apply the curing compound when standing water is still present on concrete.

The LSTK Vendor shall arrange for the manufacturer's supervision at no extra cost to the owner.

The LSTK Vendor shall remain extremely vigilant and employ proper equipment and workmen under able supervision for curing. The Engineer's decision regarding the adequacy of curing is final. In case any lapse on the part of the LSTK Vendor is noticed by the Engineer, he will inform the LSTK Vendor or his supervisor verbally or in writing to correct the deficiency in curing. If no satisfactory action is taken by the LSTK Vendor within 3 (three) hours of issuance of such instruction, the Engineer will be at liberty either to employ sufficient means through any agency to make good the deficiency and recover the cost thereof from the LSTK Vendor, or pay for the part where adequate curing was noticed at a reduced rate, entirely at the discretion of the Engineer.

3.16 Reinforcement

Mild steel round bars, cold twisted and deformed bars as medium tensile or high yield strength steel, plain hard drawn steel wire fabric etc., will be used as reinforcement as per drawings and directions. In an aggressive environment an anti-corrosive coating on the reinforcement may be provided as per IS:9077, as shown on the drawing or as directed by the Engineer.

3.16.1 Bar Bending Schedules

The LSTK Vendor shall submit to the Engineer for approval Bar Bending Schedules with working drawings in triplicate, showing clearly the arrangements proposed by the LSTK Vendor to match available stock of reinforcing steel,

within one month of receipt of the Letter of Intent or of the receipt of the relevant design drawings, whichever is later. Upon receipt of the Engineer's final approval of the Bar Bending Schedule and drawings, the LSTK Vendor shall submit 6 (six) prints of the final drawings with one reproducible print after incorporating necessary modifications or corrections, for final record and distribution. Approval of such detailed drawings by the Engineer shall not relieve the LSTK Vendor of his responsibility for correctness nor of any of his obligations to meet the other requirements of the Contract.

3.16.2 Cleaning

All steel for reinforcement shall be free from loose scales, oil, grease, paint or other harmful matters immediately before placing the concrete.

3.16.3 Cutting & Bending of Reinforcement

Unless otherwise specified, reinforcing steel shall be bent in accordance with the procedure specified in IS:2502 or as approved by the Engineer. Bends and shapes shall comply strictly with the dimensions corresponding to the approved Bar Bending Schedules. Bar Bending Schedules shall be rechecked by the LSTK Vendor before any bending is done.

No reinforcement shall be bent when already in position in the work, without approval of the Engineer, whether or not it is partially embedded in concrete. Bars shall not be straightened in a manner that will injure the material. Re-bending can be done only if approved by the Engineer. Reinforcing bars above 16 mm diameter shall be bent by machine producing a gradual and even motion. Bars of 16 mm or below may be bent by hand. All the bars shall be cold bent unless otherwise approved. Bending hot at a cherry-red heat(not exceeding 845°C) may be allowed under very exceptional circumstances except for bars whose strength depends on cold working. Bars bent hot shall not be cooled by quenching.

Reinforcing bars, whether high yield or mild steel shall be cut using either hand held shears, guillotines or foot operated pneumatic cutters. Cutting bars using cold chisels may be allowed by the Engineer at exceptional cases.

3.16.4 Placing in Position

All reinforcements shall be accurately fixed and maintained in position as shown on the drawings by such approved and adequate means like mild steel chairs and/or concrete spacer blocks irrespective of whether such supports are payable or not. Bars intended to be in contact at crossing points, shall be securely tied together at all such points by No. 20 G annealed soft iron wire. Tack welding of bars should not be done unless permitted by the Engineer. Binders shall tightly embrace the bars with which they are intended to be in contact and shall be securely held. The vertical distance between successive layers of bars shall be maintained by provision of mild steel spacer bars. They should be spaced such that the main bars should have clear gap between adjacent spacers. Before actual placing, the LSTK Vendor shall study the drawings thoroughly and inform the Engineer in case he feels that placement of certain bars is not possible due to

congestion. In such cases he should not start placing any bar before obtaining clearance from the Engineer.

3.16.5 Welding

Normal bond laps in reinforcement may be placed by lap or butt welding reinforcement bars, if asked by the Engineer, under certain conditions. The work should be done with suitable safeguards in accordance with relevant Indian Standards for welding of mild steel bars used in reinforced concrete construction as per IS:2751 and IS:456. Welded mesh fabrics conforming to IS:1566 may also be used if specified in the Schedule of Items and Drawings.

3.16.6 Control

The placing of reinforcements shall be completed well in advance of concrete pouring. Immediately before pouring, the reinforcement shall be examined by the Engineer for accuracy of placement and cleanliness. Necessary corrections as directed by him shall be carried out. Laps and anchorage lengths of reinforcing bars shall be in accordance with IS:456, unless otherwise specified. If the bars in a lap are not of the same diameter, the smaller will guide the lap length. The laps shall be staggered as far as practicable and as directed by the Engineer. Arrangements for placing concrete shall be such that reinforcement in position does not have to bear extra load and get disturbed.

The cover for concrete over the reinforcements shall be as shown on the approved drawings unless otherwise directed by the Engineer. Where concrete blocks are used for ensuring the cover and positioning reinforcement, they shall be made of mortar not leaner than 1 (one) part cement to 2 (two) parts sand by volume and cured in a pond for at least 14 (fourteen) days. The type, shape, size & location of the concrete blocks shall be as approved by the Engineer.

3.17 Cold Weather Concreting

When conditions are such that any operation of concreting may be expected to be done at 5 Deg.C atmospheric temperature or below the work shall conform to the requirement of Clause 14 of IS:456 and IS:7861. (Part. II).

3.18 Hot Weather Concreting

When depositing concrete in very hot weather, the LSTK Vendor shall take all precautions as per IS:7861 (Part-I) and stagger the work to the cooler parts of the day to ensure that the temperature of wet concrete used in massive structures does not exceed 40 Deg.C while placing. Positive temperature control by precooling, postcooling or any other method, if required, will be specified and paid for separately.

3.19 Concreting under water

When it is necessary to deposit concrete under water it shall be done in accordance with the requirements of clause 14 of IS:456.

3.20 Form Work

3.20.1 General

Formwork shall conform to the shape, grade, lines, levels and dimension as shown on the drawings. The LSTK Vendor shall prepare design & working drawings for formwork & temporary support system for important structures and get them approved by the Engineer prior to commencement of actual work.

Materials used for the formwork inclusive of the supports and centering shall be capable of withstanding the working load and remain undistorted throughout the period it is left in service. All supports and scaffolds should be manufactured from structural or tubular steel except when specifically permitted otherwise by the Engineer.

The centering shall be true to vertical, rigid and thoroughly braced both horizontally and diagonally. Rekers are to be used where forms are to support inclined members. The forms shall be sufficiently strong to carry without undue deformation, the dead weight of the concrete as a liquid as well as the working load, in case the LSTK Vendor wishes to adopt any other design criteria, he has to convince the Engineer about its acceptability before adopting it. Where the concrete is vibrated, the formwork shall be strong enough to withstand the effects of vibration without appreciable deflection, bulging, distortion or loosening of its components. The joints in the formwork shall be sufficiently tight to prevent any leakage of slurry or mortar.

To achieve the desired rigidity, tie bolts, spacer blocks, tie wires and clamps as approved by the Engineer shall be used but they must in no way impair the strength of concrete or cause stains or marks on the finished surface. Where there are chances of these fixtures being embedded, only mild steel or concrete of adequate strength shall be used. Alternatively, except in case of water retaining structures through rods and the tie bolts shall be sleeved with PVC conduits to allow retraction of the ties on removal of the shutters. Where required, the annulus of the conduits will be filled with expanding mortar to seal the void. Bolts passing completely through liquid retaining walls/slabs for the purpose of securing and aligning the formwork shall not be used.

The formwork shall be such as to ensure a smooth uniform surface free from honeycombs, air bubbles, bulges, fins and other blemishes. Any blemish or defect found on the surface of the concrete must be brought to the notice of the Engineer immediately and rectified free of charge as directed by him.

For exposed interior and exterior concrete surfaces of beams, columns and wall, plywood or other approved form shall be thoroughly cleaned and tied together with approved corrosion- resistant devices. Rigid care shall be exercised in ensuring that all column forms are plumb and true and thoroughly cross braced to keep them so. All floor and beam centering shall be crowned not less than 8 mm in all directions for every 5 meters span. Unless specifically described on the drawings or elsewhere to the contrary, bevelled forms 25 mm by 25 mm shall be fixed in the form-work at all corners to provide chamfering of the finished concrete edges without any extra charge. The formwork should lap and be secured sufficiently at the lift joints to prevent bulges and offsets.

Temporary openings for cleaning, inspection and for pouring concrete shall be provided at the base of vertical forms and at other places, where they are necessary and as may be directed by the Engineer. The temporary openings shall be so formed that they can be conveniently closed when required, during pouring operations without leaving any mark on the concrete.

3.20.2 Cleaning and Treatment of Forms

All parts of the forms shall be thoroughly cleaned of old concrete, wood shavings, saw dust, dirt and dust sticking to them before they are fixed in position. All rubbish, loose concrete, chippings, shavings, saw dust etc. shall be scrupulously removed from the interior of the forms before concrete is poured. Compressed air jet and/or water jet along with wire brushes, brooms etc. shall be used for cleaning. The inside surface of the formwork shall be treated with approved non-staining oil based shutter release agent like "Separol/Sika form oil/ Siparol Concentrate" or approved equivalent before it is placed in position. Care shall be taken that oil or other compound does not come in contact with reinforcing steel or construction joint surfaces. They shall not be allowed to accumulate at the bottom of the formwork. The oiling of the formwork will be inspected just prior to placement of concrete and redone wherever necessary.

3.20.3 Design

The formwork shall be so designed and erected that the forms for slabs and the sides of beams, columns and walls are independent of the soffits of beams and can be removed without any strain to the concrete already placed or affecting the remaining formwork. Removing any props or repropping shall not be done except with the specific approval of the Engineer. If formwork for column is erected for the full height of the column, one side shall be left open and built up in sections, as placing of concrete progress. Wedges, spacer bolts, clamps or other suitable means shall be provided to allow accurate adjustment and alignment of the formwork and to allow it to be removed gradually without jarring the concrete.

The design of formwork shall take into account all vertical and lateral loads that the forms will carry or be subjected to during the construction process. Besides weight and pressures of reinforced concrete and weight of the forms themselves, the design shall consider loading due to unsymmetrical placement of concrete; impact from dumping of concrete; movement of men and construction equipment; wind action and any other imposed load during construction. The LSTK Vendor shall assess the magnitude of vertical live load to be taken for design of formwork duly considering his method, sequence and rate of pour of concrete. However, minimum design vertical live load to be considered shall be 750 kg/sum excluding weight of concrete.

3.20.4 Inspection

Casting of Concrete shall start only after the formwork has been inspected and approved by the Engineer. The concreting shall start as early as possible within 3 (three) days after the approval of the formwork and during this period the formwork shall be kept under constant vigilance against any interference. In

case of delay beyond three days, a fresh approval from the Engineer shall be obtained.

3.20.5 Removal of Forms

Before removing any formwork, the LSTK Vendor must notify the Engineer well in advance to enable him to inspect the concrete if he so desires. The LSTK Vendor shall record on the drawing or in any other approved manner, the date on which concrete is placed in each part of the work and the date on which the formwork is removed therefrom and have this record checked and countersigned by the Engineer regularly.

The LSTK Vendor shall be responsible for the safe removal of the formwork and any work showing signs of damage through premature removal of formwork or loading shall be rejected and entirely reconstructed by him without any extra cost to the Owner. The Engineer may, however, instruct to postpone the removal of formwork if he considers it necessary.

Forms for various types of structural components shall not be removed before the minimum periods specified herein and the removal after the minimum periods shall also be subject to the approval of the Engineer in each case.

TABLE - IV

SCHEDULE OF REMOVAL OF FORM

Part of Structure		Ordinary Portland Cement Concrete				Rapid Hardening Portland Cement Concrete			
		Temperature Deg.C				Temperature Deg.C			
		Above40 Deg.	40 Deg.-20 Deg.	20 Deg. - 5 Deg.	Below5 Deg.	Above 40 Deg.	40 Deg.-20 Deg.	20 Deg. - 5 Deg.	Below5 Deg.
		Days	Days	Days	Days	Days	Days	Days	Days
a)	Columns& Walls	2	1	1	Do not remove forms until site cured test speci men develop at least test 50% of the specimen specified 28 days strength	1	1	1	Do notremoveforms untilsite cureddevelop at least50% of thespecified28 days
b)	Beam sides323	3	2	3		2	1	1	
c)	Slabs,125 mm	10	7	8		7	4	5	
d)	Slabs over125 mmthick and soffit ofminor beams	18	14	16		12	8	9	
e)	Soffit of main beams strength	24	21	22		14	10	12	

Wherever exposed surfaces of concrete can be effectively sealed to prevent loss of water, the periods specified for temperature above 40 Deg.C can be reduced to those of the temperature range of 20 Deg.C to 40 Deg.C subject to approval of the Engineer.

Construction joints in beams, if required to be provided, will be located within the middle third of span according to clause 3.13.1(b) of this specification. In such cases, however, entire span of beam shall have to be kept supported by formwork till its removal for the portion of beam, cast at a later date, is due and so approved by the Engineer.

If any type of cement other than Portland slag cement and Rapid hardening portland cement is used the time of removal or forms shall be revised as approved by the Engineer such that the strength of this cement at the time of removal of forms match with strength of portland cement at the time of removal of form as mentioned above. This has to be supported by regular tests.

3.20.6 Tolerance

The formwork shall be so made as to produce a finished concrete, true to shape, lines, levels, plumb and dimensions as shown on the drawings subject to the following tolerances unless otherwise specified in this Specification or drawings or directed by the Engineer :-

For -	a)	Sectional dimension	-	$\pm$ 5 mm
	b)	Plumb	-	1 in 1000 of height
	c)	Levels	-	$\pm$ 3 mm before any deflection has taken place

The tolerance given above are specified for local aberrations in the finished concrete surface and should not be taken as tolerances for the entire structure taken as a whole or for the setting and alignment of formwork, which should be as accurate as possible to the entire satisfaction of the Engineer. Any error, within the above tolerance limits or any other as may be specially set up by the Engineer, if noticed in any lift of the structure after stripping of forms, shall be corrected in the subsequent work to bring back the surface of the structure to its true alignment.

3.20.7 Re-use of Forms

Before re-use, all forms shall be thoroughly scraped, cleaned, joints and planes examined and when necessary repaired, and inside surface treated as specified hereinbefore. Formwork shall not be used / re-used if declared unfit or unserviceable by the Engineer.

3.20.8 Classification

Generally, the ‘ordinary’ class formwork shall be used unless otherwise directed by the Engineer:-

a) Ordinary: These shall be used in places where ordinary surface finish is required and shall be composed of steel and / or approved good quality partially seasoned timber.

b) Plywood: These shall be used in exposed surfaces, where a specially good finish is required and shall be made of approved brand of heavy quality plywood to produce a perfectly uniform and smooth surface conforming to the shape described in the drawing with required grain texture on the concrete. Re-use may only be permitted after special inspection and approval by the Engineer. He may also permit utilization of used plywood for the 'ordinary' class, if it is still in good condition.

c) Ornamental: These shall be used where ornamental and curved surface are required and shall be made of selected best quality well-seasoned timbers or of plywood, which can be shaped correctly.

3.21 Opening, Chases, Grooves, Rebates, Blockouts etc.

The LSTK Vendor shall leave all openings, grooves, chases, etc. in concrete work as shown on the drawings or as specified by the Engineer.

3.22 Anchor Bolts, Anchors, Sleeves, Inserts, Hangers/Conduits/Pipe and Other misc. Embedded Fixtures.

The LSTK Vendor shall build into concrete work all the items noted below and shall embed them partly or fully as directed and secure the same as may be required. The materials, if required to be supplied by the LSTK Vendor, shall be as specified and be of best quality available according to relevant Indian Standards of approved manufacture and to the satisfaction of the Engineer. Exposed surfaces of embedded materials are to be painted with one coat of approved anti-corrosive paint and / or bituminous paint without any extra cost to the Owner. If welding is to be done subsequently on the exposed surface of embedded material the paint shall be cleaned off the member to a minimum length of 50 mm beyond each side of the weld line.

Necessary templates, jigs, fixtures, supports etc. shall be used as may be required or directed by the Engineer, free of cost to the Owner.
Items to be embedded:-

a) Inserts, hangers, anchors, frames around openings, manhole covers, frames, floor clips, sleeves conduits and pipes.

b) Anchor bolts and plates for machinery, equipment and for structural steel work.

c) Steel structural to be left embedded for future extension, special connection etc.

d) Lugs or plugs for door and window frames occurring in concrete work.

e) Flashing and jointing in concrete work.

f) Any miscellaneous embedment and fixture as may be required.

Correct location and alignment, as per drawings/instruction of all these embedded items shall be entirely the responsibility of the LSTK Vendor.

3.23 Expansion and Isolation Joints

3.23.1 General

Expansion and isolation joints in concrete structures shall be provided at specific places as per details indicated on the drawings. The materials and types of joints shall be as specified hereinafter. In case of liquid retaining structures, additional precautions shall be taken to prevent leakage of liquids as may be specified on the drawings or as directed by the Engineer. All materials are to be procured from reliable manufacturers and must have the approval of the Engineer. Where it is the responsibility of the LSTK Vendor to supply the material, the Engineer

may demand test certificates for the materials and / or instruct the LSTK Vendor to get them tested in an approved laboratory free of cost to the Owner. Joints shall be formed true to line, level, shape, dimension and quality as per drawings and specifications. Prior approval of the method of forming the joints should be obtained from the Engineer before starting the work.

3.23.2 Bitumen Board/Expanded Polystyrene Board

3.23.2.1 Bitumen Board

Bitumen impregnated fibre board of approved manufacturer as per IS:1838 may be used as fillers for expansion joints. It must be durable and waterproof. It shall be compressible and possess a high degree of rebound. The dimensions of the board should be equal to that of the joint being formed. It should, preferably be manufactured in one piece, matching the dimension of the joint and not prepared by cutting to size smaller pieces from larger boards at site. At the exposed end, the joint shall be sealed with approved sealing compound to a depth of at least 25 mm after application of an approved primer. The sealing compound and the primer shall be applied as specified by the manufacturer.

3.23.2.2 Expanded Polystyrene Boards

If required, commercial quality of expanded polystyrene products commonly used for thermal insulation may also be used as filler material in expansion joints. The thickness may vary from 12 mm to 50 mm. The material will have to be procured from reliable manufacturers as approved by the Engineer. The method of installations will be similar to that recommended by the manufacturers for fixing on cold storage walls. A coat of Bitumen paint may have to be applied on the board against which concrete will be placed.

3.23.3 Joint Sealing Strips

Joint sealing strips may be provided at the construction, expansion and isolation joints as a continuous diaphragm to contain the filler material and / or to exclude passage of water or any other material into or out of the structure. The sealing strips will be either metallic like G.I., Aluminium or Copper, or non-metallic like rubber or P.V.C.

Sealing strips will not have any longitudinal joint and will be procured and installed in largest practicable lengths having a minimum number of transverse joints. The material is to be procured from reputed manufacturers having proven records of satisfactory supply of joint strips of similar make and shape for other jobs. The jointing procedure shall be as per the manufacturer's recommendations, revised if necessary, by the Engineer. The LSTK Vendor is to supply all labour and material for installation including the material and tools required for jointing, testing, protection, etc. If desired by the Engineer, joints in rubber seals may have to be vulcanized.

3.23.3.1 Metal Sealing Strips

Metal sealing strips shall be either G.I., Aluminium or Copper and formed straight, U shaped, Z shaped or any other shape and of thickness as indicated in the drawing and schedule of items and/or as instructed by the Engineer.

The transverse joints will be gas welded using brass rods and approved flux and will be tested by an approved method to establish that it is leak-proof. Longer lap lengths and different method of brazing which will render it leak-proof, will be adopted by the LSTK Vendor without any additional cost to the Owner. The edges shall be neatly crimped and bent to ensure proper bond with the concrete.

a) G. I. Strips

G.I. strips shall be minimum 1.5 mm thick and 300 mm in width unless specified otherwise. The standard of Galvanising shall be as per relevant Indian Standards for heavy duty work. At the joints, the overlapping should be for a minimum length of 50 mm.

b) Aluminium Strips

Aluminium strips shall be minimum 18 SWG thick and 300 mm wide unless specified otherwise and shall conform to IS : 737 of 19000 grade or 31000 grade (Designation as per IS : 6051). A minimum lap of 50 mm length is required at the joints

c) Copper Strips

The Copper strips shall be minimum 18 SWG in thickness and 300 mm wide unless specified otherwise and shall conform to the relevant Indian Standards. These should be cleaned thoroughly before use to expose fresh surface, without any reduction in gauge. A minimum lap of 50 mm in length is required at the joints.

3.23.3.2 Non - metallic sealing strips

These will be normally in Rubber or P.V.C and can be of shapes having any combination of the following features:-

a) Plain

b) Central bulb

c) Dumb-bell or flattened ends

d) Ribbed and Corrugated Wings

e) V shaped

As these types of seals can be easily handled in very large lengths, transverse joints will be allowed only under unavoidable circumstances and with the specific approval of the Engineer.

The method of forming these joints, laps etc. shall be as specified by the Manufacturer and / or as approved by the Engineer taking particular care to match the central bulbs and the edges accurately.

a) Rubber Sealing Strips

The minimum thickness of Rubber sealing strips shall be 3 mm and the minimum width 100 mm. The actual size and shape will be as shown in drawings/schedule of items and/or as directed by the Engineer. The material will be natural rubber and be resistant to corrosion, abrasion and tear and also to attacks from the acids, alkalis and chemicals normally encountered in service. The physical properties will be generally as follows. The actual requirements may be slightly different as decided by the Engineer:

Specific Gravity	:	1.1 to 1.15
Shore Hardness	:	65A to 75A
Tensile Strength	:	25-30 N/Sq.mm
Maximum Safe Continuous Temperature	:	75 Deg.C
Ultimate Elongation	:	Not less than 350%

b) P.V.C. Sealing Strips

The minimum thickness of P.V.C. sealing strips shall be 3 mm and the minimum width 100 mm. The actual size and shape will be as shown in drawings/schedule of items and/or as directed by the Engineer. The material should be of good quality Polyvinyl Chloride highly resistant to tearing, abrasion and corrosion as well as to chemicals likely to come in contact with during use. The physical properties will generally be as follows. The actual requirements, which will be directed by the Engineer, may vary slightly:-

Specific Gravity	:	1.3 to 1.35
Shore Hardness	:	60A to 80A
Tensile Strength	:	10 - 15 N/Sq.mm
Maximum Safe Continuous Temperature	:	70 Deg.C
Ultimate Elongation	:	Not less than 275%

3.23.4 Joint Sealing Compound

When directed, the gap in expansion joints shall be thoroughly cleaned and bitumen compound laid as per manufacturer's specifications. The compound to be used shall be of approved manufacture and shall conform to the requirements of IS:1834.

Alternatively, when directed, the expansion Joints may be filled with joint sealing compound like "Sikalastic" or approved equivalent and shall be applied as per manufacturer's specification.

3.23.5 Isolation Joints

Strong and tough alkathene or PVC sheet or equivalent, about 1 mm in thickness and as approved by the Engineer shall be used in isolation joints. It shall be fixed by an approved adhesive compound on the cleaned surface of the already set concrete, to cover it fully. Fresh concrete shall be laid against the sheet, care being taken not to damage the sheet in any way.

3.23.6 Rubber Pad

Hard foundation quality rubber pads of required thickness and shapes shall be put below machine or other foundations as shown on the drawings or as directed by the Engineer. The rubber shall have a unit weight of 1500 Kg/Cu.m, a shore hardness of 65A to 70A and be of best quality of approved manufacture, durable, capable of absorbing vibration and must be chemically inert in contact with moist or dry earth or any other deleterious material expected under normal conditions.

3.24 Grouting under Machinery or Structural Steel Bases

If required, grouting under base plates of machines or structural steel etc. shall be carried out by the LSTK Vendor. In general, the mix shall be 1 (one) part cement and 1 (one) part sand and just enough water to make it flow as required. The areas to be grouted shall be cleaned thoroughly with compressed air jet and/or with water in locations where accumulated surplus water can be removed. Where directed by the Engineer, 6 mm down stonechips may have to be used in the mix. Surface to be grouted shall be kept moist for at least 24 hours in advance. The grout shall be placed under expert supervision, so that there is no locked up air. Edges shall be finished properly. If desired by the Engineer, admixtures like Aluminium powder, 'Ironite' etc. may have to be added with the grout in proportions to be decided by the Engineer. Admixture, if directed to be added, will be measured and paid separately.

Alternatively non-shink, free flow, cementious grout like "Sikagrout 214/ Anckor NSG" or approved equivalent specifically selected for the type of equipment to be located (vibrating, static etc.) may also be used for grouting as per manufacturer's specification with necessary approval of the Engineer.

3.25 Precast Concrete

The Specification for precast concrete will be similar as for the cast-in-place concrete described herein and as supplemented in this section. All precast work shall be carried out in a yard made for the purpose.

This yard shall be dry, properly levelled and having a hard and even as well as well drained surface to prevent excessive uneven settlement due to softening of soil during casting & curing. If the ground is to be used as a soffit former of the units, it shall be paved with concrete or masonry and provided with a layer of plaster (1:2 proportion) with smooth neat cement finish or a layer of M.S. sheeting. Where directed by the Engineer, casting will have to be done on suitable vibrating table. The yard, lifting equipment, curing tank, finished material storage space etc. shall be designed such that the units are not lifted from the mould before 10 (Ten) days of curing and can be removed for erection after 28 (twenty eight) days of curing. The moulds shall preferably be of steel or of timber lined with G.I. sheet metal and must be rigid enough to prevent distortion during placing and compaction of the concrete. The yard shall preferably be fenced.

Other than normal curing by applying water through spray nozzles or perforated hose curing by high pressure steam, steam vapour or other accepted processes may also be employed to accelerate the hardening of the concrete and to reduce the curing time.

Lifting hooks, where necessary or as directed by the Engineer, shall be embedded in correct position of the units to facilitate erection, even though they may not be shown on the drawings, and shall be burnt off and finished after erection.

All members shall be indelibly marked with a unique identification mark on a surface which will not be permanently exposed to show on which production line they were manufactured, their type, the class of concrete, the data of casting and if they are of a symmetrical section the face which will be uppermost when the member is in its correct position after erection.

Precast concrete units, when ready, shall be transported to site by suitable means approved by the Engineer. Care shall be taken to ensure that no damage occurs during transportation. All adjustments, levelling and plumbing shall be done as per instructions of the Engineer. The LSTK Vendor shall render all help with instruments, materials and men to the Engineer for checking the proper erection of the precast units.

After erection and alignment, the joints shall be filled with grout or concrete as directed by the Engineer. If centerings have to be used for supporting the precast units, they shall not be removed until the joints have attained sufficient strength and in no case before 14 (fourteen) days. The joint between precast roof planks shall be pointed with 1:2 cement: sand mortar where called for in the drawings.

3.26 Waterproofing of Concrete Structure

3.26.1 General

Waterproofing of concrete structures shall be done by either suitable extraneous treatments like applying waterproofing paints like "Sikatop Seal" or approved equivalent, fixing bitumen felts etc. or internally by suitable design of the concrete mix, addition of suitable admixtures conforming to IS:2645 and equivalent American or British codes in the concrete or mortar at the time of mixing and/or installing water bars at the joints.

The design, material and workmanship shall conform to the relevant I.S. Codes where applicable. The Engineer's approval of the materials shall be obtained by the LSTK Vendor before procurement. If desired by the Engineer, test certificates for the materials and samples shall be submitted by the LSTK Vendor free of charge. The materials shall be of best quality available indigenously, fresh clean and suitable for the duties called upon.

3.26.2 Water Bar/ Seal/ Special Treatment of Construction Joint

Water bearing structures and underground structures may have water bar/seals installed at the joints. They may be rubber or P.V.C. The materials and installation will be as described under Clause 3.23.3. Construction joint should be provided as per clause 3.13.1 with or without water bar / Seal as shown on the drawing. In case of water bars being used at the construction Joint, fixing of the same has to be done carefully so that the water bar is not disturbed during concreting. The construction joint shall also be treated by any one of the following methods.

Method 1 : A surface retarder in the form of a thixotropic gel shall be applied on the joint surface of the previous pour in case of joint on the wall and in case of floor the same shall be applied on the formwork against which previous pour of concreting shall be done. The retarder may be liquid or paste form depending on the type of formwork. The formwork shall be removed within 24 hours after concreting. Within 2 hours of striking of the formwork the retarder shall be washed off with strong water jet to make surface rough and clean. Then a rich cement mortar using cement, sand and aggregates (maximum size 8 mm) along with synthetic rubber emulsion type water resistant bonding agent shall be applied for a depth of 50 mm just before pouring the next stage of concreting in case of walls. The above bonding agent will be mixed with water which will be used for making the cement mortar. The proportion of mixing of this bonding agent with water shall be as per manufacturer's specification. In case of floor joint, however, after washing of retarder a solvent free two component epoxy resin bonding agent will be used at the joint before the next pour of concrete. The above bonding agent shall have the following properties after 28 days:

Compressive strength	- 55 to 60 N /Sq. mm
Flexural Strength	- 25 to 30 N /Sq. mm.
Tensile strength	- 15 N Sq. mm (approx.)
Bonding strength to concrete	- 3 N / Sq. mm (approx.)

Bonding strength to steel - 20 N / Sq. mm (approx.)

The whole operation shall be done as per manufacturer's specification. The LSTK Vendor shall provide manufacturer's supervision at no extra cost to the owner.

Method 2: One row of threaded nozzles at regular intervals not exceeding 1.5 m center to center shall be placed in concrete along the construction joint during casting. Injection of cement water together with a suitable waterproof expanding grouting admixture of approved quality shall be done through the nozzles after the construction joint in walls and slabs. The injection shall be done under pressure of approximately 2 to 4 Kg/Sq cm. The nozzles shall be sealed off with suitable admixture after the injection is over. The whole operation shall be carried out as per manufacturer's specification and supervision. The cost of such manufacturer's supervision shall be borne by the LSTK Vendor.

3.26.3 Waterproofing Admixtures

The waterproofing admixture for concrete and cement mortar / plaster shall conform to relevant IS code. The admixture shall not cause decrease of strength of concrete / plaster at any stage and it is free from chlorides and sulphates. The admixture shall not affect the setting time by more than 5 %.

The maximum permissible dosage of admixture will be 3% (three percent) by weight of cement but a lower dosage will always be preferred.

The product shall be stored in strong moisture proof packings.

However, in case of important structures where M25 or higher grade concrete is specified, and melamine based, high range water resistant concrete admixture is used to provide a waterproof concrete with cement content around 410 Kg/ Cu.m, a melamine based super plasiticizer will be preferable.

a) In concrete: The approved admixture shall be based on modified lignosulphonate like "Plastocrete - N/Super" or approved equivalent. The method of application and other details shall conform to the manufacturer's specification and/or as instructed by the Engineer. The LSTK Vendor shall have the services of the manufacturer's supervisor at no extra cost to the Owner to supervise the work, if desired by the Engineer.

b) In plaster: The concrete surface, to be plastered, shall be hacked to Engineer's satisfaction, cleaned thoroughly and kept wetted for 24 hours. The plaster shall be in cement sand mortar mixed in proportion varying from 1:1 to 1:4 by volume along with the approved waterproofing admixture like "Noleak CP/Sika Latex" or approved equivalent and laid in appropriate thickness and in layers not exceeding 15 mm/layer or as per manufacturer's specification. The additive shall be of quality and type approved by the

Engineer. If desired by the Engineer, the LSTK Vendor shall have the work supervised by the manufacturer's supervisor at no extra cost to the Owner. On completion, the plastered surface shall be cured continuously for a minimum period of 14 days like concrete.

3.26.4 Bituminous or Tar Coating on External Surface

The surface to be waterproofed shall be rendered absolutely dry, clean and dust free. The surface shall be sand papered, cleaned and completely coated with hot coal tar pitch of approved manufacturer and quality as per IS:216 (not heated above 375 Deg.F) using not less than 2 Kg. per Sq.M. or with hot asphalt i.e., bitumen according to IS:73 (not heated above 400 Deg.F) using not less than 1.5 kg. pres. When the first coat has completely dried up and approved by the Engineer, the second coat shall be applied in the same manner using not less than 1.25 Kg. per Sq.M. in case of coal tar and 1 Kg. per Sq.M. in case of asphalt. Immediately after application of the second coat and before it is dried up, sand shall be spread on the surface to cover it completely. Sufficient time shall be allowed after spreading of sand before backfilling is done in order to allow the final coat to dry up completely. In place of hot application by coal tar / asphalt the coating of the outside surfaces of walls may be carried out using a ready to use liquid, bituminous emulsion / rubber protective coating of approved manufacturer.

3.26.5 Protective Coating on Inside Surface

Two coats of cement based two component polymer modified flexible protective and waterproofing slurry having 1 mm thickness for each coat shall be applied on the walls/ floor after proper surface preparation as mentioned above. The slurry shall be applied by brush.

3.26.6 Bitumen Felt : Application for Tanking

This specification shall cover laying the waterproof course on the outside and inside of the walls and bases of structures.

The materials shall conform to IS:1322, and the workmanship to IS:1609. The bitumen felt shall be hessian base and/or fibre base as specified in Drawing/Schedule of Items. If required by the Engineer, tests as specified in relevant IS Codes shall be arranged by the LSTK Vendor without charging any extra to the Owner.

The LSTK Vendor shall execute this work in direct collaboration with one of the well known specialised approved by the Engineer.

Cleaning the surface, keeping it dry, providing necessary corner fillets and cement rendering and cutting chases, etc. shall be included in the rate for this item. If any protective brickwork on/against concrete sub-bases or walls are required, these will be paid extra under suitable items in the contract. A 20 (twenty) years' guarantee for satisfactory performances shall be given by the LSTK Vendor as well as his specialist sub-contractor jointly and severally, for this item of work. Free rectification of any defects noted in the work within this

guarantee period will be carried out by the LSTK Vendor even if it is beyond the specified maintenance period of the contract as a whole.

3.26.7 Polyethylene Films: Application in Walls or base of Structures

Waterproof treatment shall be applied as outlined and as per sequence given hereunder:

i) The concrete surface shall be made smooth with 12 mm cement plaster 1:6

ii) Apply hot bitumen 80/100 grade (ref. IS:73) at the rate of 1.0 Kg/Sq. m minimum

iii) Lay black polyethylene film 250 micron (IS:2508) with cut back bitumen adhesive in overlaps over hot bitumen surface, gently pressed, taking care not to puncture the film.

Alternatively, the overlaps shall be heat sealed by an electric iron having three parallel sealing bars. A long piece of plywood is to be placed below the polyethylene film to be heat sealed. On the plywood a rubber gasket is to be laid to provide a cushion for better welding of the film. On the rubber padding, a cellophane tape is to be spread and on this the LDPE film, with 100 mm overlap, is to be stretched. On the overlapped film another cellophane tape is to be placed to prevent the heat sealer from sticking to the LDPE film. After this, the electric iron is to be pressed on the overlap joint for sufficient time so as to allow perfect welding. The operation is to be repeated for subsequent lengths of joints. After heat sealing, the celophane tape is to be removed and the joints are to be tested for leaks.

iv) Lay 100 gm brown craft paper laminated with a layer of straight run bitumen.

v) Lay hot bitumen 80/100 grade (IS:73) at 1.0 Kg/Sq. m minimum.

vi) Lay 250 micron polyethylene film as second layer similar to (iii) above.

vii) Lay second layer of 100 gm. brown craft paper laminated similar to (iv) above.

viii) Apply hot bitumen (straight run grade) to IS:73 at 1.0 Kg/Sq. m dusted with fine sand.

ix) Protect with a layer of 75 mm plain cement concrete M-100, or a layer of brick laid in cement mortar 1:6. In case of wall apply a 12 mm thick plaster as shown on the drawing or a protective brick wall in 1:6 cement mortar as shown on the drawing.

3.27 Protective coating on Concrete Surface

3.27.1 On Foundation

The outside faces of foundation of important structures will be protected from adverse effect of soil/ underground water, if shown on drawing or instructed by the Engineer, by using rubber / bitumen emulsion protective coating of approved manufacturer.

3.28 Waterproofing by Pressure / Chemical Grouting

Where required, waterproofing for underground concrete structure shall be done by injecting high polymer based non- shrink waterproof grouting compound through nozzle under pressure as per manufacturer's recommendation. The pressure during injection shall not be less than 2.5 kg/Sq.cm and the thickness of epoxy resinous emulsion waterproof paint (to be applied on the external surface of walls/slabs) shall not be less than 700 microns.

4.0 SAMPLING AND TESTING

4.1 General

The LSTK Vendor shall carry out all sampling and testing in accordance with the relevant Indian Standards and as supplemented herein for the following items at his own cost unless otherwise specified in this specification. The LSTK Vendor shall get the specimens tested in a laboratory approved by the Engineer and submit to the Engineer the test results in triplicate within 3 (three) days after completion of the test.

4.2 Cement

Representative samples will be taken from each consignment of cement received from the manufacturer/supplier for carrying out the tests for fineness (by hand sieving), setting time and compressive strengths. Soundness Tests may also be required to be carried out if required by the Engineer. The tests shall be carried out free of charge by the Owner if cement is supplied by him. In case the LSTK Vendor is directed to arrange for the supply of cement as per the terms and conditions of the Contract the tests shall be carried out by him without any expense to the owner. In case due to any circumstances, the agency of supply is changed in the middle of the Contract, the party who bore the original contractual obligation will carry on with the test, free of charge to the other, till the end of the job. No cement from a particular consignment/batch will be used on the works unless satisfactory 3 (three) days and 7 (seven) days test results for compressive strength are known. The Owner, Engineer and LSTK Vendor will jointly associate themselves with the tests irrespective of whether they are carried out by the Owner or the LSTK Vendor. These tests are of great importance as their results will have a bearing on the acceptance of concrete or otherwise as per the terms and conditions of the Contract.

4.3 Aggregates

The LSTK Vendor shall carry out any or all the tests aggregates as may be required by the Engineer in accordance with IS:2386 PARTS-I to VIII. The acceptance criteria of the samples tested shall be in accordance with the requirements of the relevant Indian Standards.

4.4 Water

Sampling and Testing of water being used for concrete works as per IS:3550 will be carried out by the LSTK Vendor at regular intervals and whenever directed by the Engineer. The final acceptance criteria in case of doubt will be as per IS:3025 & IS:456.

4.5 Admixture

4.5.1 Air Entraining Agents (A.E.A)

Initially, before starting to use A.E.A., relationship between the percentage of air entrained and the cube crushing strength vis-a-vis quantity of A.E.A. used for all types of concrete will be established by the LSTK Vendor free of charge by carrying out sufficiently large number of tests. After that, at regular intervals and whenever directed by the Engineer, the LSTK Vendor will check up free of charge, the actual percentages of air entrained and corresponding crushing strengths to correlate with the earlier test results.

4.5.2 Other Admixtures

Tests for establishing the various properties of any other admixtures which may be required to be added shall be carried out by the LSTK Vendor free of charge to the Owner.

4.6 Concrete

The sampling of concrete, making the test specimens, curing and testing procedure etc. shall be in accordance with IS:516 and IS:1199 the size of specimen being 15 cm cubes. Normally, only compression tests shall be performed but under special circumstances the Engineer may require other tests to be performed in accordance with IS:516.

Sampling procedure, frequency of sampling and test specimen shall conform to IS:456.

To control the consistency of concrete from every mixing plant, slump tests and/or compacting factor tests in accordance with IS:1199 and as mentioned in Clause 3.6 of this Specification shall be carried out by the LSTK Vendor every two hours or as directed by the Engineer. Slumps corresponding to the test specimens shall be recorded for reference.

The acceptance criteria of concrete shall be in accordance with the relevant Clause of IS:456.

Concrete work found unsuitable for acceptance shall have to be dismantled and replacement is to be done as per specification by the LSTK Vendor. No payment for the dismantled concrete, the relevant formwork and reinforcement, embedded fixtures, etc. wasted in the dismantled portion shall be made. In the course of dismantling, if any damage is done to the embedded items or adjacent structures, the same shall be made good, free of charge by the LSTK Vendor, to the satisfaction of the Engineer.

5.0 ACCEPTANCE CRITERIA

5.1 Standard Deviation

Standard deviation shall be based on test results and determination of Standard deviation shall conform to IS:456.

5.2 Acceptance Criteria

The strength requirements and acceptance criteria shall conform to Clause 16 of IS:456.

5.3 Inspection and Core Tests

Inspection of concrete work immediately after stripping the formwork and core test of structures shall conform to Clause 17 of IS:456.

5.4 Load Test

Load tests of structural members may be required by the Engineer, when the strength of test specimen results fall below the required strength, as per Clause 17.6 of IS:456. If load testing is decided by the Engineer, the member under consideration shall be subjected to a test load equal to 1.25 (one and a quarter) times the specified live load used for design and this load shall be maintained for a period of 24 (twenty four) hours before removal. The detailed procedure of the test is to be decided by the Engineer. Load tests shall not be made until the structure is at least 56 days old.

If the member shows evident failure, such changes as are necessary to make the structure adequately strong shall be made by the LSTK Vendor free of cost to the Owner. Alternatively, if permitted under Statutory Regulations and at the discretion of the Engineer, the structure under test or a portion thereof may be retained as such without any modification by derating its load bearing capacity, provided the design criteria allows such derating.

A reinforced concrete beam, floor or roof shall be deemed to have passed the test if the maximum deflection at the end of 24 hours does not exceed the deflection given in Clause 17.6 of IS:456.

The entire cost of load testing shall be borne by the LSTK Vendor. If a portion of the structure is found to be unacceptable, it shall be dismantled and replaced by a new structure as per specification. The entire cost of dismantling and replacement and restoration of the site being borne by the LSTK Vendor.

If, in the course of dismantling, any damage is done to the embedded items and or other adjacent structures, the same will be made good, free of charge by the LSTK Vendor to the satisfaction of the Engineer.

6.0 **RATES**

The rate for any item in the schedule, unless specifically excluded in the contract shall be deemed to include the cost of all materials consumed or used in the work or incidental to it as well as labour, tools, plants, equipment, templates, supports, scaffolds, approaches, security and safety measures, power, fuel, lubricants, storage, handling, transport, testing, insurances, taxes, royalties and other revenue expenses, accommodation, services, supervision, overheads, profits etc. The various items of work which are to be provided are mentioned under Clause 2.1 and elsewhere in this specification. If no separate item is provided for any such work in the schedule of items, it is implied that the LSTK Vendor shall not claim for any of the connected items of the schedule viz., detailed drawings and drawing of formwork in the item of formwork or concrete etc.

7.0 METHOD OF MEASUREMENT

7.1 Concrete

a) Actual volume of work as executed or as per drawings issued, whichever is less, shall be measured in Cu.m. Deductions for openings, conduits, pipes, ducts, pockets, chases etc. shall be made, provided they are larger than 0.1 Sq.m. in area each.

No deduction shall be made for embedded fixtures including reinforcements, sleeves, anchor bolts and similar items.

b) Precast concrete work shall be measured in the same way as specified in foregoing paragraph. No separate payment shall be made for formwork. Lifting hook where required in the design, shall be treated as reinforcement steel and paid accordingly. Payment shall be due only after detection, grouting and curing of the precast units in proper position unless otherwise provided for in the contract. All breakages and damages of the precast units will be to the LSTK Vendor's account and shall be replaced free of charge in the Owner.

7.2 Admixture

Admixture will be measured on the basis of theoretical requirement or actual consumption, whichever is less.

7.3 Reinforcement

a) Bar or any other type of reinforcement used like hard drawn steel wire fabric etc. for reinforced concrete shall be measured by weight in Tonnes. The weight will be arrived at by multiplying the actual or theoretical length, whichever is less, by the sectional weights. In case the Owner issues the reinforcing steel, the sectional weight will be the same as were applied at the time of issue. In case the steel is to be supplied by

the LSTK Vendor, the sectional weight to be adopted will be the I.S. Sectional Weight or as per actuals which will be arrived at by accurately measuring representative samples as directed by the Engineer, whichever is less.

b) Standard hooks, cranks, bends, authorised laps etc. shall be measured.

c) Lap welding or butt welding if permitted will be measured diameterwise per joint. The actual length of steel in lap will be measured separately in case of lap welding. The rate quoted for the smaller size bar will be applied in case of joint between two bars of different diameters.

d) Separator pieces between two or more layers of steel shall be measured.

e) No payment shall be made for binding wires, spacer block, supports, chairs, hangers, etc. of height 300 mm and less, required for keeping the steel in position unless otherwise specified in the contract. For supporting horizontal reinforcement at heights larger than 300 mm support drawings will be prepared by the LSTK Vendor and payment will be made for the supports as approved by the Engineer, or as actually placed, whichever is less, at the same rate as for reinforcement.

f) No extra will be paid for modification of already embedded reinforcement, if required due to faulty fabrication or placement.

g) Dowels neither shown on the drawings nor instructed by the Engineer, but required for construction facilities and/or sequence, shall not be measured.

7.4 Formwork

a) Formwork shall be measured as the actual surface in contact with the concrete and paid in Sq.m. unless included in the rate for concrete.

b) Formwork shall not be measured separately for precast concrete work, which shall be included in the concrete rates.

c) No payment for formwork or any other requirements in construction joints shall be made.

d) Openings up to 0.1 Sq.m. shall be neglected as if non-existent for the purpose of formwork measurement.

e) No extra measurement or payment shall be made for making the formwork waterproof or for supports, scaffolding, centering, approaches, etc.

f) No measurement shall be taken for the formwork in pockets, openings, chases etc. in concrete if the cross-sectional area is less than or equal to 0.1 Sq.m. in each set. If the cross-sectional area of any opening exceeds 0.1.Sq.m. then the formwork shall be measured under appropriate classification.

g) Fixing and removing pockets and openings of sectional area less than 0.1 Sq.m. shall be measured on number basis and paid separately.

7.5 Anchor Bolts, Sleeves, Inserts, Hangers, Conduit Pipes and Other Miscellaneous Embedded Fixtures

a) There will be measured on theoretical weight basis of the complete insert handled by the LSTK Vendor irrespective of the amount of insertion. Where theoretical weight cannot be assessed satisfactorily, the actual weight shall be allowed under certification of the Engineer.

b) No extra shall to be paid for templates and other arrangements required to secure there in position. The protection of these materials with proper anticorrosive paints/grease and covering with gunny bags against any damages till the structure is handed over, shall be the responsibility of the LSTK Vendor at no extra cost.

c) Any 'boxing' left for inserts etc. during construction, for facility of the LSTK Vendor's work, and later on filled in by the same LSTK Vendor after placing the insert shall be considered for measurement purpose as if the inserts, etc., were placed before concreting.

d) No extra payment shall be made for cleaning of the inserts, etc. required for bond with the concrete.

7.6 Expansion and Isolation Joints

a) Expansion and isolation joints will be measured and paid on area basis. The drawings and or schedule of items will describe the thickness, painting, filling material, sealing strips, metal fixtures, inserts, etc. to be used in the joint.

b) Formwork for the 'leading side' of the joint will be measured and paid under the relevant item. No payment for the formwork for the 'following side' will be made even if the LSTK Vendor is required to use formwork for constructional facilities.

c) Joints sealing strips made out of Copper, Aluminium or G.I. or P.V.C. or rubber will be measured and paid on area basis under relevant items. Rubber pads below foundation will be measured on area basis under the relevant item.

d) Any other fixtures and inserts like dowels, installed as per drawing, riding plates etc. will be measured and paid if under the respective items of the Schedule of Items.

e) All other work like installing Bitumen coating, Bitumen boards. Expanded Polystyrene Boards, Alkathene sheets, Bitumen filler etc. and trimming the top, repairs, finishes and other connected item will be deemed to be included in the unit rate for Expansion / Isolation Joints.

7.7 Joint Seals : G.I. Copper, Aluminium, Rubber or P.V.C.

All seals, whether used at water bars or in Expansion or Isolation joints shall be measured as joint seals and on area basis. In case of Metallic seals like G.I., Copper or Aluminium the developed area will be measured. In case of Rubber and P.V.C. seals also, developed area will be measured but the central bulb, corrugation ribs etc. will be neglected. In all cases laps will not be measured.

7.8 Rubber Pad

Rubber pads will be measured on area basis. The theoretical or actual area, whichever is less will be recorded.

7.9 Grouting under Base Plates etc.

Grouting shall be measured on theoretical volume basis neglecting the volume of embedded items. The cost shall include the cost of hacking the old concrete plus necessary formwork if any Edges of the grouting shall be measured square even if chamfered. Necessary curing shall also be included Admixtures, if added, will be measured and paid separately under the relevant items.

7.10 Waterproof Plaster

The measurement will be on finished square area basis. The thickness, method of applications, waterproofing additive to be used etc. will be specified in the specification/drawings/schedule of items.

The waterproofing additive will be measured and paid separately under admixtures (Clause 7.2). No deduction will be made for opening less than 0.1 Sq.m. in area each.

7.11 Bitumen Coating / Tar Coating / Bituminous or Rubber Protective Coating

These shall be measured on net useful area, neglecting openings up to 0.1 Sq.m. in area each.

7.12 Bitumen Felt

Bitumen felt waterproofing shall be measured net on area of structure covered, neglecting openings up to 0.1. Sq.m. in area each, measuring only once for the completed work and not once for each layer.

7.13 Polyethylene Film

Polyethylene Film waterproofing shall be measured net on area of structure covered, neglecting openings up to 0.1 Sq.m. in area each measuring only once for the completed work and not once for each layer.

7.14 Tests

a) Tests on concrete specimens shall be paid according to number of specimens tested. The specimen shall be either in the form of 15 cm

cubes or 15 cm dia., 30 cm long cylinders. No separate measurement shall be made for volume of concrete used in the specimen or for the mound.

b) No payment shall be made for tests carried out for approval of samples of different materials in accordance with the specification.

c) Load Test, if required to be made as per terms and conditions of the contract shall not be paid.

8.0 LIST OF I.S. CODES AND STANDARDS FOR REFERENCE

All work under this specification shall, unless specified otherwise, conform to the latest revisions and/or replacements of the following or any other Indian Standard Specifications and Codes of Practice. In case any particular aspect of work is not specifically covered by Indian Standard Specifications, any other standard practice, as may be specified by the Engineer, shall be followed :-

IS : 73 - Indian Standard Specification for Paving Bitumen

IS : 216 - Indian Standard Specification for Coal Tar Pitch

IS : 269 - Indian Standard Specification for 33 grade Ordinary Portland Cement

IS : 383 - Indian Standard Specification for Coarse and Fine Aggregates from Natural Sources for Concrete

IS : 432 - Indian Standard Specification for Mild Steel and Medium Tensile Steel Bars and Hard Drawn Steel Wire for concrete Reinforcement - Part 1 & 2

IS : 455 - Indian Standard Specification for Portland Slag Cement

IS : 456 - Indian Standard Code of Practice for Plain and Reinforced Concrete

IS : 457 - Indian Standard Code of Practice for General Construction of Plain and Reinforced Concrete for Dams and other Massive Structures

IS : 516 - Indian Standard Specification for Methods of Test for Strength of Concrete

IS : 737 - Indian standard specification for Wrought Aluminium and Aluminium Alloy sheet and strip for general Engineering purpose.

IS : 1199 - Indian Standard Specification for Methods of Sampling and Analysis of Concrete

IS : 1200 - (Part-II) : Indian Standard Specification for Method of Measurement Cement Concrete Works.

IS : 1200 - (Part-V) : Indian Standard Specification for Method of Measurement of Formwork

IS : 1322 - Indian Standard Specification for Bitumen Felts for Waterproofing and Damp-proofing

IS : 1489 - Indian Standard Specification for Portland - Pozzolana Cement - Part 1 & 2

IS : 1566 - Indian Standard Specification for hard drawn steel wire fabric for concrete reinforcement.

IS : 1609 - Code of Practice for Laying Damp-proofing Treatment using Bitumen Felts

IS : 1786 - Indian Standard Specification for high strength deformed steel Bars & Wires for Concrete Reinforcement

IS : 1791 - Indian Standard Specification for Batch Type Concrete Mixers

IS : 1834 - Indian standard specification for hot applied sealing compounds for joints in concrete.

IS : 1838 - Indian Standard Specification for preformed fillers for expansion joint in pavements and structures (non extruding and resilient type) - Part - 1 & 2

IS : 2062 - Steel for general structural purposes-specification.

IS : 2185 - Indian Standard Specification for Hollow and solid/solid light wt. Cement Concrete Blocks - Part - 1 & 2

IS : 2210 - Indian Standard Specification for Design of Reinforced Concrete Shell Structures and Folded Plates

IS : 2386 - Indian Standard Specification for Methods of Test for Aggregates for Concrete - Part-I to VIII

IS : 2430 - Indian standard specification for method for sampling of Aggregates for concrete.

IS : 2502 - Indian Standard Code of Practice for Bending and Fixing of Bars for Concrete Reinforcement

IS : 2505 - Indian Standard Specification for Concrete Vibrators - Immersion Type – General Requirements

IS : 2506 - Indian Standard Specification for Screed Board Concrete Vibrators

IS : 2508 - Specification for low density Polyethylene films

IS : 2514 - Indian Standard Specification for Concrete Vibrating Tables

IS : 2645 - Integral water proofing compounds for cement mortar and concrete

IS : 2722 - Indian Standard Specification for Portable Swing Weigh Batchers for Concrete (Single and Double Bucket type)

IS : 2751 - Code of Practice for Welding of Mild Steel Plain and Deformed Bars used for Reinforced Concrete Construction

IS : 2770 - Indian Standard Specification for Method of Testing Bond in Reinforced Concrete. Part - 1 : Pull out Test

IS : 3025 - Indian Standard Specification for Methods of Sampling and Test (Physical and Chemical) for Water & waste water - Part - 1 to 57

IS : 3201 - Indian Standard Specification of Criteria for Design and Construction of Precast Trusses and Purlins.

IS : 3370 - Indian Standard Specification for Code of Practice for Concrete Structures for Storage of Liquids Part 1 to 4

IS : 3384 - Indian standard specification for Bitumen primer for use in waterproofing and Damp proofing

IS : 3414 - Code of practice for Design and Installation of joints in Buildings

IS : 3550 - Indian Standard Specification for Methods of Test for Routine Control for Water used in Industry

IS : 3558 - Code of Practice for use of Immersion Vibrators for Consolidating Concrete

IS : 3696 - Safety Code for Part-1 : Scaffolds and Part-2 : Ladders

IS : 3812 - Indian Standard Specification for Fly Ash for use as Pozzolana& Admixture

IS : 4031 - Indian Standard Specification for Method of Physical Tests for Hydraulic Cement - Part - 1 to 15

IS : 4082 - Indian Standard Specification for Recommendation on Stacking and Storage of Construction Materials and Components at site

IS : 4090 - Indian Standard Specification for Design of Reinforced Concrete Arches

IS : 4634 - Indian Standard Specification for Methods for Testing Performance of Batch-type Concrete Mixers

IS : 4656 - Indian Standard Specification for Form Vibrators for Concrete

IS : 4925 - Indian Standard Specification for Concrete Batching and Mixing Plant

IS : 4926 - Indian Standard Specification for Ready Mixed Concrete

IS : 4990 - Indian Standard Specification for Plywood for Concrete Shuttering work

IS : 4991 - Indian Standard Specification for Blast Resistant Design of Structure for Explosions above ground

IS : 4995 - (Part-I & II) : Indian Standard Specification for Design of Reinforced Concrete Bins for Storage of Granular and Powdery Materials

IS : 4998 - (Part - I) : Indian Standard Specification for Design of Reinforced Concrete Chimneys

IS : 5512 - Indian Standard Specification for Flow Table for use in Tests of Hydraulic Cements and Pozzolanic Materials

IS : 5513 - Indian Standard Specification for Vicat Apparatus

IS : 5515 - Indian Standard Specification for Compaction Factor Apparatus

IS : 5751 - Indian Standard Specification for Precast Concrete Coping Blocks

IS : 5816 - Indian Standard Specification for Method of Test for Splitting Tensile Strength of Concrete

IS : 5891 - Indian Standard Specification for Hand Operated Concrete Mixer

IS : 6452 - Indian Standard Specification for High Alumina Cement for Structural Use

IS : 6909 - Indian Standard Specification for Supersulphated Cement

IS : 6923 - Indian Standard Specification for Methods of Test for performance of Screed Board Concrete Vibrators

IS : 6925 - Indian Standard Specification for Methods of Test for Determination of Water Soluble Chlorides in Concrete Admixtures

IS : 7242 - Indian Standard Specification for Concrete Spreaders

IS : 7246 - Indian Standard Specification for Recommendations for use of Table Vibrators for Consolidating Concrete

IS : 7251 - Indian Standard Specification for Concrete Finishers

IS : 7320 - Indian Standard Specification for Concrete Slump Test Apparatus

IS : 7861 - (Part-I & II) : Indian Standard Specification for Recommended Practice for hot and cold Weather Concreting

IS : 7969 - Safety Code for Handling and Storage of Building Materials

IS : 8041 - Indian Standard Specification for Rapid Hardening Portland cement

IS : 8043 - Indian standard specification for hydrophobic portland cement

IS : 8112 - Indian Standard Specification for 43 grade Ordinary Portland Cement

IS : 8142 - Indian Standard Specification for Determining Setting time of Concrete by Penetration Resistance

IS : 8989 - Safety Code for Erection of Concrete Framed Structures

IS : 9013 - Indian Standard Specification for Method of Making, Curing and Determining Compressive Strength of Accelerated cured Concrete Test Specimens

IS : 9077 - Code of Practice for Corrosion Protection of Steel Reinforcement in RB and RCC Construction

IS : 9103 - Indian Standard Specification for Admixtures for Concrete.

IS : 9417 - Recommendations for welding cold worked bars for reinforced concrete construction

IS : 10262 - Recommended Guidelines for concrete Mix Design

IS : 12269 - Indian standard specification for 53 grade ordinary portland cement

IS : 12330 - Indian standard specification for sulphate resisting portland cement

IS : 12600 - Indian standard specification for low heat portland cement

SUB-SECTION NO. C3

TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEELWORK

TECHNICAL SPECIFICATION
FOR
FABRICATION OF STRUCTURAL STEELWORK

CONTENTS

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TECHNICAL SPECIFICATION FOR FABRICATION OF STRUCTURAL STEELWORK

1.0.0 SCOPE

This specification covers supply of all raw steel materials, fabrication, testing, painting and delivery to site of structural steelwork including supply of all consumable stores and bolts, nuts, washers, electrodes and other materials required for fabrication and field connections of all structural steelwork in general covered under the scope of the contract. However, for any special structures such as rail & road bridges, steel chimney, tanks, transmission towers, furnace structures, etc., the relevant Indian Standard or IRC specification and Codes of Practices shall be given due consideration over & above this specification.

2.0.0 GENERAL

2.1.0 Work to be provided for by the LSTK Vendor

The work to be provided for by the LSTK Vendor, unless otherwise specified elsewhere in the contract, shall include, but not be limited to the following:-

a) Preparation of complete detailed fabrication drawings and erection marking drawings required for all the structures covered under the scope of the contract based on LSTK Vendor's design drawings approved by the Owner / Consultants.

b) To submit revised design with calculations and detailed fabrication drawings in case any substitution of the designed sections are to be made.

c) To submit design calculations for joints and connections developed by the LSTK Vendor along with detailed fabrication drawings.

d) Furnish all materials, labour, tools and plant and all consumables required for fabrication and supply, all necessary bolts, nuts, washers, tie rods and welding electrodes for field connections. The field connection materials supplied by the LSTK Vendor shall be in adequate quantity to avoid delay in erection.

e) Furnish shop painting of all fabricated steelwork as per requirements of this Specification.

f) Suitably mark, bundle and pack for transport all fabricated materials.

g) Prepare and furnish detailed Bill of Materials, Drawing Office Despatch lists, Bolt List and any other list of bought out items required in connection with the fabrication and erection of the structural steelwork.

h) Insure, load and transport all fabricated steelwork field connection materials to site.

2.2.0 Work by others

No work under this specification will be provided for by any agency other than the LSTK Vendor, unless specifically mentioned otherwise elsewhere in the contract.

2.3.0 Codes and standards

All work under this specification shall, unless otherwise specified in the contract, conform to the requirements of the latest revision and/or replacements of the following or any other relevant Indian Standard specifications and codes of practice. In case any particular aspect of the work is not specifically covered by any Indian Standard Specification, any other standard practice, as may be specified by the Engineer shall be followed:-

LIST OF RELEVANT TO FABRICATION OF STRUCTUTAL STEEL WORK

I.S. CODES

IS : 800 - Code of practice for general construction in steel.

IS : 801 - Code of practice for use of cold formed light gauge steel structural members in general building construction.

IS : 806 - Code of practice for use of steel tubes in general building construction.

IS : 808 - Dimensions for rolled steel beams, channels and angle sections.

IS : 812 - Glossary of terms relating to welding & cutting of metals.

IS : 813 - Scheme of symbols for welding.

IS : 814 - Covered electrodes for metal arc welding of carbon and carbon manganese steel.

IS : 816 - Code of practice for use of metal arc welding for general construction in mild steel.

IS : 817 - Code of practice for training & testing metal arc welders.

IS : 818 - Code of practice for safety and health requirements in electric and gas welding and cutting operations.

IS : 819 - Code of practice for resistance spot welding for light assemblies in mild steel.

IS : 822 - Code of practice for inspection of welds.

IS : 919 - (Part - 1&2)	Recommendations for limits and fits for engineering.
IS : 1161 -	Steel Tubes for structural purposes.
IS : 1182 -	Recommended practice for Radiographic Examination of fushion welded butt joints in steel plates.
IS : 1200 - (Part - 8)	Method of measurement of steel work and iron work.
IS : 1239 - (Part - 1&2)	Mild steel tubes, tubulars and other wrought steel fittings.
IS : 1363 - (Part - 1 to 3)	Hexagon head bolts, screws and nuts of product grade C.
IS : 1364 - (Part - 1 to 5)	Hexagon head bolts, screws & nuts of product grade A & B.
IS : 1365 -	Slotted counter sunk head screws (dia. 1.6 to 20 mm).
IS : 1367 - (Part - 1 to 18)	Technical supply conditions for threaded steel fasteners.
IS : 1608 -	Method for tensile testing of steel products.
IS : 1730 -	Dimensions for steel plate, sheet and strip for structural and general engineering purposes.
IS : 1852 -	Rolling and cutting tolerances for hot-rolled steel product.
IS : 2016 -	Plain washer.
IS : 2062 -	Steel for general structural purposes.
IS : 2629 -	Recommended practice for hot-dip galvanizing of iron and steel.
IS : 2633 -	Method for testing uniformity of coating on zinc coated articles.
IS : 3644 -	Code of practice for ultrasonic pulse echo testing by contact and immersion method.
IS : 3757 -	High Strength Structural Bolt.
IS : 4000 -	High strength bolts in steel structure.
IS : 4759 -	Specifications for hot-dip zinc coatings on structural steel and other allied products.

IS : 4923 - Hollow steel sections for structural use.

IS : 5334 - Code of practice for magnetic particle flaw detection of weld.

IS : 5369 - General requirements for plain washers and lock washer.

IS : 6005 - Code of practice for phosphating of iron and steel.

IS : 6649 - Specification for hardened and tempered washers for high strength structural bolts and nuts.

IS : 6623 - Specification for high strength structural nuts.

IS : 7215 - Tolerances for fabrication of steel structures.

IS : 7280 - Bare wire electrode for submerged arc welding.

IS : 8629 - Code of practice for protection of iron and steel structures from atmospheric corrosion. (Part - I to III)

IS : 9595 - Recommendation for metal arc welding of carbon manganese steels.

PAINTING

IS : 1477 - Code of practice for painting of ferrous metal in building. (Part - I & II)

IS : 2074 - Ready mixed paint, air-drying red-oxide zinc chrome priming.

IS : 2339 - Specification for aluminium paints for general purposes in dual container.

IS : 2932 - Specification for enamel, synthetic exterior type - I.

IS : 2933 - Specification for enamel, synthetic exterior type - II.

IS : 13607 - Ready Mixed Paint, Finishing, General Purposes, Synthetic

2.4.0 Conformity with Design

The LSTK Vendor shall design all connections, supply and fabricate all steelwork and furnish all connection materials in accordance with the approved drawings and/or as instructed by the Engineer keeping in view the maximum utilization of the available sizes and sections of steel materials. The methods of painting, marking, packing and delivery of all fabricated materials shall be in accordance with the provisions of the contract and/or as approved by the Engineer. Provision of all relevant Indian Standard Specifications and Codes of Practice shall be followed unless otherwise specified in the contract.

2.5.0 Materials to be used

2.5.1 General

All steel materials shall be free from all imperfections, mill scales, slag intrusions, laminations, pitting, rusts etc. that may impair their strength, durability and appearance. All materials shall be of tested quality only unless otherwise permitted by the Engineer and/or Consultant. If desired by the Engineer, Test Certificates of materials supplied by the LSTK Vendor in respect of each consignment shall be submitted in triplicate. Whenever the materials are required to be used from unidentified stocks, if permitted by the Engineer, a random sample shall be tested at an approved laboratory from each lot of 50 tonnes or less of any particular section.

The arc welding electrodes shall conform to the relevant Indian Standard Codes of Practice and Specifications and shall be of heavily coated type and the thickness of the coating shall be uniform and concentric. With each container of electrodes, the manufacturer shall furnish instructions giving recommended voltage and amperage (Polarity in case of D.C. supply) for which the electrodes are suitable.

2.5.2 Steel

All steel materials to be used in construction within the purview of this specification shall comply with any of the following Indian Standard Specifications as may be applicable: -

1) IS : 801 - Cold formed light gauge steel structural member.

2) IS : 806 -Steel tubes in general building construction.

3) IS : 1161 - Steel tubes for structural purpose.

5) IS : 2062 - Steel for general structural purpose.

In case of imported steel materials being used, these shall conform to specifications equivalent to any of the above as may be applicable.

2.5.3 Electrodes

All electrodes to be used under the Contract shall comply with any of the following Indian Standard Specifications as may be applicable: -

1) IS : 814 - Covered electrodes for metal arc welding structural steel

3) IS : 7280 - Base wire electrode for submerged arc welding.

2.5.4 Bolts and Nuts

All bolts and nuts shall conform to the requirements of Indian Standard Specification IS:1367 - Technical Supply Conditions for Threaded Fasteners.

Materials for Bolts and nuts under the purview of this contract shall comply with any of the following Indian Standard Specifications as may be applicable.

a) Mild Steel : All mild steel for bolts and nuts when tested in accordance with the following Indian Standard Specification shall have a tensile strength of not less than 44 Kg/mm2 and a minimum elongation of 23 per cent on a gauge length of 5.6 /A, where 'A' is the cross sectional area of the test specimen : -

1) IS:1367 - Technical supply conditions for threaded fasteners.

2) IS:1608 - Method for tensile testing of steel other than sheet, strip, wire and tube.

b) High Tensile Steel : The material used for the manufacture of high tensile steel bolts and nuts shall have the mechanical properties appropriate to the particular class of steel as set out in IS:1367 or as approved by the Engineer.

2.5.5 Washers

Washers shall be made of steel conforming to any of the following Indian Standard Specifications as may be applicable under the provisions of the Contract: -

2) IS : 2062 - Steel for general structural purpose

4) IS : 6623 - High Strength Structural Nuts

5) IS : 6649 - Hardened and tampered washers for high strength structural bolts & nuts.

2.5.6 Paints

Paints to be used for shop coat of fabricated steel under the perview of this contract shall conform to the Indian Standard Specification IS:2074 - Ready mixed Paint, Air Drying, Red Oxide - Zinc Chromate Priming.

In highly corrosive environment other type of primer such as epoxy rasin based zinc rich primer (such as blast steel EZ1 of Shalimar Paints Ltd., or equivalent) may be necessary.

2.6.0 Storage of Material

2.6.1 General

All materials shall be so stored as to prevent deterioration and to ensure the preservation of their quality and fitness for the work. Any material which has deteriorated or has been damaged shall be removed from the LSTK Vendor's yard immediately, failing which, the Engineer shall be at liberty to get the material removed and the cost incurred thereof shall be realised from the LSTK Vendor. The LSTK Vendor shall maintain up to date accounts in respect of receipt, use and balance of all sizes and sections of steel and other materials. In case the fabrication is carried out in LSTK Vendor's fabrication shop outside the plant site where other fabrication works are also carried out, all materials meant for use in this contract shall be stacked separately with easily identifiable marks.

2.6.2 Steel

The steel to be used in fabrication and the resulting cut-pieces shall be stored in separate stacks off the ground sectionwise and lengthwise so that they can be easily inspected, measured and accounted for at any time. If required by the Engineer, the materials may have to be stored under cover and suitably painted for protection against weather.

2.6.3 Electrodes

The electrodes for electric are welding shall be stored in properly designed racks, separating different types of electrodes in distinctly marked compartments. The electrodes shall be kept in a dry and warm condition if necessary by resorting to heating.

2.6.4 Bolts, Nuts and Washers

Bolts, nuts and washers and other fastening materials shall be stored on racks off the ground with a coating of suitable protective oil. These shall be stored in separate gunny bags or compartments according to diameter, length and quality.

2.6.5 Paints

Paints shall be stored under cover in air tight containers. Paints supplied in sealed containers shall be used up as soon as possible once the container is opened.

2.7.0 Quality Control

The LSTK Vendor shall establish and maintain quality control procedures for different items of work and materials to the extent he deems necessary to ensure that all work is performed in accordance with this specification. In addition to the LSTK Vendor's quality control procedures, materials and workmanship at all times shall be subjected to inspection by the Engineer or Engineer's representative. As far as possible, all inspection by the Engineer or Engineer's representative shall be made at the LSTK Vendor's fabrication shop whether located at Site or elsewhere. The LSTK Vendor shall co-operate with the

Engineer or Engineer's representative in permitting access for inspection to all places where work is being done and in providing free of cost all necessary help in respect of tools and plants, instrument, labour and materials required to carry out the inspection. The inspection shall be so scheduled as to provide the minimum interruption to the work of the LSTK Vendor.

Materials or workmanship not in reasonable conformance with the provisions of this Specification may be rejected at any time during the progress of the work.

The quality control procedure shall cover but not be limited to the following items of work : -

1) Steel	:	Quality, manufacturer's test certificates, test reports of representative samples of materials from unidentified stocks if permitted to be used.
2) Bolts, Nuts&	:	Manufacturer's certificate, dimension checks, Washers material testing.
3) Electrodes	:	Manufacturer's certificate, thickness and quality of flux coating.
4) Welders	:	Qualifying Tests
5) Welding sets	:	Performance Tests
6) Welds	:	Inspection, X-ray, Ultrasonic tests
7) Paints	:	Manufacturer's certificate, physical inspection reports
8) Galvanizing	:	Tests in accordance with IS:2633 - Method for testing uniformity of coating on Zinc Coated Articles and IS:4759 - Specification for Hot-Dip Zinc coatings on Structural Steel and other allied products.

2.8.0 Standard dimensions, forms and weights

The dimensions, forms, weights and tolerances of all rolled shapes bolts, nuts, studs, washers etc. and other members used in the fabrication of any structure shall, wherever applicable, conform to the requirements of the latest relevant Indian Standards, wherever they exist, or, in the absence of Indian Standards, to other equivalent standards.

2.9.0 Shop Drawings

The LSTK Vendor shall submit to the Engineer the Schedule of Fabrication and delivery of structural steelwork for approval. He shall start to submit progressively for approval the shop drawings based on the approved Design Drawings and before proceeding with the fabrication work, shall get the said shop drawings approved in accordance with the contract.

The sequence of submission of shop drawings for approval shall match with the approved fabrication and delivery schedule. The approval for the shop drawings will be accorded only towards the general conformity with the design requirements as well as specification and will ensure the correctness of general arrangement for centreline dimensions and levels, Section sizes, and adequacy of connections including splice joints as to the no. of bolts, weld length, size of gusset/end plates.

The correctness of all other details like cutting lengths, matching of holes, notch dimensions, match markings, bill of materials, bolt list etc. will be entirely the LSTK Vendor's responsibility. The approval of the drawing however shall not relieve the LSTK Vendor of his sole responsibility in carrying out the work correctly and fulfilling the complete requirements of contract documents.

The shop drawings shall include but not be limited to the following: -

a) Assembly drawings giving exact sizes of the sections to be used and identification marks of the various sections.

b) Dimensional drawings of base plates, foundation bolt location etc.

c) Details of all connections with supporting calculations.

d) Comparison sheets to show that the proposed alternative section, if any, is as strong as the original sections shown on the Design Drawings.

e) Complete Bill of Materials and detailed drawings of all sections as also their billing weights.

f) Any other drawings or calculations that may be required for the clarification of the works or substituted parts thereof.

The shop drawings shall give all the necessary information for the fabrication, erection and painting of the steelwork in accordance with the provisions of this Specification. Shop drawings shall be made in accordance with the best modern practice and with due regard to sequence, speed and economy in fabrication and erection. Shop drawings shall give complete information necessary for fabrication of various components of the steelwork, including the location, type, size and extent of welds. These shall also clearly distinguish between shop and field bolts and welds and specify the class of bolts and nuts. The drawings shall be drawn to a scale large enough to convey all the necessary information adequately. Notes on the shop drawings shall indicate those joints or groups of joints in which it is particularly important that the welding sequence and technique of welding shall be carefully controlled to minimize the locked -up stresses and distortion.

Welding symbols used shall be in accordance with the requirements of the Indian Standard Specification --IS:813 - Scheme of symbols for Welding, and shall be consistent throughout. Weld lengths called for on the drawings shall mean the net effective length.

The LSTK Vendor shall be responsible for and shall pay for any alterations of the work due to any discrepancies, errors or omissions on the drawings or other particulars supplied by him, whether such drawings or other particulars have been duly approved or not in accordance with the Contract.

3.0.0 WORKMANSHIP

3.1.0 Fabrication

3.1.1 General

All workmanship shall be equal to the best practice in modern structural shops, and shall conform to the provisions of the Indian Standard IS:800 - Code of Practice for use of Structural Steel in General Building Construction and other relevant Indian Standards or equivalent.

3.1.2 Straightening Material

Rolled materials before being laid off or worked, must be clean, free from sharp kinks, bends or twists and straight within the tolerances allowed by the Indian Standard Specification IS:1852 - Specification for rolling and cutting tolerance for hot-rolled steel products. If straightening is necessary, it may be done by mechanical means or by the application of a limited amount of localized heat. The temperature of heated areas, as measured by approved methods, shall not exceed 600 Deg. C.

3.1.3 Cutting

Cutting shall be effected by shearing, cropping or sawing. Use of a mechanically controlled gas cutting torch may be permitted for mild steel only. Gas cutting of high tensile steel may also be permitted provided special care is taken to leave sufficient metal to be removed by machining, so that all metal that has been hardened by flame is removed. Gas cutting without a mechanically controlled torch may be permitted if special care is taken and done under expert hand, subject to the approval of the Engineer.

To determine the effective size of members cut by gas, 3 mm shall be deducted from each cut edge. Gas cut edges, which will be subjected to substantial stress or which are to have weld metal deposited on them, shall be reasonably free from gouges. Occasional notches or gauges not more than 4 mm deep will be permitted. Gouges greater than 4 mm, that remain from cutting, shall be removed by grinding. All re-entrant corners shall be shaped notch-free to a radius of at least 12 mm. Shearing, cropping and gas cutting shall be clean, reasonably square and free from any distortion.

3.1.4 Planning of edges

Planning or finishing of sheared or cropped edges of plates or shapes or of edges gas-cut with a mechanically controlled torch shall not be required, unless specifically required by design and called for on the drawings, included in a stipulation for edge preparation for welding or as may be required after the

inspection of the cut surface. Surface cut with hand-flame shall generally be ground, unless specifically instructed otherwise by the Engineer.

3.1.5 Clearances

The erection clearance for cleated ends of members connecting steel to steel shall preferably be not greater than 2 mm at each end. The erection clearance at ends of beams without web cleats shall be not more than 3 mm at each end, but where, for practical reasons, greater clearance is necessary, suitably designed cleatings shall be provided.

3.2.0 Bolted construction

3.2.1 Holes

Holes through more than one thickness of material for members, such as compound stanchions and girder flanges, shall be drilled after the members are assembled and tightly clamped or bolted together. Punching may be permitted before assembly, if the thickness of the material is not greater than the nominal diameter of bolt plus 3 mm subject to a maximum thickness of 16 mm provided that the holes are punched 3 mm less in diameter than the required size and reamed after assembly to the full diameter.

Holes for rivets or black bolts shall be not more than 1.5 mm or 2.0 mm (depending on whether the diameter of the bolt is less or more than or equal to 25 mm) larger in diameter than the nominal diameter of the black bolt passing through them.

Holes for turned and fitted bolts shall be drilled to a diameter equal to the nominal diameter of the shank or barrel subject to a tolerance grade of H8 as specified in IS:919. Parts to be connected shall be firmly held together by tacking welds or clamps and the holes drilled through all the thicknesses in one operation and subsequently reamed to size. Holes not drilled through all thickness in one operation shall be drilled to a smaller size and reamed out after assembly.

Holes for bolts shall not be formed by gas cutting process.

3.2.2 Assembly

Drifting to enlarge unmatching holes shall not generally be permitted. In case drifting is permitted to a slight extent during assembly, it shall not distort the metal or enlarge the holes. Holes that must be enlarged to admit the bolts shall be reamed. Poor matching of holes shall be cause for rejection. The component parts shall be so assembled that they are neither twisted nor otherwise damaged, and shall be so prepared that the specified cambers, if any, are maintained.

Bolted construction shall be permitted only in case of field connections if called for on the Drawings and is subjected to the limitation of particular connections as may be specified. In special cases, however, shop bolt connections may be allowed if directed by the Engineer.

Washers shall be tapered or otherwise suitably shaped, where necessary, to give the heads and nuts of bolts a satisfactory bearing. The threaded portion of each bolt shall project out through the nut at least one thread. In all cases the bolt shall be provided with a washer of sufficient thickness under the nut to avoid any threaded portion of the bolt being within the thickness of the parts bolted together. In addition to the normal washer, one spring washer or lock-nut shall be provided for each bolt for connections subjected to vibrating forces or otherwise as may be specified on the Drawings.

3.3.0 Welded Construction

3.3.1 General

Welding shall be in accordance with relevant Indian Standards and as supplemented in the Specification. Welding shall be done by experienced and good welders who have been qualified by tests in accordance with IS:817.

3.3.2 Preparation of Material

Surface to be welded shall be free from loose scale, slag, rust, grease, paint and any other foreign material except that mill scale, which withstands vigorous wire brushing, may remain. Joint surfaces shall be free from fins and tears. Preparation of edges by gas-cutting shall, wherever practicable, be done by a mechanically guided torch.

3.3.3 Assembling

Parts to be fillet welded shall be brought in as close contact as practicable and in no event shall be separated by more than 4 mm. If the separation is 1.5 mm or greater, the size of the fillet welds shall be increased by the amount of the separation. The fit of joints at contact surfaces, which are not completely sealed by, welds, shall be close enough to exclude water after painting. Abutting parts to be butt-welded shall be carefully aligned. Misalignments greater than 3 mm shall be corrected and in making the correction the parts shall not be drawn into a sharper slope than two degrees (2 Deg.).

The work shall be positioned for flat welding whenever practicable.

3.3.4 Welding Sequence

In assembling and joining parts of a structure or of built-up members, the procedure and sequence of welding shall be such as will avoid needless distortion and minimize shrinkage stresses. Where it is impossible to avoid high residual stresses in the closing welds of a rigid assembly, such closing welds shall be made in compression elements.

In the fabrication of cover-plated beams and built-up members, all shop splices in each component part shall be made before such component part is welded to other parts of the member. Long girders or girder sections may be made by shop splicing not more than three sub-sections, each made in accordance with this paragraph. When required by the Engineer, welded assemblies shall be stress

relieved by heat treating in accordance with the provisions of the relevant Indian Standard or any other Standard approved by the Engineer.

3.3.5 Welding technique

All complete penetration groove welds made by manual welding, except when produced with the aid of backing material not more than 8 mm thick with root opening not less than one-half the thickness of the thinner part joined, shall have the root of the initial layer gouged out on the back side before welding is started from that side, and shall be so welded as to secure sound metal and complete fusion throughout the entire cross-section. Groove welds made with the use of the backing of the same material as the base metal shall have the weld metal thoroughly fused with the backing material. Backing strips need not be removed. If required, they may be removed by gouging or gas cutting after welding is completed, provided no injury is done to the base metal and weld metal and the weld metal surface is left flush or slightly convex with full throat thickness.

Groove welds shall be terminated at the ends of a joint in a manner that will ensure their soundness. Where possible, this should be done by use of extension bars or run-off plates. Extension bars or run-off plates need not be removed upon completion of the weld unless otherwise specified elsewhere in the Contract.

To get the best and consistent quality of welding, automatic submerged arc process shall be preferred. The technique of welding employed, the appearance and quality of welds made, and the methods of correcting defective work shall all conform to the relevant Indian Standards.

3.3.6 Temperature

No welding shall normally be done on parent material at a temperature below (-) 5 Deg.C. However, if welding is to be undertaken at low temperature, adequate precautions as recommended in relevant Indian Standard shall be taken. When the parent material is less than 40 mm thick and the temperature is between (-) 5 Deg. C and 0 Deg. C, the surface around the joint to a distance of 100 mm or 4 times the thickness of the material, whichever is greater, shall be preheated till it is handwarm. When the parent material is more than 40 mm thick, the temperature of the area mentioned above shall be in no case be less than 20 Deg. C. All requirements regarding preheating of the parent material shall be in accordance with the relevant Indian Standard.

3.3.7 Peening

Where required, intermediate layers of multiple-layer welds may be peened with light blows from a power hammer, using a round-nose tool. Peening shall be done after the weld has cooled to a temperature warm to the hand. Care shall be exercised to prevent scaling or flaking of weld and base metal from over peening.

3.3.8 Equipment

These shall be capable of producing proper current so that the operator may produce satisfactory welds. The welding machine shall be of a type and capacity

as recommended by the manufacturers of electrodes or as may be approved by the engineer.

3.4.0 Finish

Column splices and butt joints of compression members depending on contact for stress transmission shall be accurately machined and close-butted over the whole section with a clearance not exceeding 0.2 mm locally at any place. In column caps and bases, the ends of shafts together with the attached gussets, angles, channels etc., after welding together, should be accurately machined so that the parts connected butt over the entire surfaces of contact. Care should be taken that those connecting angles or channels are fixed with such accuracy that they are not reduced in thickness by machining by more than 2.0 mm.

3.5.0 Slab bases and caps

Bases and caps fabricated out of steel slabs, except when cut from material with true surface, shall be accurately machined over the bearing surface and shall be in effective contact with the end of the stanchion. A bearing face which is to be grouted direct to a foundation need not be machined if such face is true and parallel to the upper face. To facilitate grouting, holes shall be provided, where necessary, in stanchion bases for the escape of air.

3.6.0 Lacing bars

The ends of lacing bars shall be neat and free from burrs.

3.7.0 Separators

Rolled section or built-up steel separators or diaphragms shall be required for all double beams except where encased in concrete, in which case, pipe separators shall be used.

3.8.0 Bearing Plates

Provision shall be made for all necessary steel bearing plates to take up reaction of beams and columns and the required stiffeners and gussets whether or not specified in Drawings.

3.9.0 Architectural Clearances

Bearing plates and stiffener connections shall not be permitted to encroach on the designed architectural clearances.

3.10.0 Shop connections

a) All shop connections shall be welded as specified on the Drawings.

b) Certain connections, specified to be shop connections, may be changed to field connections if desired by the Engineer for convenience of erection and the LSTK Vendor will have to make the desired changes at no extra cost to the Owner.

3.11.0 Castings

Steel castings shall be annealed

3.12.0 Shop erection

The steelwork shall be temporarily shop-erected complete or as directed by the Engineer so that accuracy of fit may be checked before despatch. The parts shall be shop-erected with a sufficient number of parallel drifts to bring and keep the parts in place. In case of parts drilled or punched using steel jigs to make all similar parts interchangeable, the steelwork shall be shop erected in such a way as will facilitate the check of interchangeability.

3.13.0 Shop painting

3.13.1 General

Unless otherwise specified, steelwork which will be concealed by interior building finish need not be painted; steelwork to be encased in concrete shall not be painted. Unless specifically exempted, all other steelwork shall be given one coat of shop paint, applied thoroughly and evenly to dry surfaces which have been cleaned, in accordance with the following paragraph, by brush, spray, roller coating, flow-coating or dipping as may be approved by the Engineer.

After inspection and approval and before leaving the shop, all steelwork specified to be painted shall be cleaned by hand-wire brushing or by other mechanical cleaning methods to remove loose mill scale, loose rust, weld slag or flux deposit, dirt and other foreign matter. Oil and grease deposits shall be removed by solvent. Steelwork specified to have no shop paint shall, after fabrication, be cleaned of oil or grease by solvent cleaners and be cleaned of dirt and other foreign material by through sweeping with a fibre brush.

After completion of the precleaning, the metal surface shall immediately painted with red oxide zinc chromate primer conforming to IS : 2074.

In highly corrosive environment, all steelwork shall be given a coat of shop paint, applied thoroughly and evenly to dry surfaces which have been cleaned by sand blasting to SA 2/1/2 grade minimum. The shop paint shall be epoxy rasin based zinc rich primer such as Blast Steel EZ1 of Shalimer Paint Limited or equivalent.

3.13.2 Inaccessible parts

Surfaces not in contact, but inaccessible after assembly, shall receive two coats of shop paint, positively of different colours to prove application of two coats before assembly. This does not apply to the interior of sealed hollow sections.

3.13.3 Contact surfaces

Contact surface shall be cleaned in accordance with Sub-clause 3.13.1 before assembly.

3.13.4 Finished surfaces

Machine finished surfaces shall be protected against corrosion by a rust inhibiting coating that can be easily removed prior to erection or which has characteristics that make removal unnecessary prior to erection.

3.13.5 Surfaces adjacent to field welds

Unless otherwise provided for, surfaces within 50 mm of any field weld location shall be free of materials that would prevent proper welding or produce objectionable fumes while welding is being done.

3.14.0 Galvanizing

3.14.1 General

Structural steelwork for switchyard or other structures as may be specified in the Contract shall be hot dip galvanized in accordance with the American Society for Testing and Materials Specification ASTM-A 123 or IS : 2629 - Recommended practice for Hot-Dip Galvanizing of Iron and steel. Where the steel structures are required to be galvanized the field connection materials like bolts, nuts and washers shall also be galvanized.

3.14.2 Surface Preparation

All members to be galvanized shall be cleaned, by the process of pickling of rust, loose scale, dirt, oil, grease, slag and spatter of welded areas and other foreign substances prior to galvanizing. Pickling shall be carried out by immersing the steel in an acid bath containing either sulphuric or hydrochloric acid at a suitable concentration and temperature. The concentration of the acid and the temperature of the bath can be varied, provided that the pickling time is adjusted accordingly.

The pickling process shall be completed by thoroughly rinsing with water, which should preferably be warm, so as to remove the residual acid.

3.14.3 Procedure

Galvanizing shall be carried out by hot dip process in a proper and uniformly heated bath. It shall meet all the requirements when tested in accordance with IS:2633 - Method for testing uniformity of coating on Zinc Coated Articles and IS:4759 - Specification for Hot-dip zinc coatings on Structural Steel & other allied products.

After finishing the threads of bolts, galvanizing shall be applied over the entire surface uniformly. The threads of bolts shall not be machined after galvanizing and shall not be clogged with zinc. The threads of nuts may be tapped after galvanizing but care shall be taken to use oil in the threads of nuts during erection.

The surface preparation for galvanizing and the process of galvanizing itself, shall not adversely affect the mechanical properties of the materials to be

galvanized. Where members are of such lengths as to prevent complete dipping in one operation, great care shall be taken to prevent warping.

Materials on which galvanizing has been damaged shall be acid stripped and re-galvanized unless otherwise directed, but if any member becomes damaged after having been dipped twice, it shall be rejected. Special care shall be taken not to injure the skin on galvanized surfaces during transport and handling. Damages, if occur, shall be made good in accordance with the provisions of this Specification or as directed by the Engineer.

4.0.0 INSPECTION, TESTING, ACCEPTANCE CRITERIA AND DELIVERY

4.1.0 Inspection

Unless specified otherwise, inspection to all work shall be made by the Engineer or Engineer's representative at the place of manufacture prior to delivery. The Engineer or his representative shall have free access at all reasonable times to those parts of the manufacturer's works which are concerned with the fabrication of the steelwork under this Contract and he shall be afforded all reasonable facilities for satisfying himself that the fabrication is being done in accordance with the provisions of this Specification.

The LSTK Vendor shall provide free of charge, such labour, materials, electricity, fuel, water, stores, tools and plant, apparatus and instruments as may be required by the Engineer to carry out inspection and/or tests in accordance with the Contract.

The LSTK Vendor shall guarantee compliance with the provisions of this Specification.

4.2.0 Testing and Acceptance Criteria

4.2.1 General

The LSTK Vendor shall carry out sampling and testing in accordance with the relevant Indian Standards and as supplemented herein for the following items at his own cost, unless otherwise specified in the Contract. The LSTK Vendor shall get the specimens tested in a laboratory approved by the Engineer and submit to the Engineer the test results in triplicate within 3 (three) days after completion of the test.

4.2.2 Steel

All steel supplied by the LSTK Vendor shall conform to the relevant Indian Standards. Except otherwise mentioned in the Contract, only tested quality steel having mill test reports shall be used. In case unidentified steel materials are permitted to be used by the Engineer, random samples of materials will be taken from each unidentified lot of 50 M.T. or less of any particular section for tests to conform to relevant Indian Standards. Cost of all tests shall be borne by the LSTK Vendor.

All material shall be free from all imperfections, mill scales, slag intrusions, laminations, pittings, rusts etc. that may impair their strength, durability and appearance.

4.2.3 Testing Criteria for checking Lamination in Raw Steel Plates

All raw steel plate of thickness more than 20 mm supplied by the LSTK Vendor shall be checked against lamination before procurement & prior to commencement of fabrication work in the following ways as directed by the Engineer.

(a) Ultrasonic testing along the edge of specified points of the plates shall be carried out to delete lamination in the plates, if any.

(b) If the results of the tests in (a) are not satisfactory, the whole area of the plates shall be checked by ultrasonic testing at specified nodal points formed at equidistant grid locations. The spacing of the grids shall be determined from tests in (a) or as directed by the Engineer.

If the results of the above tests are not satisfactory, the plates shall not be taken up for fabrication work. Even after fabrication at shop, if the Engineer requires any ultrasonic testing to detect lamination of plates, the same shall be carried out by the LSTK Vendor. If the plates in the fabricated item are found to be laminated, the component will be rejected.

4.2.4 Welding

All electrodes shall be procured from reliable manufacturers with test certificates. The correct grade and size of electrode which has not deteriorated in storage shall be used. The inspection and testing of welding shall be performed in accordance with the provisions of the relevant Indian Standards or other equivalents. For every 50 tonnes of welded fabrication, the Engineer may ask for at least 1 (one) test-destructive or non-destructive including X-ray, ultrasonic test or similar, the cost of which shall be borne by the LSTK Vendor. In the event of further tests as may be desired by the Engineer, the cost of such test shall be borne by the LSTK Vendor if the results are found to be unsatisfactory; and if the test shows no defect, the cost shall be borne by the Owner. In cases of the test results showing deficiency, the Engineer shall have option to reject or instruct any remedial measures to be taken free of charge to the Owner.

4.2.5 Bolts, Nuts and Washers

All bolts, nuts and washers shall be procured from reputed manufacturer approved by the Engineer and shall conform to the relevant Indian Standards. If desired by the Engineer, representative samples of these materials may have to be tested in an approved laboratory and in accordance with the procedures described in relevant Indian Standards. Cost of all such testing shall have to be borne by the LSTK Vendor.

4.2.6 Shop Painting

All paints and primers shall be of standard quality and procured from approved manufacturers and shall conform to the provisions of the relevant Indian Standards.

4.2.7 Galvanizing

All galvanizing shall be uniform and of standard quality when tested in accordance with IS:2633 - Method for testing uniformity of coating on Zinc Coated Articles and IS:4759 - specification for Hot-Dip Zinc Coatings on Structural Steel & other allied products.

4.3.0 Tolerance

The tolerances on the dimensions of individual rolled steel components shall be as specified in IS:1852 - specification for rolling and Cutting Tolerances for Hot-rolled Steel Products. The tolerances on straightness, length etc. of various fabricated components (such as beams and girders, columns, crane gantry girder etc.) of the steel structures other than steel railway & road bridges, structures subjected to dynamic loading (like wind, seismic etc.) and thin walled construction (like box girders) shall be as specified in IS:7215 - Tolerances for Fabrication of Steel Structures.

4.4.0 Acceptance

Should any structure or part of a structure be found not to comply with any of the provisions of this Specification, the same shall be liable to rejection. No structure or part of the structure, once rejected, shall be offered again for test, except in cases where the Engineer considers the defects rectifiable. The Engineer may, at his discretion, check the test results obtained at the LSTK Vendor's works by independent tests at an approved laboratory and should the items, so tested, be found to be unsatisfactory, the costs shall be borne by the LSTK Vendor, and if satisfactory, the costs shall be borne by the Owner.

When all tests to be performed in the LSTK Vendor's shop under the terms of this contract have been successfully carried out, the steelwork will be accepted forthwith and the Engineer will issue an acceptance certificate, upon receipt of which, the items will be shop painted, packed and despatched. No item to be delivered unless an acceptance certificate for the same has been issued. The satisfactory completion of these tests or the issue of the certificates shall not bind the Owner to accept the work, should it, on further tests before or after erection, be found not in compliance with the Contract.

4.5.0 Delivery of Materials

4.5.1 General

The LSTK Vendor will deliver the fabricated structural steel materials to site with all necessary field connection materials in such sequence as will permit the most efficient and economical performance of the erection work. the Owner may prescribe or control the sequence of delivery of materials, at his own discretion.

4.5.2 Marking

Each separate piece of fabricated steelwork shall be distinctly marked on all surfaces before delivery in accordance with the markings shown on approved erection drawings and shall bear such other marks as will further facilitate identification and erection.

4.5.3 Packing and Shipping

All projecting plates or edges and all ends of members of joints shall be stiffened, all straight members and plates, shall be bundled, all screwed ends and machined surfaces shall be suitably packed and all bolts, nuts, washers, and small loose parts shall be packed separately in order to prevent damage or distortion during shipping.

Shipping shall be strictly in accordance with the sequence stipulated in the agreed programme. Payment may be held up for items sent in advance of the sequence till they could be erected. The LSTK Vendor shall include and provide for in his rates, the freight and other charges for despatching the materials to the worksite and also for securely protecting and packing the materials to avoid loss or damage during transport by rail, road or water. All packings shall allow for easy removal and checking at site. Special precautions shall be taken against rusting, corrosion, breakage or damage otherwise of the materials. All parts shall be adequately braced to prevent damage in transit.

Each bundle, bale or package delivered under this contract shall be marked on as many sides as possible and such distinct marking (all previous irrelevant markings being carefully obliterated) shall show the following : -

a) Name and address of the consignee

b) Name and address of the consignor

c) Gross weight of the package in tonnes and its dimensions

d) Identification marks and/or number of the package

e) Custom registration number, if required

All markings shall be carried out with such materials as would ensure quick drying and indelibility.

Each component or part or piece of material when shipped, shall be indelibly marked and/or tagged with reference to assembly drawings and corresponding piece numbers.

Each packing case shall contain in duplicate in English a packing list pasted on to the inside of the cover in a water-proof envelope, quoting especially -

a) Name of the LSTK Vendor
b) Number and date of the Contract

c) Name of the office placing the contract

d) Nomenclature of stores

e) A schedule of parts or pieces, giving the parts or piece number with reference to assembly drawings and the quantity of each.

The shipping dimensions of each package shall not exceed the maximum dimensions permissible for transport over the Indian Railways/Roads.

After delivery of the materials at site, all packing materials shall automatically become the property of the Owner without any extra payment.

Notwithstanding anything stated hereinbefore, any loss or damage resulting from inadequate packing shall be made good by the LSTK Vendor at no additional cost to the Owner. When facilities exist, all shipments shall be covered by approved Insurance Policy for transit at the cost of the LSTK Vendor.

The LSTK Vendor shall ship the complete materials or part on board a vessel belonging to an agency approved by the Owner or on rail and/or road transport as directed. The LSTK Vendor shall take all reasonable steps to ensure correct appraisal of freight rates, weights and volumes and in no case will the Owner be liable to pay any warehouse, wharfage, demurrage and other charges.

If, however, the Owner has to make payment of any of the above mentioned charges, the amount paid will be deducted from the progressive bills of the LSTK Vendor.

Necessary advice regarding the shipment with relevant details shall reach the Engineer at least a week in advance.

5.0.0 INFORMATION TO BE SUBMITTED

5.1.0 With Tender

The following information are required to be submitted:

a) Progress Schedule

The LSTK Vendor shall furnish a detailed schedule of progress of work and total time of completion, itemizing the time required for each of the following aspects of work.

1) Preparation and approval of shop drawings

2) Procurement of materials

3) Fabrication and shipping of all anchor bolts

4) Fabrication and shipping of main steelwork

5) Fabrication and shipping of steelwork for bunkers. Tanks and/ or silos as applicable.

6) Fabrication and shipping of all other remaining steel work including miscellaneous steelwork

7) Final date of completion of all shipments

Time required for completion being one of the main criteria for selecting the successful LSTK Vendor, it is desired that the LSTK Bidder quotes the minimum time required by him for completing the work.

b) Shop

Location of the LSTK Bidder's fabrication workshop giving details of equipment, manpower, the total capacity and the capacity that will be available exclusively for this contract shall be submitted.

5.2.0 After Award

After award of contract the successful LSTK Vendors to submit the following

a) Complete fabrication drawings, material lists, cutting lists, bolt lists, field welding schedules based on the design drawings in accordance with the approved schedule.

b) Monthly Progress Report with necessary photographs in six (6) copies to reach the Engineer on or before the 7th day of each month, giving the up to date status of preparation of detailed shop drawings, bill of materials, procurement of materials, actual fabrication done, shipping and all other relevant information.

c) Results of any test as and when conducted and as required by the Engineer.

d) Manufacturer's mill test report in respect of steel materials, bolts, nuts and electrodes as may be applicable.

SUB-SECTION NO. C4

TECHNICAL SPECIFICATION FOR ERECTION OF STRUCTURAL STEELWORK

TECHNICAL SPECIFICATION
FOR
ERECTION OF STRUCTURAL STEELWORK

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TECHNICAL SPECIFICATION FOR ERECTION OF STRUCTURAL STEELWORK

1.0.0 SCOPE

This specification covers the erection of structural steelwork including receiving and taking delivery of fabricated structural steel materials arriving at Site and installing the same in position, painting and grouting the stanchion bases all complete as per Drawings, this Specification and other provision of the Contract.

2.0.0 GENERAL

2.1.0 Work to be provided for by the LSTK Vendor

The work to be provided for by the LSTK Vendor, unless otherwise specified in the Contract, shall include but not be limited to the following:-

a) The LSTK Vendor shall provide all construction and transport equipment, tools, tackles, consumables, materials, labour and supervision required for the erection of the structural steelwork.

b) Receiving, unloading, checking and moving to storage yard at Site including prompt attendance to all insurance matters as necessary for all fabricated steel materials arriving at Site. The LSTK Vendor shall pay all demurrage and/or wharfage charges etc. on account of default on his part.

c) Transportation of all fabricated structural steel materials from Site storage yard, handling, rigging, assembling, bolting, welding and satisfactory installation of all fabricated structural steel materials in proper location according to approved erection drawings and/or as directed by the Engineer. If necessary suitable temporary approach roads to be built for transportation of fabricated steel structures.

d) Checking center lines, levels of all foundation blocks including checking line, level, position and plumb of all bolts and pockets. any defect observed in the foundation shall be brought to the notice of the Engineer. The LSTK Vendor shall fully satisfy himself regarding the correctness of the foundations before installing the fabricated steel structures on the foundation blocks.

e) Aligning, plumbing, levelling, bolting, welding and securely fixing the fabricated steel structures in accordance with the Drawings or as directed by the Engineer.

f) Painting of the erected steel structures.

g) All minor modifications of the fabricated steel structures as directed by the Engineer including but not limited to the following:-

i) Removal of bends, kinks, twists etc. for parts damaged during transport and handling.

ii) Cutting, chipping, filling, grinding etc. if required for preparation and finishing of site connections.

iii) Reaming of holes for use of higher size bolt if required.

iv) Welding of connections in place of bolting for which holes are either not drilled at all or wrongly drilled during fabrication. Welding in place of bolting will be permitted only at the discretion of the Engineer.

v) Re-fabrication of parts damaged beyond repair during transport and handling or Re-fabrication of parts which are incorrectly fabricated.

vi) Fabrication of parts omitted during fabrication by error, or subsequently found necessary.

vii) Drilling of holes which are either not drilled at all or are drilled in incorrect location during fabrication.

viii) Carry out tests in accordance with this Specification if directed.

2.2.0 Work by Others

No work under this Specification will be provided for by any agency other than the LSTK Vendor unless specifically mentioned elsewhere in the Contract.

2.3.0 Codes and Standards

All work under this Specification shall, unless specified otherwise, conform to the latest revisions and/or replacements of the following or any other Indian Standard Specification and codes of Practice of equivalent:-

IS-800 : Code of Practice for general construction in steel

IS-456 : Code of Practice for plain or reinforced concrete

IS-7205 : Safety Code for erection of Structural Steel work

IS-12843 : Tolerance for erection of Steel Structures

2.4.0 Conformity with Design

The LSTK Vendor will erect the entire fabricated steel structure, align all the members, complete all field connections and grout the foundations all as per the

provisions of this specification and the design criteria detailed in the approved erection drawings and/or other stated document. All work shall conform to the provisions of the relevant Indian Standard Specifications and/or the instructions of the engineer. The testing and acceptance of the erected structures shall be in accordance with the provisions of this Specification and/or the instructions of the Engineer.

2.5.0 Material

2.5.1 General

The LSTK Vendor shall check the quantity, quality and the sizes of the fabricated materials and verify the adequacy of the same in accordance with the Drawings and Specifications. The LSTK Vendor shall make good any deficiency, if detected, either by repair or with fresh material as may be directed by the Engineer at the LSTK Vendor's Own cost.

All consumables like oxygen and acetylene gas, paints, fuels, lubricants, oil, grease, cement, sand, aggregates and any other material that may be required for the execution of the works in accordance with the contract will be supplied by the LSTK Vendor for erection work and will be deemed to have been included in this rates.

2.5.2 Materials to conform to Indian Standards

All materials required to be supplied by the LSTK Vendor under this Contract shall conform to the relevant Indian Standard Specifications.

2.6.0 Storage of Materials

2.6.1 General

All materials shall be so stored as to prevent deterioration and to ensure the preservation of their quality and fitness for use in the works. Any material which has been deteriorated or damaged beyond repairs and has become unfit for use shall be removed immediately from the site, failing which, the Engineer shall be at liberty to get the materials removed by agency and the cost incurred thereof shall be realised from the LSTK Vendor's dues.

2.6.2 Yard

The LSTK Vendor will have to establish a suitable yard in an approved location at site for storing the fabricated steel structures and other materials which will be delivered to him by the Owner according to the Contract. The yard shall have proper facilities like, drainage, lighting, suitable access for large cranes, trailers and other heavy equipment. The yard shall be fenced all around with security arrangement and shall be of sufficiently large area to permit systematic storage of the fabricated steel structures without overcrowding and with suitable access for cranes, trailers and other equipment for use in erection work in proper sequence in accordance with the approved programme of work. The LSTK Bidder should visit the site prior to submission of his Tender to acquaint himself with the availability of land and the development necessary by way of filling,

drainage, access roads, fences, sheds etc. all of which shall be carried out by the LSTK Vendor at his own cost as directed by the Engineer.

2.6.3 Covered Store

All field connection materials, paints, cement etc. shall be stored on well designed racks and platforms off the ground in a properly covered store building to be built at the cost of the LSTK Vendor.

2.7.0 Quality Control

The LSTK Vendor shall establish and maintain quality control procedures for different items of work and materials as may be directed by the Engineer to assure compliance with the provisions of the Contract and shall submit the records of the same to the Engineer. The quality control operation shall include but not be limited to the following items of work:-

1) Erection : Lines, levels, grades, plumbs, joint characteristics including tightness of bolts.

2) Grouting : Cleaning and roughness of foundation, quality of materials used for grouting, admixtures, consistency and strength of grout.

3) Painting : Preparation of surface for painting, quality of primers and paints, thinners, application and uniformity of coats.

The LSTK Vendor shall salvage, collect and deliver all the packing materials to the Owner free of charge.

2.8.0 Taking Delivery

The LSTK Vendor shall take delivery of fabricated structural steel and necessary connection materials supplied by the fabrication Contractor from railhead, trucks and/or the Owner's stores at site as may be necessary and as directed by the Engineer. He shall check, unload, transport the materials to his stores for proper storing at his own cost. The LSTK Vendor shall submit claims to insurance or other authorities and pursue the same in case of loss or damage during transit and handling and all loss thereof shall be borne by him.

The LSTK Vendor shall also take all precautions against damage of the materials in his custody after taking delivery and till the same are erected in place and accepted. The LSTK Vendor shall salvage, collect and deliver all the packing materials to the Owner free of charge.

3.0.0 WORKMANSHIP

3.1.0 Erection

3.1.1 Plant and Equipment

The suitability and adequacy of all erection tools and plant and equipment proposed to be used shall be efficient, dependable, in good working condition and shall have the approval of the Engineer.

3.1.2 Method and Sequence of Erection

The method and sequence of erection shall have the prior approval of the Engineer. The Erection shall be arranged for most economical method and sequence available to him consistent with the Drawings and Specifications and such information as may be furnished to him prior to the execution of the Contract.

3.1.3 Temporary Bracing

Unless adequate bracing is included as a part of the permanent framing, the erector during erection shall install, free of cost to the Owner, temporary guys and bracings where needed to secure the framing against loads such as wind or seismic forces comparable in intensity to that for which the structure has been designed, acting upon exposed framing as well as loads due to erection equipment and erection operations.

If additional temporary guys are required to resist wind or seismic forces acting upon components of the finished structure installed by others during the course of the erection of the steel framing, arrangement for their installation by the erector shall be made free of cost to the Owner.

The responsibility of the LSTK Vendor in respect of temporary bracings and guys shall cease when the structural steel is once located, plumbed, levelled, aligned and grouted within the tolerances permitted under the specification and guyed and braced to the satisfaction of the Engineer.

3.1.4 Temporary Floors for Buildings

It shall be the responsibility of the LSTK Vendor to provide free of cost planking and to cover such floors during the work in progress as may be required by any Act of Parliament and/or by-laws of state, Municipal or other local authorities.

3.1.5 Setting out

Positioning and levelling of all steelwork, plumbing of stanchions and placing of every part of the structure with accuracy shall be in accordance with the approved Drawings and to the satisfaction of the Engineer. Concrete foundations, where required, shall be made by other agencies. Anchor bolts and other anchor steel shall be embedded by other agencies. The LSTK Vendor shall check the positions and levels of the anchor bolts, etc. before concreting and get

them properly secured against disturbance during pouring operations. He shall remain responsible for correct positioning. For heavy columns, etc. the LSTK Vendor shall set proper screed bars if desired by the Engineer, to maintain proper level. No extra payment shall be made for this.

Each tier of column shall be plumbed and maintained in a true vertical position subject to the limits of tolerance allowable under this Specification.

No permanent field connections by bolting or welding shall be carried out until proper alignment and plumbing has been attained.

3.1.6 Field Riveting(not applicable)

All rivets shall be heated and driven with pneumatic tools. Hand passing or 'throwing' of rivets are desirable. Any other method of conveying hot rivets from the furnace to the driving point must be approved by the engineer. No cold rivets shall be driven. All other requirements of riveting including quality and acceptance criteria shall be in accordance with the relevant portions of the Specification for Fabrication of Structural Steelwork of the Project.

3.1.7 Field Bolting

All relevant portions in respect of bolted construction of the Specification for Fabrication of Structural Steelwork applicable to the Project shall also be applicable for field bolting in addition to the following:-

Bolts shall be inserted in such a way so that they may remain in position under gravity even before fixing the nut. Bolted parts shall fit solidly together when assembled and shall not be separated by gaskets or any other interposed compressible materials. When assembled, all joint surfaces, including those adjacent to the washers shall be free of scales except tight mill scales. They shall be free of dirt, loose scales, burns, and other defects that would prevent solid seating of the parts. Contact surfaces within friction-type joints shall be free of oil, paint, lacquer, or galvanizing.

All high tensile bolts shall be tightened to provide, when all fasteners in the joint are tight, the required minimum bolt tension by any of the following methods:-

a) Turn-of-nut method

When the turn-of-nut method is used to provide the bolt tension, there shall first be enough bolts brought to a "snug tight" condition to ensure that the parts of the joint are brought into good contact with each other. "snug tight" is defined as the tightness attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench.

Following this initial operation, bolts shall be placed in any remaining holes in the connection and brought to snug tightness. All bolts in the joint shall then be tightened additionally by the applicable amount of nut rotation specified in Table-1 with tightening progressing systematically from the most rigid part of the joint to its free edges. During this operation there shall be no rotation of the part not turned by the wrench.

TABLE - I

Bolts length not exceeding 8 x dia. or 200 mm	Bolt length exceeding 8 x dia. or 200 mm	Remarks
1/2 turn	2/3 turn	Nut rotation is relative to bolt regardless of the element (nut or bolt) being turned. Tolerance on rotation - 30° over or under.

Bolts may be installed without hardened washers when tightening is done by the turn-of-nut method. However, normal washers shall be used.

Bolts tightened by the turn-of-nut method may have the outer face of the nut match-marked with the protruding bolt point before final tightening, thus affording the inspector visual means of noting the actual nut rotation. Such marks can be made by the wrench operator by suitable means after the bolts have been brought up snug tight.

b) Torque Wrench tightening

When torque wrenches are used to provide the bolt tensions, the bolts shall be tightened to the torques specified in TABLE - II. Nuts shall be in tightening motion when torque is measured. When using torque wrenches to install several bolts in a single joint, the wrench shall be returned to touch up bolts previously tightened, which may have been loosened by the tightening of subsequent bolts, until all are tightened to the required tension.

TABLE - II

Nominal Bolt Diameter (mm)	Torque to be applied (Kg.M) for bolt class 8.8 of IS : 1367
20	59.94
22	81.63
24	103.73

In either of the above two methods, if required, for bolt entering and wrench operation clearances, tightening may be done by turning the bolt while the nut is prevented from rotating.

Impact wrenches if used shall be of adequate capacity and sufficiently supplied with air to perform the required tightening of each bolt in approximately ten seconds.

Holes for turned bolts to be inserted in the field shall be reamed in the field. All drilling and reaming for turned bolts shall be done only after the parts to be connected are assembled. Tolerances applicable in the fit of the bolts shall be in accordance with relevant Indian Standard Specifications. All other requirements regarding assembly and bolt tightening shall be in accordance with this sub clause.

3.1.8 Field Welding

All field assembly and welding shall be carried out in accordance with the requirements of the specification for fabrication work applicable to the project, excepting such provisions therein which manifestly apply to shop conditions only. Where the fabricated structural steel members have been delivered painted, the paint shall be removed before field welding for a distance of at least 50 mm on either side of the joints.

3.1.9 Holes, Cutting and Fitting

No cutting of sections, flanges, webs, cleats, bolts, welds etc. shall be done unless specifically approved and / or instructed by the Engineer.

The erector shall not cut, drill or otherwise alter the work of other trades, or his own work to accommodate other trades, unless such work is clearly specified in the Contract or directed by the Engineer. Wherever such work is specified the LSTK Vendor shall obtain complete information as to size, location and number of alterations prior to carrying out any work. The LSTK Vendor shall not be entitled for any payment on account of any such work.

3.2.0 Drifting

Correction of minor misfits and reasonable amount of reaming and cutting of excess stock from rivets will be considered as permissible. For this, light drifting may be used to draw holes together and drills shall be used to enlarge holes as necessary to make connections. Reaming, that weakens the member or makes it impossible to fill the holes properly or to adjust accurately after reaming shall not be allowed.

Any error in shop work which prevents the proper assembling and fitting of parts by moderate use of drift pins and reamers shall immediately be called to the attention of the Engineer and approval of the method of correction obtained. The use of gas cutting torches at erection site is prohibited.

3.3.0 Grouting of stanchion bases and bearings of beams and girders on stone, brick or concrete (Plain or reinforced)

For cement grout the mix shall be one (1) part cement and one (1) part sand and just enough water to make it workable. The positions to be grouted shall be cleaned thoroughly with compressed air jet and wetted with water and any accumulated water shall be removed. These shall be placed under expert supervision, taking care to avoid air-locks. Edges shall be finished properly. If the thickness of grout is 25 mm or more, two (2) parts of 6 mm downgraded stone chips may be added to the above noted cement-sand grout mix, if required by the Engineer or shown on the drawings.

Admixtures like aluminium powder/ "ironite" or equivalent may be required to be added to the grout to enhance certain desirable properties of the grout.

If specified, the grouting is to be done with non-shrink high strength free flow cement grout (ready mixed) like "Anckor NSG" or approved equivalent.

No grouting shall be carried out until a sufficient number of bottom lengths of stanchions have been properly lined, levelled and plumbed and sufficient floor beams are tied in position.

Whatever method of grouting is employed, the operation shall not be carried out until the steelwork has been finally levelled and plumbed, the stanchion bases being supported meanwhile by steel wedges, and immediately before grouting, the space under steel shall be thoroughly cleaned.

3.4.0 Painting after Erection

Field painting shall be done by the erection LSTK Vendor only after the structure is erected, levelled, plumbed, aligned and grouted in its final position, tested and accepted by the Engineer. Touch up paintings, making good any damaged shop painting and completing any unfinished portion of the shop coat shall be carried out by the erection LSTK Vendor free of cost to the Owner. The materials and specification for such painting in the field shall be in accordance with the requirements of the specification for fabrication of structural steelwork applicable for the project.

Painting shall not be done in rainy or foggy weather or when humidity is such as to cause condensation on the surfaces to be painted. Before painting of steel, which is delivered unpainted, is commenced, all surfaces to be painted shall be dried and thoroughly cleaned from all loose scale and rust.

All field bolts, welds and abrasions to the shop coat shall be spot painted with the same paint used for the shop coat. Where specified, surfaces which will be in contact after site assembling shall receive a coat of paint (in addition to the shop coat, if any) and shall be brought together while the paint is still wet.

Surface which will be inaccessible after field assembly shall receive the full specified protective treatment before assembly. Bolts and fabricated steel members which are galvanized or otherwise treated and steel members to be encased in concrete shall not be painted.

The specification for paint and workmanship shall be in accordance with the requirements of the specification for fabrication of structural steelwork applicable to the project. The number of coats and the shades to be used shall be as specified or as directed by the Engineer.

3.5.0 Steel Plate Lining in Bin, Bunker & Hopper

All the skin plates of Bins, Bunkers and hoppers are of mild steel construction and shall be lined with abrasive resistant steel plate [egg, Tiscral/Sailma/Sail hard or equivalent] The work includes supply, fabrication, welding and fixing of these lining plate to Skin plates as per approved drawings and specification.

3.6.0 Final Cleaning up

Upon completion of erection and before final acceptance of the work by the Engineer, the LSTK Vendor shall remove free of cost all falsework, rubbish and all Temporary Works resulting in connection with the performance of his work.

3.7.0 Safety Measures during Erection

The safety measures to workmen and supervisors during all types of erection work (e.g., use of lifting appliances, slinging, welding, gas cutting, etc.) should be taken as per IS : 7205. When any statutory provisions exist, the same shall be complied with in addition to the provisions contained in the above code.

4.0.0 TESTING AND ACCEPTANCE CRITERIA

4.1.0 General

Loading tests shall be carried out on erected structures, if required by the Engineer, to check adequacy of fabrication and/or erection. Any structure or a part thereof found to be unsuitable for acceptance as a result of the test shall have to be dismantled and replaced with suitable member. In course of dismantling, if any damage is done to any other parts of the structure or to any fixtures, the same shall be made good free of cost by the LSTK Vendor responsible, to the satisfaction of the Engineer.

The structure or structural member under consideration shall be loaded with its actual dead load for as long a time as possible before testing and the tests shall be conducted as indicated in the following Sub-clauses 4.1.1, 4.1.2 and 4.1.3. The method of testing and application of loading shall be as approved by the Engineer.

4.1.1 Stiffness Test

In this test, the structure or member shall be subjected, in addition to its actual dead load, to a test load equal to 1.5 times the specified superimposed load, and this loading shall be maintained for 24 hours. The maximum deflection attained during the test shall be within the permissible limit. If, after removal of the test load, the member or structure does not show a recovery of at least 80 per cent of the maximum strain or deflection shown during 24 hours under load, the test shall be repeated. The structure or member shall be considered to have sufficient stiffness, provided that the recovery after this second test is not less than 90

percent of the maximum increase in strain or deflection recorded during the second test.

4.1.2 Strength Test

The structure or structural member under consideration shall be subjected, in addition to its actual dead load, to a test load equal to the sum of the dead load and twice the specified superimposed load, and this load shall be maintained for 24 hours.

In the case of wind load, a load corresponding to twice the specified wind load shall be applied and maintained for 24 hours, either with or without the vertical test load for more severe condition in the member under consideration or the structure as a whole. Complete tests under both conditions may be necessary to verify the strength of the structure. The structure shall be deemed to have adequate strength if, during the test, no part fails and if on removal of the test load, the structure shows a recovery of at least 20 per cent of the maximum deflection or strain recorded during the 24 hours under load.

4.1.3 Structure of same Design

Where several structures are built to the same design and it is considered unnecessary to test all of them, one structure, as a prototype, shall be fully tested, as described in previous Sub-clauses, but in addition, during the first application of the test load, particular note shall be taken of the strain or deflection when the test load 1.5 times the specified superimposed load has been maintained for 24 hours. This information is required as a basis of comparison in any check test carried out on samples of the structure.

When a structure of the same type is selected for a check test, it shall be subjected, in addition to its actual dead load, to a superimposed test load, equal to 1.5 time the specified live load, in a manner and to an extent prescribed by the Engineer. This load shall be maintained for 24 hours, during which time, the maximum deflection shall be recorded. The check test shall be considered satisfactory, provided that the maximum strain or deflection recorded in the check test does not exceed by more than 20% of the maximum strain or deflection recorded at similar load in the test on the prototype.

4.1.4 Repair for subsequent test and use after strength tests

An actual structure which has passed the "Strength Test" as specified in Sub-clause 4.1.2 hereinbefore and is subsequently to be erected for use, shall be considered satisfactory for use after it has been strengthened by replacing any distorted members and has subsequently satisfied the 'Stiffness Test' as specified in Sub-clause 4.1.1. hereinbefore.

4.2.0 Tolerances

Some variation is to be expected in the finished dimensions of structural steel frames. Unless otherwise specified, such variations are deemed to be within the limits of good practice when they are not in excess of the cumulative effect of detailed erection clearances, fabricating tolerances for the finished parts and the rolling tolerances for the profile dimensions permitted under the Specifications

for fabrication of structural steelwork applicable to this Project and as specified below :

I. For Buildings Containing Cranes

Component	**Description**		**Variation Allowed**
Main columns	a)	Shifting of column axis at foundation level with respect to building line	
	i)	In longitudinal direction	i) ± 3.0 mm
	ii)	In lateral direction	ii) ± 3.0 mm
	b)	Deviation of both major column axes from vertical between foundation and other member connection levels :	
	i)	For a column up to and including 10M height	i) ± 3.5 mm from true vertical
	ii)	For a column greater than 10M but less than 40M height measured between connection levels, but not more than ± 7.0 mm per 30 m length.	ii) ± 3.5 mm from true vertical for any 10M length
	c)	For adjacent pairs of columns across the width of the building prior to placing of truss. True span.	± 9 mm on
	d)	For any individual column deviation of any bearing or resting level from levels shown on drawings.	± 3.0 mm

	e)	For adjacent pairs of columns either across the width of building or longitudinally level difference allowed between bearing or seating level supposed to be at the same level.	3 mm
Trusses	a)	Deviation at center of span of upper chord member from vertical plane running through center of bottom chord .	1/1500 of the span or not greater than 10 mm whichever is the least.
	b)	Lateral displacement of top chord at center of span from vertical plane running through center of supports.	1/250 of depth of truss or 20 mm whichever is the least.
Crane Girders & Tracks	a)	Difference in levels of crane rail measured between adjacent columns.	2.0 mm
	b)	Deviation to crane rail gauge	± 3.0 mm
	c)	Relative shifting of ends of adjacent crane rail in plan and elevation after thermit welding.	1.0 mm
	d)	Deviation of crane rail axis from center line of web.	± 3.5 mm
Setting of Expansion gaps	At the time of setting of the expansion gaps, due regard shall be taken of the ambient temperature above or below 30°C. The coefficient of expansion or contraction shall be taken as 0.000012 per °C per unit length.		

Bunker	a)	Deviation in length of of the Bunker from true length	+- 1/1000 length in mm
	b)	Deviation in width of of the Bunker from true width	+-1/1000 width in mm
	c)	Deviation in height of the Bunker from true height in mm	+- 1/1000 of

II. For Buildings without Cranes

The maximum tolerances for line and level of the steel work shall be ± 3.0 mm on any part of the structure. The structure shall not be out of plumb more than 3.5 mm on each 10M section of height and not more than 7.0 mm per 30 M section.

These tolerances shall apply to all parts of the structure unless the drawings issued for erection purposes state otherwise.

4.3.0 Acceptance

Structures and members which have passed the tests and conform to all requirements specified in the foregoing Sub-clause 4.1.0, 4.1.1, 4.1.2, 4.1.3 and 4.1.4 and other applicable provisions of this Specification and are within the limits of tolerances specified in Sub-clause 4.2.0 and/or otherwise approved by the Engineer shall be treated as approved and accepted for the purpose of fulfillment of the provisions of this Contract.

5.0.0 INFORMATION TO BE SUBMITTED

5.1.0 With Tender

Along with the Tenders the LSTK Bidder will be required to submit the following information :

5.1.1 Tentative Programme

The LSTK Bidder shall submit a tentative programme based on the information available in the Tender Document and visit to Site indicating the structure-wise erection schedule proposed to be maintained by the LSTK Vendor to complete the job in time in accordance with the Contract.

5.1.2 Constructional Plant & Equipment, Tools, Temporary Works & Manpower

A detailed list of all Constructional Plant & Equipment like cranes, derricks, winches, welding sets, erection tools etc. along with their make, model, present condition and location available with the LSTK Bidder which he will be able to employ on the job to maintain the progress of work in accordance with the Contract shall be submitted along with the Tender. The total number of each

category of experienced personnel like fitters, welders, riggers etc. that he will be able to employ on the job shall also be indicated.

5.1.3 Erection yard

A site plan showing the layout and location of the erection yard proposed to be established by the LSTK Bidder shall be attached with the Tender indicating the storage space for fabricated steel materials, site-fabrication and repair shop, covered stores, offices, locations of erection equipment's and other facilities. The Engineer shall have the right to modify the arrangement and location of the proposed yard to suit site conditions and the LSTK Vendor shall comply with the same without any claim whatsoever.

5.2.0 After award of the Contract

After award of the contract, the LSTK Vendor shall submit the following:-

5.2.1 Detailed Programme

The LSTK Vendor shall submit a detailed erection programme for completion of the work in time in accordance with the Contract. This will show the target programme, with details of erection proposed to be carried out in each fortnight, details of major equipment required and an assessment of required strength of various categories of workers in a proforma approved by the Engineer.

5.2.2 Fortnightly Progress Report

The Contractor shall submit fortnightly progress reports in triplicate to the Engineer showing along with necessary photographs, 125 mm x 90 mm size, and all details of actual achievements against the target programme specified in Sub-clause 5.2.1 above. Any shortfall in the achievement in a particular fortnight must be made up within the next fortnight. Along with this report, the LSTK Vendor shall also furnish details of fabricated materials in hand at site and the strength of his workers.

6.0.0 RATES

Even though it may not be specifically mentioned in the Schedule of Items, the rates shall include all work to be provided by the LSTK Vendor in accordance with Sub-clause 2.1.0 of this Contract and cost of all materials and labour required to complete the work or incidental to it, hire charges of Constructional Plant & Equipment and erection tools, insurance, all necessary transport, taxes and royalties, making necessary arrangements for approaches, yard, security, safety and other facilities, power, fuel, lubricant, services, supervisions, overheads, profits etc. complete in all respects. It shall also include cost of all other work and supplies not specifically mentioned but reasonably implied as being necessary to complete the works in all respects in accordance with the Contract.

7.0.0 METHOD OF MEASUREMENT

7.1.0 Erection

All measurement shall be in metric tonnes and based on the theoretical unit weights as per Indian Standard and on the following considerations:

i) All members, except plate work paid under rates for bunkers, tanks, etc. shall be measured square.

ii) All plate work paid at rates for bunkers, tanks, etc. shall be measured as actual.

iii) No deduction shall be made for bolt and / or holes and / or holes for other purposes up to 25 Sq.cm. in area.

7.2.0 Grouting

The measurement of grouting the stanchion and other base plates shall be on the basis of theoretical volume of the voids to be filled in Cu.M. without any deduction for the volume of embedments. Edge of the grouting shall be measured square neglecting chamfers, if any.

7.3.0 Painting

The finish painting, other than touch up and other painting, if required to be done within the quoted rates as per this Specification, shall be measured on the basis of the tonnage of the structure erected and painted calculated on the basis of Sub Clause 7.1.0.

SUB-SECTION NO. C5

TECHNICAL SPECIFICATION FOR SHEETING WORK IN ROOF AND SIDING

TECHNICAL SPECIFICATION
FOR
SHEETING WORK IN ROOF AND SIDING

CONTENTS

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE
2.00.00	INSTALLATION
3.00.00	ACCEPTANCE CRITERIA
4.00.00	IS CODES

TECHNICAL SPECIFICATION FOR SHEETING WORK IN ROOF AND SIDING

1.00.00 SCOPE

This specification covers the erection of corrugated fibre cement, C.G.I., aluminium, colour coated and other sheet covering to roof and side walls at various elevations, as shown on drawings and/or schedule of items.

2.00.00 INSTALLATION

2.01.00 Storage of Materials

All materials shall be stored by the LSTK Vendor in proper way to prevent any damage. If the materials are issued at site by the Owner, the LSTK Vendor shall at the time of issue, satisfy himself about the condition of issued sheets, gutters, etc. and no complaints shall be entertained later. If colour coated sheets are used, necessary storage recommendations of the sheet manufacturer shall be followed.

2.02.00 Workmanship

The workmanship shall be according to best construction practice to give a watertight finish to the satisfaction of the Engineer. Fixing of gutters and down pipes shall be according to IS:2527. In case of colour coated sheets, manufacturer's recommended installation of cladding, flashing and trimming shall be followed.

2.02.01 Corrugated Fibre Cement Sheeting

Asbestos free corrugated fibre cement sheets (e.g. Eternia or equivalent, manufactured as per IS:14871) shall be fixed with minimum 150 mm end lap and side laps as per manufacturer's specification. The sheets shall be fixed with the supporting members with GI Hook bolts or J-bolts of 8 mm dia., at 305 mm centers (max), with GI flat washers and bitumen washers. 8 mm dia galvanized iron seam bolt and nut with G.I. flat washers and bitumen washers shall also be used for stitching corner pieces.

2.02.02 C.G.I. Sheeting , Aluminium Sheeting and color coated aluminium sheeting

For these sheets side laps shall be 2 corrugations for roof and one corrugation for side sheeting. End laps shall be minimum 150 mm for roof and 100 mm for side sheeting. In ridges and hips where plain sheets are used the end laps shall be minimum 100 mm. Holes in C.G.I sheets shall preferably be made on the ground. The sheets should be placed on trestles and holes punched in the ridge of the corrugation from the outside inward for obtaining proper seating of limpet washers. Sheets shall be secured to the supporting members by 8 mm dia. galvanized iron hooks or J-bolts provided at a maximum spacing of 305 mm, with GI flat washers and bitumen washers. Sheets shall also be bolted at the ends at every third corrugation with 8 mm dia. galvanised iron seam bolts and G.I. flat washers and bituminous washers.

2.02.03 Fibre Glass Reinforced Plastic Sheeting

These sheets, if specified to be used, shall be of thickness and profile as mentioned in the drawings. Color and light transmittance shall be as mentioned in drawings and or schedules. Where used in conjunction with C.G.I. or other sheeting the profile end and side laps and fixing arrangement shall be same as specified for the main sheeting. In all cases, the installation shall be completely watertight and able to withstand the design wind and other applicable loading.

2.02.04 Color coated steel sheeting

If specified, precoated galvanized steel sheets, corrugated or provided with other approved profile and of approved make, is to be used. In these sheets the multiple layers of protective coatings must have been applied in the factory, during manufacture, in a continuous coil coating process as per IS:14246. The protective coatings shall be zinc, epoxy, polyester, LDPE etc., as specified. These sheets shall be fixed with the supporting members with polycoated hook bolts/self-tapping screws.

2.02.05 Galvanised / colour coated wind tie (FL. 45x6) shall be provided at all eaves and ridges which fixing the roof sheeting.

3.00.00 ACCEPTANCE CRITERIA

The installations shall present a neat appearance and shall be checked for water tightness. The following shall be checked:-

a) Side and end laps

b) Absence of cracks, holes or damages in sheet

c) Spacing of bolts

d) Provision of double washers (G.I. and bituminous washers) and use of sealant and seal lap as per sheet manufacture's recommendations.

e) Proper installation of flashing, copping and guttering

4.00.00 IS CODES

The following are some of the important IS Codes relevant to this section :-

IS : 277 : Specification for galvanized steel sheets (plain and corrugated).

IS : 2527 : Code of practice for fixing rain water gutters and down pipes for roof drainage.

IS : 3007 (Pt. I & II) : Code of practice for laying of asbestos cement sheets.

IS : 14246 : Continuously pre-painted galvanized steel sheets & coils-specification

IS : 14871 : Products in fibre reinforced cement–Long corrugated or asymmetrical section sheets & fittings for roofing and cladding-Specification

IS : 12866 : Specification for plastic translucent sheets made from thermosetting polyester resin (glass fibre reinforced)

SUB-SECTION NO. C6

TECHNICAL SPECIFICATION FOR MASONRY & ALLIED WORK

TECHNICAL SPECIFICATION
FOR
MASONRY & ALLIED WORK

CONTENTS

CLAUSE NO.	DESCRIPTION
1.0.0	SCOPE
2.0.0	INSTALLATION
3.0.0	I.S. CODES

TECHNICAL SPECIFICATION FOR MASONRY & ALLIED WORK

1.0.0 SCOPE

This specification covers furnishing, installation, repairing, finishing, curing, protection, maintenance till handing over of masonry and allied work for use in structures and locations covered under the scope of the Contract.

2.0.0 INSTALLATION

2.1.0 Soling

2.1.1 Brick Soling

The ground shall be dressed, consolidated by ramming or by light rolling and a 12 mm thick cushion of sand laid. On the sand cushion the bricks shall be laid with fine joints and placed firmly in position by hammering with wooden mallet. The surface shall be free from undulations. The 'frog' side shall be on the underside. Orientation shall be as desired by the Engineer. After laying of each layer of bricks sand shall be spread over and worked into the joints to pack the bricks tight.

2.1.2 Stone Soling

The stones for soling shall be selected on the basis of thickness of soling as shown in the drawings. The larger stones shall be laid and the gaps filled by smaller stones. The interstices shall then be firmly packed with sand by flooding with water.

2.2.0 Brick Edging

Excavation shall be done close to the brick dimensions and in perfect alignment. Bricks shall be firmly placed by hammering with wooden mallets and sides and joints packed firmly with earth so that the edging is not disturbed easily. Alignment and level shall be such that it is acceptable to the Engineer.

2.3.0 Masonry

2.3.1 General

All masonry work shall be true to lines and levels as shown on drawings. All masonry shall be tightly built against structural members and bonded with dowels, inserts etc. as shown on drawings.

2.3.2 Mortar

Mix for mortar shall be as specified in drawing.

When lime is used hydrated lime shall be mixed with water to form a putty and stored with care to prevent evaporation for at least 24 hours before use. Quick lime shall be slaked with enough water to make a cream, passed through a No. 10 seive and stored avoiding evaporation for seven days before use.

Lime putty and sand in proper proportion shall be mixed on a water-tight platform with necessary addition of water and thoroughly ground in a mortar mill. This mix shall be transferred to a mechanical mix, required quantity of cement added and the content mixed for at least 3 minutes. Mixtures of lime putty and sand may be stored avoiding drying out. For cement sand mortar cement and sand in requisite proportions shall be mixed dry in a mechanical mixer and then water added and mixed further. Minimum quantity of water shall be added to achieve working consistency.

Surplus mortar droppings from masonry, if received on surface free from dirt may be mixed with fresh mortar if permitted by the Engineer who may direct addition of additional cement without any extra payment. No mortar which has stood for more than half an hour shall be used.

2.3.3 Brick Masonry

Bricks shall be soaked by submergence in clean water for at least two hours in approved vats before use. Bricks shall be laid in English bond unless specified otherwise. Broken bricks shall not be used. Cut bricks shall be used if necessary to complete bond or as closers. Bricks shall be laid with frogs upwards over full mortar beds. Bricks shall be pressed into mortar and tapped into final position so as to embed fully in mortar. Inside faces shall be buttered with mortar before the next brick is placed and pressed against it. Thus all joints between bricks shall be fully filled with mortar.

Mortar joints shall be kept uniformly 10 mm thick. All joints on face shall be raked to minimum 10 mm depth using raking tool while the mortar is still green to provide bond for plaster or pointing. Where plaster or pointing is not provided, the joints shall be struck flush and finished immediately. Brickwork two bricks thick or more shall have both faces in true plane. Brickwork of lesser thickness shall have one selected face in true plane.

2.3.4 Exposed Brickwork

Brickwork in superstructures which is not covered by plaster shall be as shown on drawing and executed by specially skilled mason. Courses shall be truly horizontal and vertical joints truly vertical. Wooden straight edges with brick course graduations and position of window sills and lintels shall be used to control uniformity of brick courses. Masons must check workmanship frequently with plumb, spirit level, rule and string. All brick-work shall be cleaned at the end of days work. If face bricks are specified in the drawings, the brickwork shall be in composite bricks, with face bricks on the exposed face and balance in routine bricks, but maintaining the bond fully. Where face bricks are not specified, bricks for the exposed face shall be specially selected from routine bricks. All exposed brickwork on completion of work shall be rubbed down, washed clean and pointed as specified. Where face bricks are used carborandum stone shall be used for rubbing down.

2.3.5 Reinforced Brickwork

Reinforcements shall be as specified in the drawings. All reinforcements shall be thoroughly cleaned and fully embeded in mortar. Where M.S. bars are used as reinforcement, these shall be lapped with dowels if left in R.C. columns or welded to steel stanchions.

2.3.6 Stone Masonry

Stones shall be thoroughly soaked before laying. Stones shall be laid on their natural quarry beds. Individual stones shall be fitted with mallet and properly wedged to reduce thickness of mortar joints. Thickness of joint shall be not less than 8 mm and not greater than 25 mm. Al least two stones shall run the full width of the wall for every square meter of surface area.

2.3.7 Exposed Stonework

Stonework which is to be kept exposed shall be as shown on drawing or described in the Schedule of Items. It shall be executed by specially skilled mason. Stones used for exposed face shall be specially selected. All exposed stone faces shall be kept clean and free from mortar and pointed up neatly as the work proceeds in a manner called for in the drawings or the Schedule of Items or instructions. A sample wall, 10 sq.m. in area shall be built and approved by the Engineer and all work shall match with this sample.

2.3.8 Composite Masonry

Where stonework facing with brick masonry backing is specified the bond between them shall be achieved by bond stones of dimensions and frequency as desired by the Engineer.

2.3.9 Expansion & Separation Joints

Location of joints shall strictly be as shown on drawings or as instructed by the Engineer. Expansion joints shall be as shown on drawings. Expansion joint filler boards and sealing strips shall have minimum transverse joints. Transverse joints shall meet the approval of the Engineer.

Separation joints shall be with standard water proof paper or with alkathene sheets about 1 mm in thickness. Length and sealing of laps shall be to the satisfaction of the Engineer.

2.3.10 Mouldings, Cornices, Drip Course

These shall be made as shown in drawings. Bricks or stone shall be cut and dressed as required. If no subsequent finish is envisaged, these shall be rubbed to correct profile with carborandum stone.

2.3.11 Curing

Masonry shall be cured by keeping it wet for seven days from the date of laying. In dry weather at the end of days work top surface of masonry shall be kept wet by ponding.

2.3.12 Embedding of fixtures

All fixtures shall generally be embedded in mortar and masonry units shall be cut as required.

2.3.13 Encasing of Structural Steel

This shall be done by building masonry work around flanges, webs etc. and filling the gap between steel and masonry by minimum 12 mm thick mortar. Encased members shall be wrapped with chicken wire mesh when shown on drawings or instructed by the Engineer. The minimum lap in chicken wire mesh shall be 50 mm.

2.4.0 Damp Proof Course

Unless otherwise specified Damp-proof course shall be 40 mm thick 'artificial stone' in proportion 1 :1.5 :3 cement sand stone-chips (10 mm down) with admixture of a waterproofing compound as approved by the Engineer. The percentage of admixture shall be as per manufacturer's specifications but not less than 2% by weight of cement. The top surface shall be double chequered and cured by ponding for seven days.

2.5.0 Damp Proof Membrane

Damp proof treatment using fibre or hessian base bitumen felt shall be 6, 8 or 10 course treatment as specified in IS:1609. The number of courses shall be as mentioned in the schedule of items. Sequence or work shall be as directed by the Engineer. Extreme care shall be taken to prevent damage to felt during and after laying. The LSTK Vendor shall be obliged, at his own expense, to rectify any leakage appearing within 5 years of installation by removing and renewing the coats at the point of leakage.

Where shown on drawing, damp proof membrane with one layer bitumen paper or one layer alkathene sheet shall be laid with minimum 150 mm lap under slabs on grade.

3.0.0 I.S. CODES

Some of the important relevant codes for this section are:-

IS:1127	:	Recommendations for dimensions and workmanship of natural building stones for masonry work.
IS:1597	:	Code of Practice for Construction of stone Masonry.

IS:1609	:	Code of Practice for laying Damp-proof treatment using bitumen felts.
IS:2212	:	Code of Practice for Brickwork.
IS:2250	:	Code of Practice for preparation and use of Masonry Mortar.
IS:5134	:	Bitumen Impregnated Paper & Board.

SUB-SECTION NO. C7

TECHNICAL SPECIFICATION FOR FINISH TO MASONRY & CONCRETE

TECHNICAL SPECIFICATION
FOR
FINISH TO MASONRY & CONCRETE

CONTENTS

CLAUSE NO.	DESCRIPTION
1.0.0	SCOPE
2.0.0	INSTALLATION
3.0.0	ACCEPTANCE CRITERIA
4.0.0	I.S. CODES

TECHNICAL SPECIFICATION FOR FINISH TO MASONRY & CONCRETE

1.0.0 SCOPE

This Specification covers furnishing, installation, repairing, finishing, curing, testing, protection, maintenance till handing over of finishing items for masonry and concrete. This shall also include the work to be done to make the surface suitable for receiving the finishing treatment. Before commencing finishing items the LSTK Vendor shall obtain the approval of the Engineer regarding the scheduling of work to minimize damage by other trades. He shall also undertake normal precaution to prevent damage or disfiguration to work of other trades or other installation.

2.0.0 INSTALLATION

2.1.0 Preparation of Surface

All joints in masonry walls shall be raked out to a depth of at least 10 mm with a hooked tool made for the purpose while the mortar is still green. Walls shall be brushed down with stiff wire brush to remove all loose dust from joints and thoroughly washed with water. All laitance shall be removed from concrete to be plastered.

For all types of flooring, skirting and dado work, the base cement concrete slab or masonry surface shall be roughened by chipping and cleaned of all dirt, grease or loose particles by hard brush and water. The surface shall be thoroughly moist to prevent absorption of water from the base course. Any excess water shall be mopped up.

At any point, the level of base shall be lower than the theoretical finished floor level by the thickness of floor finish. Any chipping or filling to be done to bring the base to the required level shall be brought to the notice of the Engineer and his approval shall be taken regarding the method and extent of rectification work required.

Prior to commencement of actual finishing work, the approval or the Engineer shall be taken as to the acceptability of the base.

2.2.0 Plastering

2.2.1 Mortar

Mortar for plastering shall be as specified in the drawings.

For sand cement plaster, sand and cement in the specified proportion shall be mixed dry on a watertight platform and minimum water added to achieve working consistency.

For lime gauged plaster, lime putty or hydrated lime and sand in the required proportion shall be mixed on a watertight platform with necessary addition of

water and thoroughly ground in mortar mill. This mix shall then be transferred to a mechanical mixer to which the required quantity of cement is added and mixed for at least 3 minutes.

No plaster which has stood for more than half-an-hour shall be used. Plaster that shows tendency to become dry before this time, shall have water added to it.

2.2.2 Application of Plaster

Plaster, when more than 12 mm thick, shall be applied in two coats - a base coat followed by the finishing coat. Thickness of the base coat shall be sufficient to fill up all unevenness in the surface; no single coat, however, shall exceed 12 mm in thickness. The lower coat shall be thicker than the upper coat, the overall thickness of the coats shall not be less than the minimum thickness shown on the drawings. The undercoat shall be allowed to dry and shrink before applying the second coat of plaster. The undercoat shall be scratched or roughened before it is fully hardened to form a mechanical key. The method of application shall be 'thrown on' rather than 'applied by trowel'.

To ensure even thickness and true surface, patches of plaster about 100 mm to 150 mm square or wooden screed 75 mm wide and of the thickness of the plaster, shall be fixed vertically about 2000 mm to 3000 mm apart, to act as gauges. The finished wall surface shall be true to plumb, and the LSTK Vendor shall, without any extra cost to the Owner, make up any irregularity in the brickwork with plaster.

All vertical edges of brick pillars, door jambs etc. shall be chamfered or rounded off as directed by the Engineer. All drips, grooves, mouldings and cornices as shown on drawing or instructed by the Engineer shall be done with special care to maintain true lines, levels and profiles. After the plastering work is completed, all debris shall be removed and the area left clean. Any plastering that is damaged shall be repaired and left in good condition at the completion of the job.

2.2.3 Finish

Generally, the standard finish shall be used unless otherwise shown on drawing or directed by the Engineer. Wherever any special treatment to the plastered surface is indicated, the work shall be done exactly as shown on the drawings, to the entire satisfaction of the Engineer regarding the texture, colour and finish.

a) Standard Finish

Wherever punning is indicated, the interior plaster shall be finished rough. Otherwise the interior plaster shall generally be finished to a smooth surface. The exterior surface shall generally be finished with a wooden float.

b) Neat Cement Finish

Immediately after achieving a true plastered surface with the help of a wooden straight edge, the entire area shall be uniformly treated with a

paste of neat cement at the rate of one (1) kg. per Sq.M. and rubbed smooth with a trowel.

c) Coloured Plaster Finish

This shall be done in the same way as specified in Clause 2.2.2 but using colored cement in place of ordinary cement. When colored plastering is specified in more than one coat, the top coat only shall be made with colored cement.

Coloured cement shall be either ready mixed material or may be obtained by mixing pigments and cement at site, as approved by the Engineer. The pigments to be mixed with cement shall conform to Appendix-A of IS:2114, latest edition. Samples of colouring material shall be submitted to the Engineer for approval and material procured, shall conform in all respects to the approved samples, which shall remain with the Engineer. All colored cement and/or pigments shall be stored in an approved manner in order to prevent deterioration.

d) Pebble-dash Finish

Mortar of required thickness consisting of 1 part cement and 4 parts sand by volume shall be applied in the usual manner as described under plastering Clause 2.2.2. While the mortar is still plastic small pebbles or crushed stone of size generally from 10 mm to 20 mm as approved by the Engineer shall be thrown on the plastered surface. The aggregate shall be lightly tapped into the mortar with a wooden float or the flat end of a trowel, in order to ensure satisfactory bond between the dashing and the mortar.

e) Rough-Cast Finish

A wet plastic mix of 3 parts colored cement, 6 parts sand and 4 parts aggregate by volume (gravel or crushed stone of size from 6 mm to 12 mm as approved by the Engineer) shall be thrown on to the wall by means of a plaster's trowel and left in the rough condition.

f) Scraped Finish

Ordinary plaster as described under Clause 2.2.2 after being levelled and allowed to stiffen for a few hours, shall be scraped with a steel straight edge to remove the surface skin. The pattern shall be as approved by the Engineer.

g) Textured Finish

Mortar consisting of 1 part cement and 3 parts sand by volume shall be applied in a manner as specified under "Plastering" Clause 2.2.2. Ornamental treatments in the form of horizontal or vertical rib texture, fan texture etc. shall be applied by means of suitable tools to the freshly applied plastered surface, as approved by the Engineer.

2.2.4 Curing

All plastered surfaces after laying, shall be watered, for a minimum period of seven days, by an approved method, and shall be protected from excessive heat and sunlight by suitable approved means. Moistening shall commence, as soon as the plaster has hardened sufficiently and not susceptible to damage. Each individual coat of plaster shall be kept damp continuously, for at least two days, and then dried thoroughly, before applying the next coat.

2.3.0 Pointing to Masonry

All joints of brickwork shall be raked out to a depth of 10 mm with a hooked tool made for the purpose while the mortar is still green. The brickwork shall then be brushed down with a stiff wire brush, so as to remove all loose dust from the joints and thoroughly washed with water. Mortar consisting of 1 part cement and 3 parts clean, sharp, well graded sand by volume shall be pressed carefully into the joints and finished with suitably tools to shape as shown on the drawings. Any surplus mortar shall be scraped off the wall face leaving the surface clean.

The pointed surface shall be kept wet for at least three days for curing.

2.4.0 Plaster with Metal Lath

The supports, hangers, brackets, cleats etc. shall be as shown on drawings and/or as approved by the Engineer. These shall have a coat of prime paint before and another coat of approved paint after erection.

The metal lath shall be expanded metal, with 12 mm x 38 mm mesh, 16 BG thick and 3 mm wide strands. Side laps shall be minimum 12 mm and end laps 25 mm minimum. The plastering shall be minimum 20 mm thick measured from the back of lath and applied in two layers.

The mortar for plastering shall consist of 1 part cement, 1/2 part lime and 4 parts sand by volume, or 1 part cement and 4 parts sand by volume mixed as specified in plastering, Clause 2.2.1. The application, finish etc. shall be as specified under relevant clause above. Where called for in the Schedule of Items, a 2 mm Plaster of Paris punning shall be applied over plaster as a finishing coat to give perfectly smooth and even finish.

2.5.0 Lime Punning

For plastered surfaces, where an even smooth surface is specified, lime punning with 5 parts of shell lime properly slaked, strained and aged, mixed with 1 part clean, washed, sieved, fine sand by volume shall be done. The thickness of lime punning shall be not less than 2 mm and more than 3 mm. The plastered surface shall be saturated with water before application of the lime punning. The punning shall be applied by skilled workman and given a smooth and even finish free from undulations, cracks etc. and to the satisfaction of the Engineer.

2.6.0 Plaster of Paris Punning

Plastered surfaces, where specified shall be finished with Plaster-of-Paris punning. The material shall be from approved manufacturers and approved by the Engineer. The thickness of the punning shall be 2 mm and shall be applied by skilled workmen. The finish shall be smooth, even and free from undulation, cracks etc.

Before bulk work is taken in hand, a sample of punning shall be done on roughly 10 Sq.M. area and approval of the Engineer taken. The work shall then be taken in hand as per approved sample.

2.7.0 Stone Facing

Stone facing where specified shall be done as shown on design drawings and approved shop drawings. The stone shall be as specified on drawings and/or schedule of items. Samples of stone shall be submitted to the Engineer for approval & then bulk purchase made. The LSTK Vendor shall submit three copies of shop drawing for the Engineer's approval before commencing the work.

The thickness of facing stone shall be not less than 25 mm unless otherwise specified on drawings.

The stone slabs shall be cut and finished to sizes as per pattern shown on drawings. They shall be fastened to wall with suitable non-corrodible anchorage as approved by the Engineer. Where mild steel clamps, stays etc. are used for anchorage, they shall be galvanized (weight of zinc coating shall not be less than 700 gms per square meter of surface) to prevent rust stains developing on the finished surface. There shall be at least 12 mm gap between the stone and masonry, which shall be filled up and packed by a mortar of 1 part cement and 3 parts of sand by volume. After the mortar is set and cured for at least four days, the exposed surface shall be rubbed and polished as approved by the Engineer. The completed surface shall be neat, with uniform texture and acceptable to the Engineer.
Where pointing is specified on drawings it shall be done by mortar as specified on drawings and/or Schedule of Items.

3.0.0 ACCEPTANCE CRITERIA

Finish to masonry and concrete shall fully comply with the Specifications, approved samples and instructions of the Engineer with respect to lines, levels, thickness, colour, texture, pattern and any other special criteria as mentioned in the body of the specification or as shown on drawings.

4.0.0 I.S. CODES

Important relevant codes for this Section are:-

a) IS:1661 : Code of practice for cement and cement-lime plaster finish on walls & ceilings.

b) IS:4101 : Code of practice for external facings and veneers.

SUB-SECTION NO. C8

TECHNICAL SPECIFICATION FOR FLOOR FINISHES AND ALLIED WORK

TECHNICAL SPECIFICATION
FOR
FLOOR FINISHES AND ALLIED WORK

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TECHNICAL SPECIFICATION FOR FLOOR FINISHES AND ALLIED WORKS

1.0.0 SCOPE

This specification covers furnishing, installation, finishing, curing, testing, protection, maintenance till handing over various types of floor finishes and allied items of work as listed below :

a) In Situ Finishes

- i) Integral finish to concrete base
- ii) Red Oxide of Iron finish
- iii) Terrazzo finish
- iv) Granolithic finish
- v) Patent Stone
- vi) Metallic Hardener like "Ironite" finish
- vii) Mastic Asphalt finish
- viii) Chemical Resistant finish

b) Tiled Finishes

- i) Terrazzo tile
- ii) Chequered tile
- iii) Glazed tile
- iv) Terrazzo (Mosaic etc.)
- v) Chemical Resistant
- vi) Rubber, Vinyl etc.
- vii) Stone Slab

1.0.1 Base

The base to receive the finish is covered under other relevant specifications.

1.0.2 Sequence

Commencement, scheduling and sequence of the finishing works shall be planned in detail and must be specifically approved by the Engineer in view the activities of

other agencies working in that area. However, the LSTK Vendor for the finishing items shall remain fully responsible for all normal precautions and vigilance to prevent any damage whatsoever till handing over.

2.0.0 INSTALLATION

2.0.1 Special Materials

Basic materials are covered under Specification "Properties Storage and Handling of Common Building Materials". Special materials required for individual finishing items are specified under respective items. In general, all such materials shall be as per relevant I.S. Codes where available. In all cases these materials shall be of the best quality available indigenously, unless specified otherwise.

The materials for finishing items must be procured from well-reputed specialized manufacturers and on the basis of approval of samples by the Engineer. The materials shall be ordered, procured and stored well in advance to avoid compulsion to use substandard items to maintain in the construction schedule.

2.0.2 Workmanship

Only workers specially experienced in particular items of finishing work shall be engaged. Where such workers are not readily available, with the Engineer's permission, experienced supervisors recommended by the manufacturer shall be engaged. In particular cases where the Engineer so desires the LSTK Vendor shall get the finishing items installed by the manufacturer.

2.0.3 Preparation of the Base Surface

The surface to be treated shall be thoroughly examined by the LSTK Vendor. Any rectification necessary shall be brought to the notice of the Engineer and his approval shall be taken regarding method and extent of such rectification work.

For all types of flooring, skirting, dado and similar locations, the base to receive the finish shall be adequately roughened by chipping, raking out joints and cleaning thoroughly all dirts, grease etc. with water and hard brush and detergent if required, unless otherwise directed by the manufacturer of any special finishing materials or specifically indicated in this specification under individual item.
To prevent loss of water from the finishing treatment the base shall be thoroughly soaked with water and all excess water mopped up.

The surface shall be made dry where adhesives are used for fixing the finishes.

Prior to commencement of actual finishing work the approval of the Engineer shall be taken as per the acceptability of the surface.

2.1.0 In-Situ Finishes

2.1.1 Integral Finish To Concrete Base

While the surface of the concrete laid as per specification for 'Cement Concrete' has been fully compacted and levelled but the concrete is still 'green' a thick slurry made

with neat cement shall be applied evenly and worked in with iron floats. When the slurry starts to set it shall be pressed with iron floats to have a firm compact smooth surface without trowel mark or undulations. This finish shall be as thin as possible by using 2.2 kg. of cement per Sq. M. of area.

The surface shall be kept in shade for 24 hours and then cured for at least 7 days continuously by flooding with water. The surface shall not be subjected to any load or abrasion till 21 days after laying.

As desired by the Engineer the surface, while still 'green' shall be indented by pressing strings. Te marking shall be of even depth, in straight lines and the panels shall be of uniform and symmetrical patterns.

2.1.2 Red Oxide of iron Finish

It shall consist of an underbed and a topping over already laid and matured concrete base.

a) Thickness

Unless otherwise specified the total thickness of the finish shall be minimum 40 mm for horizontal and 25 mm for vertical surface of which the topping shall (not less than 10 mm) while the topping shall be of uniform thickness the underbed may vary in thickness to provide necessary slopes. The vertica surface shall project out 6 mm from the adjacent plaster or other finishes. Necessary cutting into the surface receiving the finish shall be done to accommodate the specified thickness.

All junctions of vertical with horizontal shall be rounded neatly to uniform radius of 25 mm.

b) Mix

i) Underbed

The underbed for floors and similar horizontal surfaces shall consist of a mix of 1 part cement, 2 parts coarse sand and 4 parts 10 mm down graded stone chips by volume. For vertical and similar surfaces the mix shall consist of 1 part cement to 3 parts coarse sand by volume.

ii) Topping

For the topping cement, screened through a fine mesh and red oxide of iron pigment powder similarly screened shall be dry mixed thoroughly in right proportions to produce the desired colour when laid. The mix shall then be prepared with 1 part cement (mixed with pigment) and 3 parts coarse sand volume. The whole quantity required for each visible area shall be prepared in one batch to ensure uniform colour.

c) Laying

The underbed shall be laid in panels of mixing area 5 Sq.M. each and no side shall be more than 2.5M long. For outdoor locations the maximum area shall be 2.0 Sq.M. The forms for the panels shall have perfectly aligned edges to the full depth of the total thickness of finish. If specified aluminium or glass dividing strips shall be used.

The panels shall be laid in alternate bays or in chequered board pattern. No panel shall be cast in contact with another already laid until the contraction of the latter has taken place. The underbed shall be laid, compacted, levelled and brought to proper grade with a screed or float. The topping shall be placed after about 24 hours while the underbed is still somewhat 'green' but firm enough to receive the topping. The surface of the underbed shall be roughened for better bonding. The topping shall be rolled for horizontal areas and thrown and pressed for vertical areas to extract all superfluous cement and water to achieve a compact dense mass fully bonded with the underbed. The topping shall then be levelled up by trowelling and finished smooth with slurry made with already prepared cement and pigment mixture. About 2.0 Kg. of the mixture shall be consumed per Sq.M. for horizontal surface, and 1.0 Kg. for vertical surface. The surface shall be cured for seven days by keeping it moist.

d) Polishing

About 36 hours after laying when the surface has hardened sufficiently it shall be polished with polishing stone till a smooth shiny surface, to the satisfaction of the Engineer, is achieved. The finish shall be washed and cleaned just before handing over.

2.1.3 Terrazzo Finish: In-Situ

It shall consist of an underbed and a topping laid over an already laid and matured concrete base.

a) Thickness

Unless otherwise specified the total thickness of the finish shall be minimum 40 mm for horizontal and 25mm for vertical surface of which the topping shall be not less than 10 mm. While the topping shall be of uniform thickness the underbed may vary in thickness to provide necessary slopes. The vertical surface shall project cut 6 mm from the adjacent plaster or other finish. Necessary cutting into the surface receiving the finish shall be done to accommodate the specified thickness.

All junctions of vertical with horizontal shall be rounded neatly to uniform radius of 25 mm.

b) Mix

i) Underbed

The underbed for floors and similar horizontal surfaces shall consist of a mix of 1 part cement, 1.5 parts sand and 3 parts stone chips by volume. For vertical surfaces the mix shall consist of 1 part cement to 3 parts sand by volume. The sand shall be coarse. The stone chips shall be 10 mm down well graded. Only sufficient water to be added to give a workable consistency.

ii) Topping

The mix for the topping shall be composed of cement, colour pigment, marble dust and marble chips. Proportions of the ingredients shall be such as to produce the terrazzo of colour texture and pattern approved by the Engineer. The cement shall be white or grey or a mixture of the two to which pigment shall be added to achieve the desired colour. To 3 parts of this mixture 1 part marble powder by volume shall be added and thoroughly mixed dry. To 1 part of this mix 1 to 1.5 parts of marble chips by volume shall be added and thoroughly mixed dry again.

The pigment must be stable and nonfading. It must be very finely ground. The marble powder shall be from white marble and shall be finer than IS Sieve No. : 30. The size of marble chips may be between 1 mm to 20 mm.

Sufficient quantity to cover each visible area shall be prepared in one lot to ensure uniform colour. Water to make it just workable shall be added to a quantity that can be used up immediately before it starts to set.

c) Laying

The underbed shall be laid in panels. The panels shall not be more than 5 sq.m in area of which no side shall be more than 2.5 M long. For exposed locations the maximum area of a panel shall be 2.0 Sq.M. The panel shall be laid in alternate bays or chequered board pattern. No panel shall be cast in contact with another already laid until the latter has contracted to the full extent.

Dividing strips made of aluminium or glass shall be used for forming the panels. The strips shall exactly match the total depth of underbed plus topping.

After laying, the underbed shall be levelled, compacted and brought to proper grade with a screed or float. The topping shall be laid after about 24 hours while the underbed is still somewhat "green" but firm enough to receive the topping. A slurry of the mixture of cement and pigment

already made shall be spread evenly and brushed in just before laying the topping. The topping shall be rolled for horizontal areas and thrown and pressed for vertical areas to extract all superfluous cement and water and to achieve a compact dense mass fully bonded with the underbed. The surface of the topping shall be trowelled over, pressed and brought to a smooth dense surface showing a minimum 75% area covered by marble chips in an even pattern of distribution.

d) Curing

The surface shall be left for curing for about 12 to 18 hours and then cured by allowing water to stand on the surface or by covering with wet sack for four days.

e) Grinding and Polishing

When the surface has sufficiently hardened it shall be watered and ground evenly with rapid cutting coarse grade (no.60) grit blocks, till the marble chips are exposed and the surface is smooth. Then the surface shall be thoroughly washed and cleaned. A grout with already prepared mixture of cement and pigment shall be applied to fill up all pinholes. The surface shall be cured for 7 days by keeping it moist and then ground with fine grit blocks (no.: 120). It shall again be cleaned with water, the slurry applied again to fill up any pinholes that might have appeared and allowed to be cured again for 5 days. Finally, the surface is ground a third time with very fine grit blocks (no.: 320) to get smooth surface without any pinhole. The grinding shall be done by a suitable machine. Where grinding machine cannot be used hand grin- ding may be allowed when the first rubbing shall be with carborundum stone of coarse grade (no.60), second rubbing with medium grade (no.: 80) and final rubbing and polishing with fine grade (no.: 120). The surface shall be cleaned with water, dried and covered with soil free, clean sawdust if directed by the Engineer. The final polishing shall be positioned till before handing over if desired by the Engineer. Just before handing over the surface shall be dusted with oxalic acid at the rate of 0.33 gm. per. Sq.M, water sprinkled on to it and finished by buffing with felt or hessian bobs. The floor shall be cleaned with soft moist rag and dried. However, all excess wax polish to be wiped off and the surface to be left glossy but not slippery.

2.1.4 Granolithic Finish

Granolithic finish shall either be laid monolithically over base concrete or separately over hardened base concrete.

a) Thickness

The finish shall be average 20 mm and minimum 12 mm thick, unless specified otherwise.

b) Mix

The mix shall consist of 1 part cement : 1 part coarse sand : 2 parts coarse aggregate by volume. The coarse aggregate shall be very hard like granite and well graded between 6 mm and 12 mm. Minimum quantity of water to get workability shall be added.

c) Laying of Monolithic Topping

The concrete base shall be laid as per specification for "Cement Concrete" and levelled up to the required grade. The form shall remain sufficiently protruding to take the finish.

Within about 3 hours of laying the base while it is still "green" the topping shall be laid evenly to proper thickness and grade. If considered necessary the surface of the base shall roughened by wire brushing. Unless manual operation is permitted by the Engineer, mechanical vibrators of suitable design shall be used to press the topping firmly and work vigorously and quickly to secure full bond with concrete base.

The laitance brought to the surface during compression shall be removed carefully without disturbing the stone chips. The surface shall then be lightly trowelled to remove all marks. When sufficiently set, hand trowelling shall be done to secure a smooth surface without disturbing the stone chips.

For large areas the laying shall be in panels of maximum 25 Sq. Area. The panels shall be laid in chequered board pattern.

d) Laying of Topping Separately on Hardened Base

The base concrete shall be prepared as stated in clause 2.0.3 and a slurry of neat cement applied just prior to laying the granolithic concrete mix (1:1:2). The method of compaction etc. shall be same as for monolithic topping.

e) Curing

Immediately after laying, the finish shall be protected against rapid drying. As soon as the surface had hardened sufficiently, it shall be kept continuously moist for at least 10 days by means of wet gunny bags or pounding of water on the surface. The floor shall not be exposed to heavy traffic during this period.

f) Grinding

If grinding is specified, it shall start only after the finish has fully set. Clause 2.1.3 (c) shall be followed. However, the ultimate polish required shall be decided upon by the Engineer.

g) Finishing

Where specified, sodium silicate or magnesium or zinc silicon fluoride treatment shall be done. The number of coats to be applied shall be as specified in the Schedule of Items. The concentration and method of application of the solutions shall be as specified in IS : 5491.

2.1.5 Patent Stone

It shall consist of an underbed and a topping laid on an already laid and matured concrete base.

a) Thickness

The patent stone finish shall have thickness as stipulated under clause 2.1.2 (a) except that the topping shall be 6 mm thick.

b) Mix

i) Underbed

The mix shall be as stipulated under clause 2.1.3(b).

ii) Topping

The mix for the topping shall consist of 1 part cement and 1 part fine sand by volume.

c) Laying

The Patent Stone finish, including the underbed shall be laid in alternate bays or in chequered board pattern. No panel shall be cast in contact with another already laid till the contraction of the latter has already taken place.

The maximum area of each panel shall be 3 Sq.M of which no side shall be more than 2 M long.

A cement grout shall be applied and worked into the surface to receive the finish, the underbed then laid, compacted and levelled to proper grade with a screed or float. The topping shall be applied evenly on the underbed while it is not fully set but firm enough and rolled and pressed to get full bond.

The topping shall trowelled to a dense finish to the satisfaction of the Engineer. All trowel marks shall be mopped out with a soft cloth to give a clean smooth surface.

After the surface is sufficiently set, the finished floor shall be kept moist for 7 days for curing. If desired the finish shall be polished as directed by the Engineer.

2.1.6 Metallic Hardener Like "Ironite" Finish

This shall consist of a topping (incorporating iron particles) to bond with concrete base while the latter is "Green".

a) Thickness

Unless otherwise specified the metallic hardener finish shall be of 12 mm depth.

b) Material

The hardening compound shall be uniformly graded iron particles free from non-ferrous metal impurities, oil, grease, sand soluble alkaline compounds or other injurious materials. When desired by the Engineer, actual samples shall be tested.

c) Mix

Proportion of the metallic hardener shall be as specified or as indicated by the manufacturer. However, in absence of any such direction 1 part metallic hardener shall be mixed dry with 4 parts cement, by weight. To this mixture 6 mm nominal size stone chips shall be added in proportion of 1 part cement (mixed with hardener) to 2 parts of stone chips by volume and uniformly mixed. Minimum quantity of water shall be added to make it workable.

d) Laying

The concrete floor shall be laid as per specification for "Cement Concrete" an levelled up to the required grade. The forms, if any shall remain sufficiently projecting to take the finish. The surface shall be roughened by wire brush as soon as possible.

The finish shall be laid while the concrete underbed is still" green" within about 3 hours of laying of the latter. The finish shall be of uniform thickness and even dense surface without trowel marks, pin holes etc. This topping layer shall be pressed firmly and worked vigorously and quickly to secure full bond with the concrete base. Just when the initial set starts the surface shall be finished /smoothened with steel trowel.

The finished floor shall be cured for 7 days by keeping it wet.

2.1.7 Mastic Asphalt Finish

This is a one layer treatment on concrete or brick base.

a) Thickness

The thickness shall be as specified in the drawing or schedule of items.

b) Materials

Bitumen shall be industrial bitumen of the grades 90/15 and 75/15 conforming to IS: 702.

Mineral filler shall be dry stone dust passing through 75-micron IS Sieve.

Fine aggregate shall be crushed and graded natural lime stone or other approved aggregate.

Coarse aggregate shall be crushed siliceous stone or other approved aggregate. 6 mm stone chips shall be used for finish up to 20 mm thick & 10 mm chips for thicker finish.

c) Composition

Bitumen mastic shall conform to IS: 1195 and shall be either brought to site in blocks weighing about 25Kg. or prepared at site. If brought in blocks, these shall be remelted in mechanically agitated mastic cookers and coarse aggregate, preferably preheated fed in successive portions until the complete change is thoroughly incorporated. At no stage during the remelting and mixing process, shall the temperature exceed 205°C.

d) Laying

The hot mastic shall be laid on dry base surface cleaned thoroughly by wire brushing and sweeping. The mastic shall be levelled and when cooled to some extent shall be finished with a wooden float with addition of small quantity of fine sand if required. No load shall be allowed till the finish has cooled to normal temperature.

The mastic shall be laid in suitable panels of about 15 Sq.M in area each formed by formers. Succeeding panels shall be laid overlapping the finish panel so as to melt its edges and form a continuous finish without joint.

2.1.8 Chemical Resistant in Situ Finish

Chemical resistant in situ finish shall be epoxy resin with suitable filler material over a primer or as called for in the Schedule of Items. The minimum thickness shall be 6 mm. About its performance the Engineer shall have to be fully satisfied by test results and examination of similar treatment already in existence.

The LSTK Vendor shall get it done by a specialized manufacturer, get guarantee of performance from the organization and pass it on to the Owner in addition to his own guarantee.

2.2.0 Tiled Finish

These shall include finish tiles, stone slabs and similar manufactured or natural items laid over a matured base of concrete or masonry with an underbed or an adhesive layer.

2.2.1 Terrazzo Tile Finish

The finish will consist of manufactured terrazzo tiles and an underbed.

a) Thickness

The total thickness including the underbed shall be minimum 40 mm for floors and 30 mm for walls unless otherwise specified.

The skirting, dado and similar vertical surfaces shall project out 6 mm uniformly from the adjacent plaster or other wall finishes. The necessary cutting into the surface receiving the tiled finish, to accommodate the specified thickness shall be done.

b) Tiles: Terrazzo

The tiles shall, unless specifically permitted in special cases be machine made under quality control in a shop. The tiles shall be pressed hydraulically to a minimum of 140 Kg. per Sq.cm.

Each tile shall bear on its back permanent and legible trade mark of the manufacturer. All angles of the tiles shall be right angles all arises sharp and true, colour and texture of the wearing face uniform throughout. Maximum tolerance allowance on length and breadth shall be $\pm$ 1 mm and on thickness + 3 mm. Face of the tile shall be plane, free from pin holes and other blemishes.

The tiles shall be composed of a backing and topping. The topping shall be of uniform thickness not less than 10 mm. The total thickness including the topping shall be as specified but not less than 20 mm in any case.

The backing shall be composed of 1 part ordinary grey cement and 3 parts of stone chips by weight mixed with water.

The topping shall be as specified under clause 2.1.3 (b).

The tiles shall be cured at the shop for at least 14 days before delivery to the site. First grinding shall be given to the tiles at the shop before delivery. Tiles shall be packed properly to prevent damage during transit and storage. The tiles must be carefully stored to prevent staining by damp, rust, oil, and grease or other chemicals.

Tiles made in each batch shall be kept and used separately so that colour of each area of the floor may remain uniform.

The manufacturer shall supply along with the tiles the grout mix containing cement and pigment in exact proportions as used in topping of the tiles. The containers for the grout mix shall be suitably marked to relate it to the particular type and batch of tiles.

c) Mix: Underbed

The underbed for floor and similar horizontal surfaces shall be 1 part lime putty: 1 part surkhi : 2 parts coarse sand by weight mixed with sufficient water to form a stiff workable mass. For skirting and dado and all vertical surfaces it shall be about 12 mm thick and composed of 1 part cement and 3 parts coarse sand by weight.

d) Laying

The underbed mortar shall be evenly spread and brought to proper grade and consolidated to a smooth surface. The surface shall be roughened for better bond. Before the underbed had time to set and while it is still fairly moist but firm, cement shall be hand dusted over it or a cement slurry applied and the tiles shall immediately be placed upon and firmly pressed by wooden mallet on to the underbed until it achieves the desired level. The tiles shall be kept soaked for about 10 minutes just before laying. The joints between tiles shall be as close as possible and not more than 1.5 mm wide.

Special care shall be taken to check the level of the surface and the lines of the joints frequently so that they are perfect.

When tiles are required to be cut to match the dimensions these shall be sawn and edges rubbed smooth. The location of cut tiles shall be planned in advance and approval of the Engineer taken.

At the junction of horizontal surface with vertical surface the tiles on the former shall enter at least 12 mm under the latter.

After fixing, the floor shall be kept moist and allowed to mature undisturbed for 7 days. Heavy traffic shall not be allowed.

If desired dividing strips as specified under Clause 2.1.3 (c) may be used for dividing the work into suitable panels.

e) Grinding and Polishing

Procedure shall be same as Clause 2.1.3 (e). Grinding shall not commence earlier than 14 days after laying of tiles

2.2.2 Chequered Tile Finish

The finish shall consist of manufactured grey or colored cement tiles or terrazzo tiles with chequered face and an underbed laid over concrete or brick surface.

a) Thickness

Thickness shall be same as in clause 2.2.1 (a).

b) Tiles: Chequered

The tiles shall have chequers not less than 2.5 cm. c/c and not more than 5 cm c/c. Depth of grooves shall be not less than 5 mm. The grooves shall be uniform and straight.

The tiles shall conform to clause 2.2.1 (b) except that these may have the topping in terrazzo or plain grey cement or colour pigment added to cement as specified.

c) Underbed

As per clause 2.2.1 (c).

d) Laying

As per clause 2.2.1 (d).

e) Grinding and Polishing

As per clause 2.2.1 (e) except that the tiles shall be ground and polished by hand after laying taking special care in polishing the grooves properly and uniformly.

2.2.3 Glazed Tiles Finish

This finish shall be composed of glazed earthenware tiles with an underbed laid over a concrete or masonry base.

a) Thickness

The total thickness shall be between 20 mm and 25 mm including the underbed. The tile finish on vertical surface shall project out 6 mm uniformly from the adjacent plaster or other wall finishes. The necessary cutting into the surface receiving the finish, to accommodate the specified thickness shall be done.

b) Tiles : Glazed

The tiles shall be of earthenware, covered with glaze white or colored, plain or with designs, of 150 mm x 150 mm nominal sizes and 10 mm thick unless otherwise specified. The tolerance shall be $\pm$ 1.5 mm for length and breadth and $\pm$ 0.5 mm for thickness specials like internal and external angles, beads, covers, cornices, corner pieces etc. shall match. The top surface of the tiles shall be glazed with a gloss or matt unfading stable finish as desired by the Engineer. The tiles shall be flat and true to shape. The colour shall be uniform and fractured section shall be fine grained in textures, dense and homogeneous. The tiles shall be strong and free from flaws like cracks, craze, specks, crawlings, etc. and other

imperfections. The edge and the underside of the tiles shall be completely free from glaze and the underside shall have ribs or indentations for better anchorage with the fixing mortar.

The colored tiles, when supplied, shall preferably come from one batch to avoid difference in colour.

c) Mix: Underbed

The mix for the underbed shall consist of 1 part cement and 3 parts coarse sand by weight mixed with sufficient water or any other mix if specified.

d) Laying
Same as clause 2.2.1 (d).

e) Finishing

The joints shall be cleaned and flush pointed with white cement and cured for 7 days by keeping it wet. The surface shall be cleaned with soap or suitable detergent, washed fully and wiped with soft cloth to prevent scratching before handing over.

2.2.4 Terrazzo Finish (Mosaic etc.)

This finish consists of manufactured vitreous, glass, ceramic or similar hard small pieces set in an underbed over a concrete or masonry surface, already laid.

a) Thickness

The total thickness including the under bed hall be between 16 mm and 25 mm.

b) Terrazzo Finish

These shall usually be 6 mm thick small piece of ceramic vitreous china, tinted glass or similar hard wearing, strong and durable material in desired shapes and sizes and patterns.

The supply shall come in the desired pattern in full or sections conveniently for handling, stuck to pieces of strong thick paper on the surface to be exposed. The gum used for this purpose must be water soluble and non-staining. The sections shall be properly marked to avoid mistakes and master drawing shall be available at the site for guidance.

c) Mix : Under bed

Same as clause 2.2.3 (c)

d) Laying

The specification for laying if given by the manufacturer of the item shall be followed provided it is approved by the Engineer. Otherwise clause 2.2.3 (d) shall generally be followed. However, instead of grey cement the slurry shall be made with white cement to fix the panels. The paper mounted patterns in sections shall be carefully placed and pressed in position true to lines and levels. Earliest possible the paper shall be peeled off and surface examined and cleaned, joints flush pointed with white cement and cured for 7 days by keeping it wet.

2.2.5 Chemical Resistant Tiled Finish

This shall include all varieties of special tiles used for specific chemical resistance function and an under bed over already laid concrete or masonry.

a) Tiles

The chemical resistant tiles as detailed in the Schedule of items shall be of the best indigenous manufacture unless otherwise specified and shall be resistant to the chemical described in the Schedule of Items. The tiles shall have straight edges, uniform thickness, plain surface, uniform non-fading colour and textures.

Glazed tiles if permitted to act as chemical resistant finish shall be considered under clause 2.2.3.

Usually the chemical resistant tiles shall not absorb water more than 2% by weight. The tiles shall have at least compression strength of 700 Kg/cm^2. The surface shall be abrasion resistant and durable.

b) Laying

The mortar used for setting the tiles shall be durable and strong. The grout which shall be to the full depth of tile shall have equal chemical resistant properties. Joints shall be pointed if so desired. The setting and fixing shall be according to the manufacturer's specification approved by the Engineer.

2.2.6 Rubber, Vinyl or Vinyl Asbestos Tiles Finish

This shall include various types of tiles manufactured from rubber, vinyl, etc. set with an adhesive on concrete or masonry base. An under bed may be required to secure desirable surface and grade.

a) Thickness

The thickness of the tiles shall be as mentioned in the Schedule or in drawing.

b) Tiles

Unless otherwise desired the tiles shall be square and of approved dimensions. The tolerance on dimensions shall be ± 1.5 mm.

The face of the tiles shall be free from porosity, blisters, cracks, embedded foreign matters or either physical defects which affect appearance or serviceability. All edges shall be cut true and square. The colour shall be non-fading and uniform in appearance, insoluble in water and resistant to alkali, cleaning agents & usual floor polishes.

Each tile shall be marked on the back legibly and indelibly with manufacturer's trade mark, the thickness, sizes, batch number and date of manufacturer.

Tiles shall be delivered securely packed and stored in clean, dry well ventilated place at a temperature near about to that the tiles shall be called upon to stand ultimately.

Adhesive to be used for sticking the tiles shall be approved by the tile manufacturer. The adhesive shall have a short drying time and long life in addition to toughness.

c) Mix : Under bed

The under bed where required to make up the specified thickness or to give the required grade or to get the right type of surface shall be composed of 1 part lime putty : 1 part cement : 4 parts coarse sand mixed with just sufficient water to make it workable.

d) Laying

The tiles shall be kept in the room to be tiled for at least 24 hours to bring them to the same temperature as the room. For air conditioned space, the air-conditioning shall be completed before tiling is taken up.

The surface to receive this finish shall be firm, even textured but not too smooth, without undulations and other deficiencies. If an under bed is laid the same shall be cured for at least 7 days by keeping it moist and then fully dried.

The surface shall be thoroughly cleaned. All loose dust particles shall be removed. Oil and grease if any shall be completely cleaned by use of detergent.

The adhesive shall be applied to fully dry surface in desired thickness uniformly. The adhesive shall also be applied to the backs and edges of the tiles and allowed to surface dry. The tiles shall be placed neatly on the surface exactly to the approved pattern and set with a suitable tool. If the edges tend to curl, weights are to be used to keep the edges down. Special care shall be taken to avoid formation of air pockets under the

tiles. The joints shall be very fine. Any adhesive squeezed out through the joints shall be removed immediately.

e) Finishing

If any adhesive mark remains on the surface a soft cloth soaked in solvent shall be used to wipe it off. The surface shall be cleaned with soft soap, dried and polished with an approved type of polish just before handing over.

2.2.7 Stone Slab Finish: Marble, Stone and Similar Fine Grained Stone

a) Thickness

The under bed shall be minimum 12 mm and average 20 mm thick. The slabs may be 25 mm, 30 mm or 40 mm thick as specified.

b) Stone Slab

The stone slabs shall be made from selected stock which are hard, sound, homogeneous and dense in texture and free from flaws. Angles and edges shall be true, square, free from chipping and surface shall be plane. The slabs shall preferably be machine cut to the required dimensions.

Tolerance of ± 5 mm in dimensions and ± 2 mm in thickness will be allowed. Unless specified otherwise, the slabs shall be minimum 300 mm x 300 mm.

The stone slabs shall come from specific regions and in specified quality with top surface fine chisel dressed. All sides shall also be fine chisel dressed to the full depth to allow finest possible joints.

The slabs shall be delivered to the site well protected against damages and stored in dry place under cover.

c) Mix: Under bed

Same as clause 2.2.1 (c).

d) Laying

The sides and top surface of the slabs shall be machine rubbed or table rubbed with coarse sand stone and washed clean before laying.

The under bed mortar shall be evenly spread and brought to proper level on the area under each slab. The slab shall be laid over the under bed, pressed and tapped down with wooden mallet to the proper level. The slab shall then be lifted and the under bed corrected as necessary and allowed to stiffen a little. Next, a thick cement slurry shall be spread over the surface. The edges of the slab shall be buttered with slurry of cement, grey / white / mixed with pigment matching the colour of the

stone slabs. The slab shall be gently laid and tapped with wooden mallet to bed properly to a very fine joint and to the required level. All surplus cement slurry shall be removed and the surface mopped clean with wet soft cloth. The laid finish shall be cured for 7 days by keeping it wet.

e) Polishing, Finishing

Fine chiseling shall be done to remove the slight undulations that usually exist at the joints. The polishing and finishing shall be done as specified under clause 2.2.1 (e). However, the joints shall be so fine in the case of stone slabs that grouting shall not be called for.

2.2.8 Stone Slab Finish : Sand Stone and Similar Coarse Grained Stone Finish

Generally clause 2.2.7 shall be followed. However, the workmanship and finish need not be fine but shall be as specified hereunder.

The slabs shall be rough chiseled or fine chiseled as specified. Tolerance may be allowed up to± 6 mm for rough finish, but no sharp unevenness and shall be allowed. For fine chiseling the unevenness shall be limited to ± 2 mm. The sides shall be chisel dressed at least to half slab depth so that the maximum deviation from straight line shall be within 25 mm. Beyond this depth the edge may be slightly splayed.

The joint thickness shall be kept limited to 5 mm in case of rough finish and 3 mm in case of fine finish unless wider joints are specified. The joints shall be grouted with white or colored cement.

3.0.0 ACCEPTANCE CRITERIA

The finish shall be checked specially for :

a) Level, Slope, Plumb as the case may be

b) Pattern and Symmetry

c) Alignment of joints, dividing strip etc.

d) Color, texture

e) Surface finish

f) Thickness of joints

g) Details at edges, junctions etc.

h) Performance

i) Precautions specified for durability

4.0.0 I.S. CODES

Important relevant codes for this section are :-

IS : 1196	:	Code of practice for laying bitumen mastic flooring
IS : 1197	:	Code of practice for laying of rubber floors
IS : 1237	:	Cement concrete flooring tiles
IS : 1443	:	Code of practice for laying and finishing of cement concrete flooring tiles
IS : 2114	:	Code of practice for laying in-situ terrazzo floor finish
IS : 3461	:	PVC asbestos floor tiles
IS : 4860	:	Specification for acid resistant bricks
IS : 5518	:	Code of practice for laying of flexible PVC Sheet and tile flooring.
IS : 5491	:	Code of practice for laying in situ granolithic concrete flooring topping

SUB-SECTION NO. C9

TECHNICAL SPECIFICATION FOR METAL DOORS, WINDOWS, VENTILATORS, LOUVRES ETC.(SUPPLY AND INSTALLATION)

TECHNICAL SPECIFICATION
FOR
METAL DOORS, WINDOWS, VENTILATORS, LOUVRES, ETC.
(SUPPLY AND INSTALLATION)

CONTENTS

CLAUSE NO.	DESCRIPTION
1.0.0	SCOPE
2.0.0	INSTALLATION
3.0.0	ACCEPTANCE CRITERIA
4.0.0	I.S. CODES

TECHNICAL SPECIFICATION FOR METAL DOORS, WINDOWS, VENTILATORS, LOUVRES, ETC. (SUPPLY AND INSTALLATION)

1.0.0 SCOPE

The work in general shall consist of supplying and/or erecting and installing of all metal doors, windows, ventilators, louvers, glazed partitions, etc. as shown on drawings with all materials complete excluding supply of glass and glazing. The scope of work shall also include the assembly and erection of all doors, windows, louvres, glazed partitions, etc. for which fabricated materials shall be supplied by the Owner from the store at site. Supplying and/or fixing of all door and window accessories and hardware is also included in the scope.

2.0.0 INSTALLATION

2.1.0 Materials

Steel sections used for fabrication of doors, windows etc. shall be standard rolled steel sections specified in IS:1038 and IS:1361 or as specified in drawing and schedules.

Steel sheets for frames, shutters, louvre blades etc. shall be of gauge mentioned in drawings and schedules.

Aluminium sections for fabricating doors, windows, partitions etc. shall be extruded sections conforming to IS:1948 and 1949 or as manufactured by Indian Aluminium Company Limited or approved equivalent. The alloy used shall conform to IS Designation HE 9-WP of IS:733.

Hardware and fixtures shall be as specified in "Schedule of Fixtures" and the best quality from approved manufacturers shall only be used. The LSTK Vendor shall specifically state the particular manufacturer's materials he proposes to use. "Schedule of Fixtures" is for the purpose of stating the minimum requirement and improper alignment or faulty operation due to inadequate strength of hardware or fixture shall entirely be the LSTK Vendor's responsibility.

All hardware and fixtures shall be able to withstand repeated use. Door closers shall conform to IS:3564 and shall be suitable for doors weighing 61-80 Kg. unless otherwise stated in schedule. Each closer shall be guaranteed against manufacturing defect for one year and any defect found within this period shall be rectified or the closer replaced free of charge. Concealed door closers shall be either floor mounted or transom mounted, suitable for installation with metal doors. It shall conform to the performance requirements and endurance test stated in IS:3564- Appendix A.

The LSTK Vendor shall submit samples of each type of hardware to the Engineer. The approved samples shall be retained by the Engineer for comparison of bulk supply. The samples shall be returned to the LSTK Vendor towards the end for incorporation in the job.

The mastic for caulking shall be of best quality from a manufacturer approved by the Engineer. In general, the mastic for fixing of metal frames shall be as per IS:1081 and/or as approved by the Engineer.

2.2.0 Fabrication

2.2.1 Steel Doors, Windows, Ventilators, Louvres etc.

a) Door Frames

Frames shall be fabricated from 16 g sheets. They shall be mortised, reinforced, drilled and tapped for hinges and lock and bolt strikes. Where necessary, frames shall be reinforced for door closers. Welded construction with mitred corners shall be used. Rubber door silencers shall be furnished for the striking jamb. Loose "T" masonry anchors shall be provided. Frames shall finish flush with floor and adjustable floor anchors shall be supplied. Frames shall be brought to site with floor ties/weather bars installed in place.

b) Double Plate Flush Door Shutters

Door shutters shall be 45 mm. thick, completely flush design and shall comprise two outer sheets or 18 G steel sheets, rigidly connected and reinforced inside with continuous vertical 20 G stiffeners, spot welded in position at not more than 150 mm on centers.

Both edges of doors shall be joined and reinforced full height by steel channels placed immediately inside and welded to the door faces. Top and bottom of doors shall be reinforced horizontally as shown on drawing by steel channels running full width of door. Doors shall not have more than 2.5 mm clearance at jambs and heads, shall have proper level on lock stiles and rails to operate without binding, and shall be reinforced at corners to prevent sagging or twisting. Pairs or double doors shall have meeting stile edges beveled or rebated. Where shown on drawing, or called for in the schedule of items, the doors shall be sound deadened by filling the inside voids with mineral wool or other suitable approved materials.

Doors shall be mortised, reinforced, drilled and tapped in shop for hinges, locks and bolts. They shall also be reinforced for closers, push plates and other surface hardware's where necessary. Any drilling and tapping required for surface hardware shall be done at site. Where shown on drawing, provision shall be made for fixing glazing, vision panels, louvres etc. glazing moldings shall be of 18 G steel or extruded aluminium sections with profiles shown on drawing and suitable for fixing 6 mm. glass. Louvre blades shall be V or Z shaped and made out of 16 G sheets.

c) Single Sheet Door Shutters

Single sheet doors shall be made from best quality 18 G mild steel sheets, and shall present a flush surface on the outside. The inside shall be stiffened with semi tubular edge and central stiffening rail, which shall

convey the lock and other furniture. The frames shall be made from best quality 16 G mild steel sheets.

Wherever required as shown on drawings, provisions for fixing glass panes, louvres etc. shall be made.

The manufacturing shall be done as specified in 2.2.1(b) : "Double Plate Flush Door Shutters".

d) Sliding Doors

Sliding doors shall be either double plate or single plate construction as called for in drawings and schedules made out of 18 gauge steel sheets with adequate stiffeners. The LSTK Vendor shall specify the weight of the door in his shop and submit the manufacturer's catalogue of the sliding gear he proposes to use. Where shown on drawings or call for in the Schedule of Items, the LSTK Vendor shall make provision for openings to the door for mono-rail beams. Doors shall close positively to exclude rain water from seeping in. When called for in schedule, sliding doors shall withstand specified wind loads without buckling or jamming. The door shall slide freely under all ambient conditions.

e) Fire resistant door**.**

Fire proof door shall conform to I.S.3614(part I & II) and shall have fire rating as indicated in schedule of item and where TAC approval will be required fire door shall also conform to TAC regulations

Door shall be double or single leaf and shall be of fully metal insulated box section frame and fully insulated shutter faced with steel sheet on both faces. Door shall be procured from manufacturer specialized in fire door manufacturing.

f) Door Threshold

Door threshold shall be provided as shown on drawing. Doors without threshold shall have bottom tie of approved type.

g) Steel Windows, Sashes, Ventilators etc.

These shall conform in all respects to IS:1038 and IS:1361, latest editions and as shown on drawings. The details as called for in the above codes shall be applicable for coupling mullions, transoms, weather bars, pivot arrangements for ventilators, etc. or as shown on drawings or called for in the Schedule of Items.

All welds shall be dressed flush on all exposed and contact surfaces.

Where composite unit openings are shown on drawings, the individual window units shall be joined together with requisite transoms and mullions as shown on drawings. All windows shall be outside glazed, fixed with putty or metal glazing beads as shown on the drawings and/or specified under Schedule of Items. Where aluminium glazing beads are specified,

they shall be extruded aluminium channel 9.5 mm x 9.5 mm x 1.6 mm (Indal Section No. 2209) unless otherwise shown on drawings. Aluminium beads shall be given one coat of zinc chromate primer before fixing to windows.

2.2.2 Aluminium Doors, Windows and Frames

Extruded sections shall have a minimum 3 mm wall thickness unless otherwise approved in samples by the Architect/Engineer. All sections shall be approved by the Architect/Engineer before fabrication is taken up. Doors, frames, mullions, transom etc. shall be anodized /powder coated in a bath of sulphuric acid to provide a clear coating of minimum0.6 mm thickness. The anodized materials shall then be sealed by immersing in bailing water for 15 minutes. A protective transparent coating shall be applied to the sections before shipment from the factory.

All work shall be fitted and shop assembled to a first class job, and ready for erection. Shop joints shall be made to hair lines and then welded or braced by such method as will produce an uniform colour throughout the work. Work on the above, other than described, shall be carefully fitted and assembled with neat joints with concealed fasteners. Wherever possible, joints shall be made in concealed locations and on edges of doors. Field connections of all work may be made with concealed screws or other approved type of fasteners. Glazing beads shall be snap fit type without visible screws and shall be of sizes to accommodate 6 mm thick glazing or as specified in schedule of items. All work shall be adequately braced and reinforced as necessary for strength and rigidity.

2.3.0 Shop Coat or Paint

The shop paint for steel doors, windows etc. shall be best lead or zinc chromate primer paint from approved manufacturer. All surfaces shall be thoroughly cleaned of rust, grease, loose mill scales etc. and given one coat of shop paint. Portions like mullions, transoms etc. which will be inaccessible after assembly of units shall be given an extra coat of paint before assembly.

Where called for in the Schedule of Items, all steel doors, windows, etc. shall be hot dip galvanised to give a coating weight of 1.5 - 2 oz. per sft. One coat of zinc chromate primer shall then be applied as shop paint.

Portions of aluminium frame which come in contact with masonry construction, shall, before shipment from workshop, be protected with a heavy coat of alkali paint. Aluminium coming in contact with other incompatible metals shall be coated with zinc chromate primer.

2.4.0 Handling & Storage of Fabricated Material

All metal doors, windows, etc. shall be packed and crated properly before despatch, to ensure that there will be no damage to the fabricated materials. Loading into wagons and trucks shall be done with all care to ensure safe arrival of materials at site in undamaged condition.

When taking delivery of items supplied by Owner, the LSTK Vendor shall satisfy himself that the items supplied are up to the specified standard. Any defect detected shall promptly be brought to the notice of the Engineer.

All metal doors, windows etc. shall be stored under cover in a way to prevent damage or distortion. Special care shall be taken to prevent staining of aluminium products by rust, mortar etc.

2.5.0 Assembly & Erection at Site

In general, the fixing of steel doors, windows, ventilators, louvres, etc. shall conform to IS:1081 and as shown on drawings. The LSTK Vendor shall assemble and install all steel doors, windows, sashes, fixed metal louvres, etc. including transoms and mullions for composite units in respective places as shown on drawing, keeping proper lines and levels, and in approved workmanlike manner, to give trouble free and leak-proof installations. The installation shall be done according to the instructions of the manufacturer, and/or as approved by the Engineer. If required by the Engineer, the installation shall have to be carried out under the supervision of the manufacturer's staff. The LSTK Vendor shall take every precaution against damage of the components during installation. Necessary holes, chases, etc. required for fixing shall be made by the LSTK Vendor and made good again as per original, after installation, without any extra charge.

After installation of steel doors, windows, etc. all abrasions to shop-coat of paint shall be retouched and made good with the same quality of paint used in shop- coat.

All coupling mullions, transoms, frames, etc. in contact with adjacent steel and other members, shall be well bedded in mastic. The LSTK Vendor shall bring to the site the mastic cement in original sealed containers of manufacturer and shall apply it as per the instructions. For all frames supplied by either the Owner or the LSTK Vendor, mastic shall be supplied by the LSTK Vendor and caulking done properly as per drawings, specifications and as per instructions of the Engineer.

Door shutters, partitions hardware fixtures etc. shall be fixed only after major equipment have been installed in rooms.

Wherever required, nylon cords of approved quality shall be supplied along with pivoted sashes and shall be of adequate length to terminate one meters from the floor. Loose ends of cords shall end in metal or plastic pull as approved by the Engineer.

1.0.0 ACCEPTANCE CRITERIA

3.1.0 For Fabricated Items

a) Overall dimensions shall be within +1.5 mm of the size shown on drawings.

b) Mullions, transoms etc. shall be in one length and permissible deviations from straightness shall be limited to ± 1.5 mm from the axis of the member.

c) Door and window shutters shall operate without jamming. The clearance at head and jamb for door shutters shall not exceed 1.5 mm. For double leaf doors, the gap at the meeting stiles shall not be more than 1.5 mm.

d) Door leaves shall be undercut where shown on drawings.

e) Doors, windows, frames, etc. shall be on a true plane, free from warp or buckle.

f) All welds shall be dressed flush on exposed and contact surfaces.

g) Correctness of location and smoothness of operations of all shop installed hardware and fixtures.

h) Provision for hardware and fixtures to be installed at site.

i) Glazing beads shall be cut with mitered corners.

j) Glazing clips, fixing devices etc. shall be supplied in adequate numbers.

k) Shop coats shall be properly applied.

l) Exposed aluminium surfaces shall be free from scratches, stains and discolouration. Anodized surfaces shall present a uniform and pleasing look.

3.2.0 For Installed Items

a) Installations shall be at correct location, elevation and in general, on a true vertical plane.

b) Fixing details shall be strictly as shown on drawings.

c) Assembly of composite units shall be strictly as per drawings with mastic caulking of transoms and mullions, gaskets, weather strips etc. complete.

d) All frames on external walls shall be mastic caulked to prevent leakage through joint between frames and masonry.

e) All openable section shall operate smoothly without jamming.

f) Locks, fasteners etc. shall engage positively. Keys shall be non-interchangeable.

g) Cutting to concrete or masonry shall be made good and all abrasions to shop paint shall be touched up with paint of same quality as shop paint.

h) Aluminium doors, windows, etc. shall be free from scratches stain or discolouration.

4.0.0 I.S. CODES

Following are some of the important I.S. Codes relevant to this section :-

Steel doors, windows and ventilators	-	IS:1038
Steel windows for industrial buildings	-	IS:1361

Aluminium doors, windows and ventilators	-	IS:1948
Aluminium windows for industrial buildings	-	IS:1949
Steel door frames	-	IS:4351
Code of practice for fixing and glazing of metal-		IS:1081
(steel and aluminium) doors, windows & ventilators		

SUB-SECTION NO. C10

TECHNICAL SPECIFICATION FOR GLASS AND GLAZING

TECHNICAL SPECIFICATION
FOR
GLASS AND GLAZING

CONTENTS

CLAUSE NO.	DESCRIPTION
1.0	SCOPE
2.0	INSTALLATION
3.0	ACCEPTANCE CRITERIA
4.0	I.S. CODES

TECHNICAL SPECIFICATION FOR GLASS AND GLAZING

1.0 SCOPE

The work in general shall consist of supplying and fixing all glass and glazing including all clips, putty, mastic cement etc. wherever required as shown on drawings and specifications, supply of metal glazing beads and neoprene gaskets shall not be included in this scope.

This shall also include the fixing of all glass and glazing supplied by the Owner from site stores.

2.0 INSTALLATION

2.1 General

The LSTK Vendor shall supply and install all glass and glazing as required for various doors, windows, sashes, ventilators and fixed louvers, miscellaneous glazing and partitions, from approved manufacturer unless otherwise stated, having uniform refractive index and free from flaws, specks and bubbles. The glass shall be brought to site in the original packing from the manufacturer and cut to size at site.

2.2 Materials

a) Glare reducing or heat absorbing glass shall be of approved manufacturer and special care shall be taken to grind smooth and round off the edges before fixing.

b) Clear glass shall be flat drawn sheet glass of required thickness and shall be minimum 4 mm thick for windows, ventilators etc. and minimum 5.5 mm thick for doors, unless otherwise specified.

c) Wired glass shall be thick rolled glass with centrally embedded 24g. wire mesh of Georgian type. This may be of clear or colored glass, as shown in drawings or schedules.

d) Obscure glass shall have a cast surface in one side.

e) Coloured and figured glass shall be as per approved sample.

f) In general, the putty shall conform to IS : 400 and be of best quality from approved manufacturer. It shall be brought to site in the manufacturer's original packing.

g) EPDM gaskets with snap-fit glazing beads shall be fixed as per manufacturer's instructions and shall sit snugly against glass to give a leakproof installation.

2.3 Glazing, Setting and Finish

All glazing clips, bolts, nuts, putty, mastic cement etc. as required shall be supplied by the LSTK Vendor.

All glass shall be thoroughly cleaned before putting in position. Each glass pane shall be held in place by special glazing clips of approved type. As specified in relevant I.S. Codes, four glazing chips shall be provided per glass pane, except for large panes were six or more clips shall be used as per Engineer's instructions. All holes that may be necessary for holding the clips, glazing heads and all other attachments shall be drilled by the LSTK Vendor.

Glass panes shall be set without springing, and shall be bedded in putty and back puttied, except where moulding or gasket is specified. Putty, mastic cement etc. shall be smoothly finished to the even line and figured glass shall be set with smooth side out.

Where glass will be supplied by Owner, the LSTK Vendor shall cut them to size and fix them in the same manner as specified above.

Necessary glazing clips, putty, mastic cement etc. shall be supplied by the LSTK Vendor. The LSTK Vendor shall be responsible for damage of glass supplied by the Owner, during handling, transportation, fixing etc. maximum wastage allowance shall be 5%.

After completion of glazing work, the LSTK Vendor shall remove all dirt stains, excess putty etc. clean the glass panes and leave the work in perfectly acceptable condition. All broken cracked or damaged glass shall be replaced by new ones at the LSTK Vendor's own cost.

3.0 ACCEPTANCE CRITERIA

a) All installation shall be free from cracked, broken or damaged glass. Edges of large panes of thicker glass and heat absorbing glass shall be inspected carefully for chipped or cracked edges.

b) Glazing shall be carefully done to avoid direct contact with metal frames.

c) All glass shall be embedded in mastic or fixed by EPDM gaskets to give a leakproof installation.

d) At completion, the panes shall be free from dirt, stains, excess putty etc. to the complete satisfaction of the Engineer.

4.0 I.S. CODES

Following are some of the important I.S.Codes relevant to this Section:

IS : 3548 - Code of practice for glazing in building.

IS :1083 - Code of practice for fixing and glazing metal doors, windows & ventilators.

SUB-SECTION NO. C11

TECHNICAL SPECIFICATION FOR PAINTING, WHITE WASHING, POLISHING ETC.

TECHNICAL SPECIFICATION
FOR
PAINTING, WHITE WASHING, POLISHING ETC.

CONTENTS

CLAUSE NO.	DESCRIPTION
1.0.0	SCOPE
2.0.0	INSTALLATION
3.0.0	ACCEPTANCE CRITERIA
4.0.0	I.S. CODES

TECHNICAL SPECIFICATION FOR PAINTING, WHITE WASHING AND POLISHING ETC.

1.0.0 SCOPE

This specification covers painting, white washing, varnishing, polishing etc. of both interior and exterior surfaces of wood work, masonry, concrete plastering, plaster or Paris, punning false ceiling, structural and other miscellaneous steel items, rain water down comer, floor and roof drains, soil, waste and service water pipes, and other ferrous and non-ferrous metal items as shown on drawings, schedule or as directed by the Engineer.

Copper, bronze, chromium plate, nickel, stainless steel, aluminium and motel metal shall generally not be painted or finished except if otherwise specified.

The LSTK Vendor shall inspect the work of others prior to the application of paint. If surface to be finished cannot be put in suitable condition for painting by customary preparatory methods, the LSTK Vendor shall notify the Engineer in writing or assume responsibility for and rectify unsatisfactory finishing that results.

Before commencing painting, the LSTK Vendor shall obtain the approval of the Engineer in writing regarding the schedule of work to minimize damage, disfiguration or staining by other trades. He shall also undertake normal precautions to prevent damage, disfiguration or staining to work of other trades or other installations.

2.0.0 INSTALLATION

2.0.1 Materials

Materials shall be highest grade products or well-known approved manufacture and shall be delivered to the site in original sealed containers, bearing brand name, manufacturer's name and colour shade, with labels intact and seals unbroken. All materials shall be subject to inspection, analysis and approved by the Engineer. It is desired that materials of one manufacturer only shall be used as far as possible & paint or one shade is obtained the same manufacturing batch. All paint shall be subject to analysis from random samples taken at site from painter’s bucket, if so desired by the Engineer.

All prime coats shall be compatible to the material of the surface to be finished as well as to the finishing coats to be applied.

All unspecified materials such as shellac, turpentine or linseed oil shall be of the highest quality available and shall conform to the latest IS standards. All such materials shall be made by reputable recognized manufacturers and shall be approved by the Engineer.

All colours shall be as per painting schedule and tinting and matching shall be done to the satisfaction of the Engineer. In such cases, where samples are

required, they shall be executed in advance with the specified materials for the approval of the Engineer.

a) White Washing

Shall be done from pure shell lime or fat lime, or a mixture of both as instructed by the Engineer; and shall conform to IS:712 latest edition. Samples of lime shall be submitted to the Engineer for approval, and lime as per approved sample shall be brought to site in unslaked condition. After slaking, it shall be allowed to remain in a tank of water for two days and then stirred up with a pole, until it attains the consistency of thin cream. 100 grams of gum to 6 litres of white wash water and a little quantity of indigo or synthetic ultramarine blue shall be added to the lime.

b) Dry distemper

Shall be made from suitable pigments, extenders, lime proof tinters, water soluble binders etc. and shall conform to IS:427.

c) Oil Bound Washable Distemper

Shall be of oil emulsion type, containing suitable preservatives and shall conform to IS:428.

d) Waterproof Cement Paint

Shall be made from best quality white cement and lime resistant colours with accelerators, waterproofing agents and fungicides. The paint shall conform to IS:5410.

e) Acrylic Emulsion Paint

Shall be water-based acrylic copolymer emulsion with retile titanium dioxide and other selected pigments and fungicide. It shall exhibit excellent adhesion to plaster and cement surface and shall resist deterioration by alkali salts. The paint film shall allow the moisture in wall to escape without peeling or blistering. The paint, after it is dried, shall be able to withstand washing with water without any deterioration in colour, or without showing flaking, blistering or peeling.

f) Synthetic Enamel Paint

Shall be made from synthetic resins and drying oil with retile titanium dioxide and other selected pigments to give a smooth, hard, durable and glossy finish to all exterior and interior surfaces. White and pastel shades shall resist yellowing and darkening with aging. The paint shall conform to IS:2932 and IS:2933.

g) Aluminium Paint

Shall be in two pack containers and shall resist weathering. The paint shall conform to IS: 2339.

h) Clear Synthetic Varnish

Shall be best quality alkyd varnish suitable for brushing over the tint of paint or light natural wood and shall not darken or yellow with age.

i) French Polish

Shall be made from best quality shellac, denatured spirit and other suitable alcohol soluble ingredients and made by a well-known approved manufacturer. The material shall conform to IS:348.

French polish shall not be used on bare wood. It shall only be used as finishing coat on wood after the wood is pretreated with application of a liquid wood filler conforming to and rubbed out.

2.0.2 Storage

The LSTK Vendor shall arrange for safe and proper storage of all materials and tools. The storage space if allotted within the building shall be adequately protected from damage, disfigurement & stains. Paint shall be kept covered at all times and mixing shall be done in suitable containers. All necessary precautions shall be taken by the LSTK Vendor to prevent fire.

2.1.0 Preparation of surface

Before starting the work the LSTK Vendor shall obtain the approval of the Engineer regarding the soundness and readiness of the surface to be painted on.

2.1.1 Wood

All surfaces shall be free from dirt and loose or peeling paints. The surface shall be rubbed down smooth. All nails & screws shall be sunk below the surface and filled with putty after applying an under coat. Small knots that do not justify cutting and sap streaks shall be covered with minimum 2 coats of pure shellac coating applied thinly & extended 25 mm beyond the area. All large, loose or resinous knots shall be removed and filled with sound wood. All work shall be done as per IS: 2338.

2.1.2 Masonry, Concrete and Plastered Surface

Surface shall be free from all oil, grease, efflorescence, mildew, loose paint or other foreign and loose materials. Masonry cracks shall be cleaned out and patch filled with mortar similar to the original surface and uniformly textured. Where this type of resurfacing may lead to the finishing paint being different in shade from the original surfaces, the resurfaced area shall be treated with minimum one coat of cement primer, which should be continued to the surrounding area for a distance of minimum 100 mm.

Surface with mildew or efflorescence shall be treated as below :

a) Mildew

All mildewed surfaces shall be treated with an approved fungicide such as ammoniacal wash consisting of 7g of copper carbonate dissolved in 80 ml. liquor ammonia and diluted to 1 litre with water, or 2.5 percent magnesium silicofluoride solution and allowed to dry thoroughly before paint is applied.

2.1.3 Metal

All metal surfaces shall be absolutely clean, dry and free from wax, grease or dried soap films. In addition, all steel and iron surfaces shall be free from rust, surfaces shall be cleaned by mechanical power tools to remove mill scales unless otherwise approved by the Engineer for exposed chemical resistant paints, surfaces shall be blast cleaned to near white metal. All galvanised iron surfaces shall be pretreated with a compatible primer according to the manufacturer's direction. Any abrasion in shop coat shall be touched up with the same quality of paint as the original coat.

2.2.0 Application

2.2.1 General

The method of application shall be as recommended by the manufacturer. In case of selection of special shades and colour (not available in standard shades) the LSTK Vendor shall mix different shades and prepare test panels of minimum size 1 meter square as per instruction of the Engineer and obtain his approval prior of application of finishing paints.

Proper tools and implements shall be used. Scaffoldings if used shall be independent of the surface to be painted to avoid shade differences of the freshly repaired anchor holes.

Painting shall be done by skilled labourers in a workmanlike manner. All materials shall be evenly applied so as to be free of sags, runs, crawls or other defects. All coats shall be of proper consistency. In case of application by brush, no brush marks shall be visible. The brushes shall be clean and in good condition before application of paint.

All priming undercoats for painting shall be applied by brush only, and rollers spray equipment etc. shall not be used.

No work shall be done under conditions that are unsuitable for production of good results. No painting shall be done when plastering is in progress or is drying. Application of paint, which seals the surfaces to moisture, shall only be done after the moisture on and below the surface has dried out.

All coats shall be thoroughly dry before succeeding coat is applied. Coats of painting as specified are intended to cover surfaces perfectly. In case the surface

is not covered properly by applying the specified number of coats, further coats shall be applied by the LSTK Vendor when so desired by the Engineer.

All primers and undercoats shall be tinted to approximate the colour of the finishing coats. Finished coats shall be of exact colour and shade as per approved samples and all finish shall be uniform in colour and texture. All parts of mouldings and ornaments shall be left clean and true to finish.

Painting on ferrous metal surface shall be done as per IS:1477 (Part 1 & 2). The total dry thickness of the film should not be less than 120 micron.

2.2.2 White Washing

The surface where white washing is to be applied shall be cleared of all loose materials and dirt. All holes and irregularities of the surface shall be filled up with lime putty and shall be allowed to dry up before application of the lime solution.

One coat of whitewash shall consist of one stroke from top downwards, another from bottom upwards over the first stroke and another from left to right before the previous one dries up. Second coat shall be applied and in case the Engineer feels that one or more coats are required the LSTK Vendor shall do so without any extra cost to the Owner. No brush marks shall show on the finished surface.

2.2.3 Dry Distemper

New plastered surface shall be allowed to dry for at least two months. New lime or lime cement plastered surface shall be washed with a solution of 1 part Vinegar to 12 parts water or 1:50 sulphuric acid solution and for 24 hours after which the wall shall be thoroughly washed with clean water. For cement plastered surface, the surface shall be washed with a solution of 100 gms. of zinc sulphate to 1 litre of water and then allowed to dry.

Dry distempering shall be done as per manufacturer's instruction. In applying the distempers the brush should first be applied horizontally and immediately crossed off perpendicularly. Brushing shall not be continued too long as otherwise brush marks may result.

2.2.4 Oil bound washable distemper

The distemper shall be applied after surface is primed with an alkali resistant primer, and followed by minimum two coats of oil bound washable distemper all as per manufacturer's instruction.

2.2.5 External Emulsion Weather Coat Paint

Surface to be coated with Emulsion Weather Coat paint shall be washed and brushed down. As soon as the moisture has disappeared, the surface shall be given one coat of paint. Care shall be taken so that the paint does not dry out too rapidly. After 4 to 6 hours, the water shall be sprinkled over the surface to assist curing and prevent cracking. After the first coat has dried (24 to 48 hours) the

second coat shall be applied in a similar manner. The finished surface shall be kept moist by occasional sprinkling with water for seven days after painting.

2.2.6 Acrylic Emulsion Paint

Lime gauged cement plastered surfaces shall not be painted for at least one month after plastering. A sample patch shall be painted to check alkali reaction if so desired by the Engineer. Painting shall be strictly as per manufacturer's specification.

2.2.7 Synthetic Enamel Paint

Shall be applied on properly primered surface. Subsequent coat shall not be applied till the previous coat is dry. The previous shall be lightly sand papered for better adhesion of subsequent coats.

2.2.8 Aluminium Paint

The paint, supplied in two pack containers shall be mixed and applied strictly as per manufacturer's direction. When more than one coat of paint is required or indicated, the next coat shall only be applied after the previous coat become hard dry.

2.2.9 Clear Synthetic Varnish

The Varnish shall be applied on wood surface after (a) filling, (b) staining & (c) sealing operations are carried out. The application of a combination of filler and stain shall not be permitted.

For the finishing coats of varnish, the surface shall be allowed to dry and be rubbed down lightly, wiped off and allowed to dry. Careful attention to cleanliness is required for varnishing. All dust and dirt shall be removed from the surface as well as from the neighbourhood. Damp atmosphere and draughts shall be avoided and exposure to extreme heat or cold and dampness shall not be allowed.

The varnish shall be applied liberally with a brush and spread evenly over a portion of the surface with light strokes to avoid frothing. It shall be allowed to flow on while the next section is being laid on excess varnish shall then be scrapped off the brush and the first section be crossed, recrossed and then laid off lightly. The varnish once it has began to set, shall not be retouched. In case of any mistake in application, the varnish shall be removed and the work started afresh.

The varnish shall be minimum of two coats, with the first coat being a flatting varnish. This shall be allowed to dry hard and be flatted down, before applying the next coat. Sufficient time must be allowed between coats to get a hard dry surface before next coat is applied. All work shall be done as per relevant IS Code.

2.2.10 French Polish

All unevenness of the surface shall be rubbed down to smoothness with sand paper and the surface shall well dusted. The pores in the wood shall be filled up with a paste of whitening in water or methylated spirit with a suitable pigment like burnt siemma or umber.
After application of the filler paste, the french polish shall be applied with a pad of woolen cloth covered by a fine cloth. The pad shall be moistened with polish and rubbed hard on the surface in a series of overlapping circles so that the polish is sparingly but uniformly applied over the entire area to give an even surface. A trace of linseed oil may be used on the pad for case of application. The surface shall be allowed to dry before further coats are applied in the same manner. To finish off, the pad shall be covered with a fresh piece of clean fine cloth, slightly damped with methylated spirit and rubbed lightly and quickly with circular motions to leave the finished surface with a uniform texture and high gloss.

2.2.11 Chemical Resistant Paint

For chemical resistant paints, epoxy, chlorinated rubber or vinyl butryl paint system shall be used. Manufacturer's recommendation regarding the paint system exposed to moderately severe corrosive condition and subject to acid/alkali spillage and fumes, shall be followed.

2.3.0 Protection

Furniture and other movable objects, equipment, fittings and accessories shall be moved, protected and replaced upon completion of work. All stationary equipment shall be well covered so that no paint can fall on them. Work finished by other agencies shall be well protected. All protections shall be done as per instructions of the Engineer.

2.4.0 Cleaning up

In addition to provisions in general conditions the LSTK Vendor shall, upon completion of painting etc. remove all marks and make good surfaces, where paint has been spilled, splashed or splattered, including all equipment, fixtures, glass, furniture, fittings etc. to the satisfaction of the Engineer.

3.0.0 ACCEPTANCE CRITERIA

a) All painted surfaces shall be uniform and pleasing in appearance.

b) All varnished surfaces shall be of uniform texture and high glossy finish.

c) The colour, texture etc. shall match exactly with those of approved samples.

d) All stains, splashes and splatters of paints and varnishes shall be removed from surrounding surfaces.

4.0.0 I.S. CODES

Important relevant IS Codes for this Section are listed below :-

IS:348	:	Specification for French Polish
IS:427	:	Specification for Distemper, dry colour as required.
IS:428	:	Specification for Washable Distemper
IS:1477 (I & II)	:	Code of Practice for painting of ferrous metal in buildings.
IS:2338 (I & II)	:	Code of Practice for finishing of wood and wood based materials.
IS:2339	:	Specification for Aluminium Paints for general purposes in dual containers.
IS:2395	:	Code of Practice for painting concrete, masonry and plaster surface.
IS:2932	:	Specification for enamel, synthetic, exterior (a) Under (b) Finishing
IS:5410	:	Specification for cement paint, colour as required.

SUB-SECTION NO. C12

TECHNICAL SPECIFICATION FOR ROOF WATERPROOFING, INSULATION AND ALLIED WORK

TECHNICAL SPECIFICATION
FOR
ROOF WATERPROOFING, INSULATION AND ALLIED WORK

CONTENTS

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE
2.00.00	INSTALLATION
3.00.00	ACCEPTANCE CRITERIA
4.00.00	I. S. CODES

TECHNICAL SPECIFICATION FOR ROOF WATER PROOFING, INSULATION AND ALLIED WORK

1.00.00 SCOPE

This specification covers furnishing, installation, repairing, finishing, curing, testing, protection, maintenance till handing over of roof water-proofing, insulation and allied work for buildings and at locations covered under the scope of the Contract.

2.00.00 INSTALLATION

2.01.00 Grading Under bed

The surface to receive the under bed shall be roughened and thoroughly cleaned with wire brush and water. Oil patches if any shall be removed with detergent. The surface shall be soaked with water and all excess water removed just before laying of the under bed.

The under bed shall not be laid under direct hot sun and shall be kept in shade immediately after laying so as to avoid quick loss of water from the mix and separation from the roof surface. The under bed shall be cured under water for at least 7 days.

The under bed shall be laid to provide an ultimate run off gradient not less than 1 in 120 and as directed by the Engineer. Upto an average thickness of 25 mm the under bed shall usually be composed of cement and sand plaster. For higher thickness the under bed shall be made with cement concrete.

The under bed shall be finished to receive the waterproofing treatment direct or insulation as the case may be.

2.01.01 Plaster

The grading plaster shall be average 25mm thick maximum. It shall consist of cement and coarse sand in the ratio 1:4 nominal by volume. The sand and cement shall be thoroughly mixed dry and then water added. Each batch of mix shall be consumed before the initial set starts.

The plaster shall be fully compacted to the desired grade in continuous operation. The surface shall be even and reasonably smooth.

2.01.02 Concrete

Concrete shall be used where the sub-grade is more than average 25mm thick. It shall consist of cement concrete 1:2:4 nominal mix by volume with 12mm down stone chips and coarse sand. The aggregate shall be mixed dry and minimum quantity of water shall be added to make the mix workable.

The mix shall be laid to proper grade, fully consolidated and surface shall be smooth and even.

2.02.00 Insulation

The LSTK Bidder shall along with the tender send specification of insulating materials he proposes to use and the proposed method of laying. Before bulk supply, the LSTK Vendor shall send samples of insulating material to the Engineer, and after approval of the samples, the LSTK Vendor shall procure and transport the bulk material to the site. Whenever asked by the Engineer, the LSTK Vendor shall furnish test certificates from testing laboratory on the insulating and other properties of the materials.

After laying the insulation the surface shall be made ready as required to receive the waterproofing treatment. If any plastering is used it shall be not leaner than 1:4 cement sand by volume and not thiner than 12mm and it shall be cured for seven days.

2.02.01 Foam Concrete

This shall be light weight foam concrete of average 50 mm thickness or as specified or as shown on drawings. This may be laid in situ in suitable panels or in precast blocks. The insulating properties shall be such that the thermal conductivity shall not exceed 0.125 KCal m/m^2 h degree C. The weight of the insulating material shall be from 0.3 to 0.5 gm/cm^3.

Before starting the laying of foam concrete samples shall be prepared at site and got tested for approval of the Engineer.

The foam concrete laid shall be sufficiently strong to take the usual work load and standard loads expected on the roof. Any damaged portion shall be removed and replaced forthwith. Approval of the Engineer shall be taken before laying the waterproofing over the insulation.

While laying the foam concrete, samples from each batch of the mix shall be kept for test if so desired by the Engineer.

2.02.02 Expanded Polystyrene Blocks

The expanded polystyrene block insulation shall be fire retardant quality and shall have a maximum thermal conductivity of 0.026 KCal m/m^2 h degree C. It must be strong enough to withstand without deformation the workload and standard loads expected on the roof.

The LSTK Vendor shall lay the expanded polystyrene block as per manufacturer's approved specification. Only specifically experienced workers shall be engaged for this work. If the Engineer is not satisfied about the efficiency of the workers the LSTK Vendor shall secure manufacturers' supervision at no extra cost to the Owner.

2.03.00 Fillets

Fillets at junction of roofs and vertical walls shall be provided with the same insulating material as provided for the main roof insulation. The fillets shall be 150 mm x 150 mm in size unless otherwise shown on drawings or instructed by the Engineer.

Where there is no insulation over roof slab, fillets shall be cast-in-situ cement concrete (1:2:4) nominal mix by volume.

2.04.00 Waterproofing with Bituminous felt

Waterproofing treatment shall be laid by a specialist firm with long experience in the particular trade.

The waterproofing treatment for roofs with Bitumen Felts shall be done as per IS:1346. Bitumen felt shall conform to IS:1322 and bitumen primer to IS:3384.

The bonding material shall consist of blown type bitumen conforming to IS:702 or residual bitumen to IS:73 or a mixture of the two to withstand local conditions of prevailing temperature or gradient of roof surface. The LSTK Vendor shall convince the Engineer that the bonding material proposed to be used is suitable for the particular job.

The LSTK Vendor shall state the source from where he proposed to procure the materials. Samples of the self-finished felt shall be submitted in advance to the Engineer along with test certificates for his review. Test certificates for the bonding materials shall also be submitted and samples, if desired by the Engineer, shall be provided for confirmatory tests. Samples of pea sized gravel shall be submitted if instructed by the Engineer.

Minimum overlaps of 100 and 75 mm shall be given at the end and sides of strips of felt and properly bonded with bitumen. Joints in successive layers of felt shall be staggered.

Normal treatment with one layer of felt, Heavy treatment with two layers of felt or Extra Heavy treatment with three layers of felt shall be specified in drawing/ schedule. Brief details of the various treatments shall be as follows :-

a) Normal Treatment : Four courses :

1) Hot applied bitumen at the rate of 1.2 kg/m^2 Min.

2) Hessian base self finished felt, type 3, grade 1

3) Hot applied bitumen at the rate of 1.2 kg/m^2 Min.

4) Pea sized gravel at the rate of 0.006 m^3 /m^2

b) Heavy Treatment : Six Courses :

With Hessian base felt

1) Hot applied bitumen at the rate of 1.2 kg/m^2 Min.

2) Hessian base self-finished felt, type 3, grade 1

3) Hot applied bitumen at the rate of 1.2 kg/m^2 Min.

4) Hessian base self-finished felt, type 3, grade 1.

5) Hot applied bitumen at the rate of 1.2 kg/m^2 Min.

6) Pea sized gravel at the rate of 0.006 m^3 /m^2

Or

With fibre base felt

1) Hot applied bitumen at the rate of 1.2 kg/m^2 Min.

2) Fibre base self-finished felt, type 2, grade 2

3) Hot applied bitumen at the rate of 1.2 kg/m^2 Min.

4) Fibre base self-finished felt, type 2, grade 2

5) Hot applied bitumen at the rate of 2.5 kg/m^2 Min.

6) Pea sized gravel at the rate of 0.008 m^3 /m^2

c) Extra Heavy Treatment : Eight courses :

With fibre base felt

1) Hot applied bitumen at the rate of 1.2 kg/m^2 Min.

2) Fibre-base self-finished felt type 2, grade 1

3) Hot applied bitumen at the rate of 1.2 kg/m^2 Min.

4) Fibre base self-finished felt type 2, grade 1

5) Hot applied bitumen at the rate of 1.2 kg/m^2 Min.

6) Fibre base self-finished felt type 2, grade 1

7) Hot applied bitumen at the rate of 2.5 kg/m^2 Min.

8) Pea sized gravel at the rate of 0.008 m^3 /m^2

Or

With Hessian base felt

1) Hot applied bitumen at the rate of 1.2 kg/m^2 Min.

2) Hessian base self-finished felt, type 3, grade 1.

3) Hot applied bitumen at the rate of 1.2 kg/m^2 Min.

4) Hessian base self-finished felt, type 3, grade 1

5) Hot applied bitumen at the rate of 1.2 kg/m^2 Min.

6) Hessian base self-finished felt, type 3, grade 1

7) Hot applied bitumen at the rate of 1.2 kg/m^2 Min.

8) Pea sized gravel at the rate of 0.006 m^3/m^2

However, in special cases, more courses or a combination of fibre base and hessian base felts may be asked for.

The surface to receive the waterproofing treatment must be cleaned and dried satisfactorily and the Engineer's approval taken before starting the work. If any existing waterproofing treatment is being augmented the pea sized gravel or any other existing top course shall be completely removed and all damaged felts or other defects repaired.

The Engineer may instruct the LSTK Vendor to lay part of the stipulated courses at the first instant to be followed later on with the balance courses. This interim finish shall be done with a course of hot applied bitumen. While doing the balance again hot bitumen shall be applied to start with after repair of all damages to the already laid course.

After completion the surface shall be cleaned taking care that loose gravels, felt cuttings etc. do not find their way into rain water down comers.

2.05.00 Waterproofing by epoxy resin based application

Exposed surfaces of cement concrete, lime concrete or brickwork to be treated for waterproofing by the resin based application shall be thoroughly cleaned and the epoxy resin based material to be applied as directed by the manufacturer. The material shall not have any adverse effect on the surface on which it is applied and must stick to it uniformly to make a strong durable bond. It shall not be affected by short duration from fire, sun, light traffic. The application shall be resistant to growth of fungus and proof against saltpeter action. If desired by the Engineer, a sample shall be prepared in advance and tested for waterproofness for 48 hours under 300 mm depth of standing water. The LSTK Vendor shall arrange the demonstration by providing free the materials and labours for the

application. This item shall carry a guarantee as specified under the relevant item in the Schedule.

2.06.00 Flashing

Unless otherwise stated flashing shall be done in the same way as the waterproofing except that the last layer, instead of being finished with pea-sized gravel, shall be finished with two coats of bituminous primer. The flashing shall be extended up the vertical surfaces as shown on drawing. The flashing shall end in grooves in vertical walls. The grooves shall be at least 65 mm deep and caulked with waterproof mastic cement. The minimum overlap with horizontal roofing felt shall be 100 mm.

Where specified on drawings or directed by the Engineer, metal flashing shall be provided. The metal flashing shall be done as shown on the drawings. The materials shall be 18g or 22g G.I. sheets, as specified on the drawings and/or as directed by the Engineer.

2.07.00 Waterproofing with Elastomeric Membrane

2.07.01 Primer Coat

It shall consist of polyurethane (P.U.) or any other equivalent material. Primer coat shall be a special blend of moisture curing urethane pre-polymers in solvent. A single coat of this primer shall be applied by brush /spray with airless spray equipment over the prepared bed as an adhesion coat with an application rate of 6-8 sq.m per litre depending on the surface porosity.

The primer shall be allowed to dry for a minimum period of 2 to 4 hours time before the successive finishing coats of P.U. liquid membrane are applied. In any case successive finishing coat shall be applied within 24 hours.

The substrate shall be properly prepared by removing all loose materials by vigorous brushing, fungal growth with proprietary fungicide as recommended. Priming coat shall not be applied to damp substrate.

2.07.02 Finishing Coats

The finishing coats shall consist of two successive liquid coatings of high solid content urethane pre-polymers or equivalent material to form an elastomeric membrane. Application shall be with brush or spray to form an uniform jointless elastomeric membrane. The overall dry film thickness shall be 1.5 mm subject to minimum 750 gm per sq.m per coat application rate.

Each coat shall be allowed to dry for minimum 12 hours before applying the next coat. The surface should be dry and smooth before application.

The coating shall be continued up the parapets/walls for minimum of 150 mm over the finished roof surface or fillet with suitable tucking into the vertical wall surface. It shall be continued into rain water pipes by at least 100 mm.

The final coat of PU liquid when tacky shall be sprinkled with the sand.

For edges, expansion joints and any vulnerable points a layer of polyscrim cloth/fabric is to be embedded between 2 finishing coats.

The entire work shall be carried out under the suspension of approved authorized agency and as per manufacturer's specification.

2.07.03 Surface Finish

Areas of roof treatment shall be provided with wearing course consisting of minimum 25 mm thick PCC 1 :1.5 :3(using 12 mm size aggregate) cast in panel of maximum size of 1.20 m x 1.20 m and reinforced with 0.56 mm diameter galvanized chicken wire mesh and sealing of joints using sealant or elastomeric compound.

When the roof surface is subjected to foot traffic or used as a working area, a cement mortar (1:4) shall be applied over the top most layer of roofing treatment. Over this, a layer of chequered cement concrete flooring tiles conforming to IS:13801 shall be provided. The tiles shall be laid as per IS 1443.

3.00.00 ACCEPTANCE CRITERIA

The surface level shall be such as to allow quick draining of rain water without leaving any pool anywhere. The finishing course shall be fully secured and shall have an even density. There shall not be any bubble formation or crushed or squeezed insulation or underbed.

The LSTK Vendor shall give a guarantee in writing for all work executed under this specification supplemented by a separate and unilateral guarantee from the specified agency for the roof water-proofing treatment work. The guarantee shall be for materials and workmanship for a period of minimum 10 years. The mode of execution of the guarantee shall be acceptable to the Owner.

4.00.00 I. S. CODES

Some important relevant codes for this section are :-

a) IS:73 : Paving Bitumen

b) IS:702 : Industrial Bitumen

c) IS:1201 : Methods of testing tar and bitumento IS: 1220

d) IS:1322 : Bitumen felts for waterproofing and dampproofing.

e) IS:1346 : Code of practice for waterproofing of roofswith bitumen felts.

f) IS:3384 : Bitumen primer for use in water-proofing anddamp proofing.

SUB-SECTION NO. C13

TECHNICAL SPECIFICATION FOR CARPENTRY AND JOINERY

TECHNICAL SPECIFICATION
FOR
CARPENTRY AND JOINERY

CONTENTS

CLAUSE NO.	DESCRIPTION
1.0	SCOPE
2.0	INSTALLATION
3.0	ACCEPTANCE CRITERIA
4.0	I.S. CODES

TECHNICAL SPECIFICATION FOR CARPENTRY & JOINERY

1.0 SCOPE

This shall include supply, fitting and fixing of timber frames to doors and windows with M S holdfasts, panelled or flush doors, windows, shutters, partitions, wall panelling, pelmets, shelves, furniture, etc. as shown in drawings, including a prime coat of approved paint, varnish, or fixing of decorative plastic laminate where called for in the schedule. This shall also include the supply and fixing of all hardware and fixtures shown in drawing or specified in the "Schedule of Fixtures".

2.0 INSTALLATION

2.1 Materials

a) Timber

Unless otherwise specified, all timber shall be best quality well seasoned C P teakwood free from large or loose, knots cracks or other defects. Where specified, timber shall be treated with approved wood preservative before use. Before starting the carpenters' work, the LSTK Vendor shall have the rough timber approved by the Engineer.

b) Plywood

Plywood shall be commercial quality or with decorative surface veneer. Unless specifically permitted otherwise, the adhesive used in plywood shall be phenol-formaldehyde resin of B W R grade conforming to IS:848.

c) Decorative Laminated Plastic Sheets

The colour, pattern, finish and texture shall be approved by the Engineer and the bulk supply procured in sheet sizes which will ensure the least number or joints in one surface.

d) Flush Doors

Flush doors shall be hollow or solid core doors with commercial or decorative faces and hardwood edges. The core for solid core doors shall be of block board or wood particle board. Manufacturer's literature and test certificates shall be submitted for the approval of the Engineer. The LSTK Vendor shall give a guarantee that the adhesive used is phenol formaldehyde of B W R grade, conforming to IS:848. The thickness shall be as specified in the "Schedule of Items".

e) Panel Doors

Panel door shall be of teakwood shutter frame unless otherwise noted and panels with teakwood /commercial ply/ teakwood particle board/ FRP as per "Schedule of items". Other considerations shall be as mentioned in item (d) above.

f) Fixtures

Fixtures for doors, windows, furniture, etc. shall be as shown on drawing or specified in the "Schedule of Fixtures". These shall be heavy type, best quality and from approved manufacturer.

2.2 Workmanship

2.2.1 General

The work shall be done by skilled carpenters as per details shown on drawing or instructed by the Engineer.

Framing timber and other work shall be close-fitting with proper wood joinery, accurately set to required lines or levels and rigidly secured in place. The surface of frames etc. which will come in contact with masonry after fixing, shall be given two coats of approved paint before fixing. Mastic caulking shall be done after fixing external door and window frames. Special care shall be taken to match the grain of timber or plywood which will be subsequently polished. Screwing or nailing will not be permitted to the edge of plywood and particle board. The edge of all plywood, blockboard and particle board shall be finished with teakwood lipping unless otherwise shown on drawings.

Fixing for frames and partitions shall generally be with 40 mm x 6 mm x 300 mm long M S holdfasts bifurcated at end and grouted with 1:2:4 cement concrete. The gap between masonry and external door and window frame shall be caulked with polysulphide mastic. M S grills or guard bars shall be provided to windows where called for in the drawings or schedule of items.

2.2.2 Finish

All carpentry work after finishing shall be sand papered smooth. A prime coat paint shall be given after inspection of the Engineer to all surfaces other than those which shall be subsequently polished or covered with laminated plastic sheet.

2.2.3 Surface Treatment

When shown on drawings or called for in Schedule, decorative ply or laminated plastic sheets shall be bonded under pressure to the surface to be finished. The adhesive used shall be of approved brand and brought to site in sealed containers. The rate of application and the length of time for which the pressure

is to be applied shall be as per the manufacturer's instructions. The edge of sheets shall be protected by teak lipping or bevelled as shown on drawings.

3.0 ACCEPTANCE CRITERIA

3.1 Door and Window Frames

All frames shall be square and flat at the time of delivery and shall be checked for dimensions and corner angles. After fixing they shall be on a fine vertical plane and the two internal diagonals should be of the same dimension. All external door and window frames shall be caulked with mastic.

3.2 Door and Window Shutters

Shall be of proper size, shape and design and free of warp. When fixed to frames, these shall operate smoothly without jamming and all latching or locking devices shall engage properly without undue pressure.

3.3 Partitions, Panelling, Pelmets, Furniture, etc.

3.3.1 General

These shall conform to drawings in all details. No unsightly nailmarks etc. shall be permitted. Plywood grains shall be matched to give a uniform and pleasing appearance.

3.3.2 Partition

Shall be checked for rigidity of fixing, plumb and horizontal as well as vertical alignment.

3.3.3 Pelmets

Shall be checked for rigidity of fixing and adequate clearance of fixture.

3.3.4 Cupboard Shutters

Shall operate smoothly without jamming and locks, bolts and double ball catches shall engage securely. Single ball catches shall not be used.

3.3.5 Drawers

Shall operate smoothly and have back stops to prevent them from being pushed too far. Locks shall engage securely.

3.3.6 Loose Furniture

When placed on a level surface tables tops etc. shall be horizontal and the pieces stand stably on legs or supports.

4.0 I.S. CODES

Some of the important relevant Codes for this Section are :-

IS:4021 - Timber door, window and ventilator frames.

IS: 1003 - Timber panelled and glazed shutters.

IS:2191 (Pt. I & II) - Wooden flush door shutter (Cellular and hollow core type).

IS:2202 (Pt. I & II) - Wooden flush door shutters (solid core type).

SUB-SECTION NO. C14

TECHNICAL SPECIFICATION FOR MISCELLANEOUS METAL

TECHNICAL SPECIFICATION
FOR
MISCELLANEOUS METAL

CONTENTS

CLAUSE NO.	DESCRIPTION
1.0.0	SCOPE
2.0.0	INSTALLATION
3.0.0	ACCEPTANCE CRITERIA
4.0.0	I.S. CODES

TECHNICAL SPECIFICATION FOR MISCELLANEOUS METAL

1.0.0 SCOPE

This shall include supply, fabrication and erection of miscellaneous metal items of light nature in gates, grills, balcony and stair handrails , structural mullions and transoms, ladders, hangers, masonry anchors, shelf angles, anchor bolts, fasteners, etc. as shown on drawing or as instructed by the Engineer. The above items shall be fabricated out of cast M.S/Aluminium/Brass, cast iron, M.S. and galvanised M.S. Sheets, aluminium sheets, expanded metal, wire mesh etc. as shown on drawings and/or described in the Schedule of Items.

2.0.0 INSTALLATION

2.1.0 Fabrication/Casting

2.1.1 General

All work shall be done according to approved shop drawings. All workmanship shall be equal to the best practice in modern structural or foundry shop.

2.1.2 Shop Connections

a) All shop connections shall be riveted or welded except when noted otherwise on drawings.

b) Welding of steel shall be done in accordance with IS 816 : Use of metal arc welding for general construction in Mild Steel.

c) Welding of aluminium shall be done in accordance with IS 2812: Arc welding of Aluminium and Alloys. Special care shall be taken to grind smooth all welded surface that shall remain exposed to view. Welds shall be electrically continuous if so required by the Engineer.

2.1.3 Shop Coat

Before leaving the shop, all metal work shall be thoroughly cleaned by effective means of all loose mill scale, rust and foreign matter. Except where encased in concrete, all steelwork shall be given one coat of approved metal protective paint, applied by brush thoroughly and evenly, well worked into joints and other open spaces. All paint shall be applied to dry surfaces. When specified in Schedule, steel work shall be galvanized or galvanized and painted with a coat of zinc chromate primer. Aluminium surfaces which shall come in contact with masonry shall be given one coat of bituminous paint.

2.2.0 Erection

2.2.1 Bracing

The LSTK Vendor shall provide all necessary temporary guys and braces to ensure alignment and stability of the members and to take care of all loads to which the structure may be subjected including erection of equipment and operation of the same.

2.2.2 Temporary Bolting-Up

As erection proceeds the LSTK Vendor shall plumb up and level all members and shall securely bolt up to take care of all dead load, wind load and erection stresses. Wherever piles of materials, erection equipment or other loads are carried during erection, proper provision shall be made to take care of the stresses resulting from the same.

2.2.3 Turned Bolt

For field connections where bolting is specified, holes for the turned bolts may be reamed in the field, if required. All drilling or reaming for turned bolts shall be done after the parts to be connected are assembled.

2.2.4 Welding

Where specified on drawings, welding shall be done in accordance with IS : 816 for steel and IS: 2812 for Aluminium and Alloys.

2.2.5 Cutting and Fitting

No cutting of sections, flanges, webs of angles shall be done without the approval of the Engineer. Where indicated on the drawings, holes, cuttings, etc. shall be provided as required for installation, to the work by LSTK Vendor. No additional holes or cuttings, than those shown on drawings, shall be made without the approval of the Engineer.

2.2.6 Drifting

Correction of minor misfits and a reasonable amount of reaming and cutting of excess stock from rivets may be permitted. For this, light drifting may be allowed to draw holes together. Twist drills shall be used to enlarge as necessary to make connections. Reaming that weakens the members or makes it impossible to fill the holes properly or to adjust accurately after reaming shall not be allowed.

Any error in shop work which prevents the proper assembling and fitting of parts by moderate use of drift pins or a moderate amount or reaming and slight chipping and cutting shall immediately be called to the attention of the Engineer and approval of the method of correction obtained. The use of cutting torches to enlarge or alter rivet holes shall not be permitted.

2.2.7 Grouting

All bearing plates, loose lintels and beams, etc. shall be set to proper grade and level by the LSTK Vendor and the Engineer's approval obtained before proceeding with the grouting. Grouting shall be done with 1 :1.5 : 3 concrete using 6 mm down stone chips.

2.2.8 Anchor Bolting

When shown on drawings, the miscellaneous metal items shall be fixed to concrete by case hardened steel expander nut and bolt. The LSTK Vendor shall submit the manufacturer's literature showing the average pull out and average shear values for bolts of various sizes. The bolts shall be fixed strictly as per the manufacturer's instructions.

2.2.9 Pipe Joints

M.S. Pipes shall be joined by threaded sockets or by welding. Cast iron pipes shall be socket and spigot jointed and caulked with hemp and molten lead.

2.2.10 Spot Painting

All field rivets and bolts and also any serious abrasion to shop paint shall be spot painted with the same materials as used for the shop paint or equivalent.

2.2.11 Making Good

All cutting to concrete or masonry shall be made good to the satisfaction of the Engineer.

3.0.0 ACCEPTANCE CRITERIA

a) All items shall be of correct shape, size, weight etc. as shown on drawings and schedule of items.

b) For installed items, the tolerances shall be as follows :

i) Permissible deviation from straightness - 1 in 1000.

ii) Seats, stiffener connections etc. shall be as per approved drawings and shall not interfere with architectural clearances.

c) All castings shall be free from blow holes, cracks and other blemishes.

4.0.0 I.S. CODES

Some important relevant codes for this section are :-

IS:800 - Code of practice for use of structural steel in general building construction.

IS : 816 - Use of metal arc welding for general construction in mild steel.

IS : 2812 - Arc welding of Aluminium and Alloys

IS : 3150 - Hexagonal Wire Netting

IS : 4948 - Welded steel wire fabric for general use.

SUB-SECTION NO. C15

TECHNICAL SPECIFICATION FOR ROLLING STEEL SHUTTERS/ GRILLS

TECHNICAL SPECIFICATION
FOR
ROLLING STEEL SHUTTERS/ GRILLS

CONTENTS

CLAUSE NO.	DESCRIPTION
1.0	SCOPE
2.0	INSTALLATION
3.0	ACCEPTANCE CRITERIA
4.0	I.S. CODE

TECHNICAL SPECIFICATION FOR ROLLING STEEL SHUTTERS/ GRILLS

1.0 SCOPE

This specification covers the design, supply of materials, fabrication, delivery and erection of Rolling Shutters/Grills with motor drive and/or manual operation including all accessories as hereinafter specified.

2.0 INSTALLATION

2.1 Components

a) Slats for rolling shutters shall be made from tested bright cold rolled, annealed M.S. strips, not less than 0.9 mm thick for shutters less than 3.5 M in width and not less than 1.25 mm thick for shutters 3.5 M wide and above, machine rolled at 75 mm rolling centers, interlocking with each other. The profile shall be such as to prevent excessive deflection under specified wind load.

b) Rolling grills shall be constructed out of 6 mm dia. rods at 35 mm on centers running horizontally flexible connected with vertical links spaced not more than 200 mm centers. Alternatively, rolling grills shall be made from perforated slats of approved design reinforced with 6 mm dia rods.

c) End locks shall be heavy type M.C.I./C.I. and shall be provided at each end of alternate slats unless specified otherwise in the Schedule.

d) Bottom bars shall be finished with two angles not less than 6 mm thick for external shutters. When shown on drawings, a flexible weather strip shall be applied to make tight contact with the floor.

e) Guides shall be of such depth as to retain the shutter under a wind pressure of 150 Kg/Sq.M or as specified in Schedule.

f) Shafts shall be of steel pipe of sufficient size to carry the torsion load with a maximum deflection of 1/360 of span.

Grease packed ball bearings or bushings shall be provided for smooth trouble free operation.

g) Hoods shall be formed of not less than 20 gauge steel, suitably stiffened to prevent sag.

h) Locks shall be slide bolt and hasp, or cylinder lock operable from one or both sides. Provision securing hand chain with pad-lock, provision for removable handle for hand cranks etc. shall be made as described in Schedule or as described by the Engineer.

i) Power unit shall be suitable for 3 phase, 50 Hz, 415 volt A.C. power supply and shall be either floor or wall mounted unit. The motor shall be of sufficient capacity to move the shutter in either direction at a speed of 0.3 meters per second. In addition to the gear motor each standard power unit shall include a magnetic brake, a reversing starter with built-in overload protection, a geared limit switch and one push button station located inside the building unless otherwise stated in Schedule or drawing.

It is desirable that the bottom bar of motor operated doors shall be provided with a sensitive edge, electrically connected to stop the travel of the door on meeting an obstruction.

j) Operating chains shall be of tested quality, heavily galvanized and with all ends rounded to assure smooth operation and hand protection.

k) Reduction gears shall be of high strength grey cast iron, machine moulded .

2.2 Manually Operated Shutters/Grills

Manually operated shutters shall be easily operable by one person. The speed of operation shall be about 0.3 meters per second. In general, manually operated shutters shall be push pull type for openings up to 9 Sq.metre in area. Larger shutters shall be either chain and gear operated or crank and gear operated. The crank handle shall be removable. All shutters shall be lockable from one or both sides as described in Schedule or as desired by the Engineer.

2.3 Power Operated Shutters/Grills

These shall be operable from a push button station conveniently located beside the door or as shown on drawings. One emergency hand chain/crank operation shall also be provided for use in case of failure of the electric system. Where called for in Schedule, externally mounted shutters shall be operated by control mechanism located inside the building.

2.4 Shop Coat

Shutters shall be painted with one coat of red lead or zinc chromate primer. Where specified, doors shall be galvanized and subsequently painted with one coat of zinc chromate for adhesion of field coat.

2.5 Erection

Door shall be installed by the manufacturer or his authorized representative and all work shall be as per manufacturer's instructions. Any drilling or cutting to concrete, masonry etc. shall be made good after erection of shutters and all abrasion to shop coat shall be touched up. All electrical work shall be in strict accordance with the latest Indian Electricity Rules.

3.0 ACCEPTANCE CRITERIA

3.1 Shop Inspection

After completing the manufacture of the different components of the rolling shutter, an arrangement for shop inspection by the Engineer shall be made to check the conformity with approved shop drawings.

3.2 Field Inspection

After installing the shutters, the LSTK Vendor shall test the performance of the shutters in the presence of the Engineer. The doors shall be smoothly operable under all ambient conditions. All control and locking devices shall give fault-free performance.

3.3 Guarantee

The LSTK Vendor shall give one year's guarantee for the successful operation of the shutters. This shall be supported by a separate and unilateral guarantee from the manufacturer of the shutters.

4.0 I.S. CODE

The following I. S. Code is relevant for this section :-

IS : 6248 - Metal rolling shutters and rolling grills.

SUB-SECTION NO. C16

TECHNICAL SPECIFICATION FOR ANTI-TERMITE TREATMENT

TECHNICAL SPECIFICATION
FOR
ANTI-TERMITE TREATMENT

CONTENTS

CLAUSE NO.	DESCRIPTION
1.0.0	SCOPE
2.0.0	EXECUTION
3.0.0	ACCEPTANCE CRITERIA
4.0.0	RATES
5.0.0	METHOD OF MEASUREMENT
6.0.0	I.S. CODE

TECHNICAL SPECIFICATION FOR ANTI-TERMITE TREATMENT

1.0.0 SCOPE

The scope of work is to set up a chemical barrier against attack by subterranean termites while the building is under construction.

2.0.0 EXECUTION

2.1.0 General

All work shall in general be executed as specified in IS:6313, Part II and as per approved specification of the agency having special know-how for the job.

All necessary work to ensure uniform distribution and proper penetration of treating solution shall be done according to the instruction of the Engineer.

Soil treatment shall not be done when it is raining or when the soil is wet due to rain or subsoil water. Once formed, the treated soil barrier shall not be disturbed.

2.2.0 Chemicals and Rate of Application

Any of the following chemicals (conforming to relevant Indian Standards) in water emulsion shall be applied by pressure pumps, uniformly over the area to be treated.

Chemicals	**Concentration by Weight (Percentage)**
Chlorpyrifos Emulsifiable (IS 8944)	1.0
Lindane (IS 632)	1.0
Imidacloprid (IS 16131)	1.0

2.3.0 Treatment

2.3.1 Treatment of Column Pits, Wall Trenches and Basement Excavations

Foundations, basements etc. may either be fully enveloped by the chemical barrier or the treatment may start 500 mm below ground level. The bottom surface and sides of excavation (up to a height of about 300 mm) for column pits, walls trenches and basements shall be treated with chemicals at the rate of 5 litres / M^2 of surface area. Backfills around columns, walls etc. shall be treated at the rate of 7.5 litres / M^2 of the vertical surface. Chemical treatment shall be done in stages following the compaction of earth in layers. The treatment shall be carried out after the ramming operation is done by roding the earth at 150 mm centers close to the wall surface and spraying the chemicals in the specified dose.

2.3.2. Treatment of Top Surface of Plinth Filling

Holes 50 mm to 75 mm deep at 150 mm centers both ways shall be made with crow-bars on the surface of compacted plinth fill. Chemical emulsion at the rate of 5 litres / M^2 of surface shall be applied prior to laying soling or sub-grade. Special care shall be taken to maintain continuity of the chemical barrier at the junction of vertical and horizontal surfaces.

2.3.3 Treatment of Soil Surrounding Pipes, Wastes and Conduits

Special care shall be taken at the points where pipes and conduits enter the building and the soil shall be treated for a distance of 150 mm and a depth of 75 mm at the point where they enter the building.

2.3.4 Treatment of Expansion Joints

These shall receive special attention and shall be treated in a manner approved by the Engineer.

3.0.0 ACCEPTANCE CRITERIA

The LSTK Vendor shall give a 10 year service guarantee in writing supplemented by a separate and unilateral guarantee from the specialised agency for the job to keep the building free of termites for the specified period at no extra cost to the owner.

4.0.0 RATES

Rates shall be given per sq.m of plinth area, for the complete treatment.

5.0.0 METHOD OF MEASUREMENT

Complete work of anti-termite treatment shall be measured for plinth area treated.

This shall include treatment to foundations, walls, trenches, basements, plinth, buried pipes, conduits etc.

6.0.0 I.S. CODE

Relevant code applicable for this section :-

IS:6313 (Part-II): Code of Practice for Anti-Termite Measures in Buildings:

Pre-constructional chemical treatment measures.

SUB-SECTION NO. C17

TECHNICAL SPECIFICATION FOR WATER SUPPLY

TECHNICAL SPECIFICATION
FOR
WATER SUPPLY

CONTENTS

CLAUSE NO.	DESCRIPTION
1.0.0	SCOPE
2.0.0	INSTALLATION
3.0.0	TESTING AND ACCEPTANCE
4.0.0	I.S. CODES

TECHNICAL SPECIFICATION FOR WATER SUPPLY

1.0.0 SCOPE

This section includes supply of all materials, labour and incidentals for water supply for residential, business and industrial and other types of buildings. The water supply system of a building or premises covers service pipes and the necessary connecting pipes, fittings, control valves and all appurtenances in or adjacent to the building or premises.

1.0.1 Materials

All materials, fittings, fixtures and appliances shall be of the best quality conforming to relevant Indian Standard and shall be procured from approved manufacturers. Unless specifically allowed by the Engineer, the LSTK Vendor shall submit samples of fittings and fixtures which will be retained by him for comparison when bulk supplies are received at the site. Ultimate choice of type, model and manufacturer lies completely with the Engineer.

It shall be the responsibility of the LSTK Vendor to procure the materials selected by the Engineer. Hence orders are to be placed with the manufacturers in time, so that the materials are available at the site well ahead of their requirement.

The materials brought to the site, shall be stored in a separate secured enclosure away from the building materials. Pipe threads, sockets and similar items shall be specially protected till final installation. Brass and other expensive items shall be kept under lock and key. Fragile items shall be checked thoroughly when received at the site and items found damaged shall not be retained at the site.

1.0.2 Pipes and Pipe Fittings

Under scope of this specification, pipes and pipe fittings may be any or a combination of the following types :

a) Cast Iron / Ductile iron

b) Steel: lined, coated with bituminous composition, out coated with cement concrete or mortar or galvanized.

c) Reinforced Concrete

d) Prestressed Concrete

e) Asbestos Cement

f) Lead (Not to be used for potable water)

g) P. V. C.

h) Copper

i) Brass

j) Wrought iron

1.0.3 Water Reservoirs

Water reservoirs like pressed steel tanks and G.I. tanks shall come under scope of this specification. Reservoirs made of concrete, masonry or fabricated steel shall be covered by respective work specifications.

1.0.4 Related Work

All work, like earthwork, masonry, concrete, steelwork, cutting holes, chases, repairs and rectification associated directly with installation of water supply systems shall come under scope of the LSTK Vendor unless specifically excluded. These works are not detailed out in this Specification.

1.0.5 Regulation

The work which is required to be carried out under the scope of this section, shall be executed by a licensed plumber only (engaged by the LSTK Vendor) and he shall obtain all necessary sanctions, permissions, certificates etc. from Municipal and/or other Local Authorities and shall abide by all the rules of such Authorities.

2.0.0 INSTALLATION

While basic layouts may be available in the drawings provided by the Owner, the details might have to be supplemented by the LSTK Vendor for approval of the Engineer.

Special attention shall be given by the LSTK Vendor to economy. Symmetry of layout is very important. Fittings meant for operation shall be located and oriented to allow easy reach and operation. Maintenance, repairs and replacements of pipes, fittings and fixtures must be conveniently possible.

2.1.0 Pipe Lines

2.1.1 Laying

In addition to fulfilling the functional requirements all pipelines shall be laid true to line, plumb and level. Any deviation shall need approval of the Engineer. Meticulous care shall be taken to avoid chances of airlock and water hammer.

Pipes shall be laid on continuous unyielding surface or on reliable supports (at least one near each joint) and at spacing as directed by the Engineer. The support must be strong, neat and shall have provisions for securing the pipes in every direction and easy maintenance. Pipes shall be encased or concealed in masonry or concrete if shown on drawing or directed by the Engineer.

2.1.2 Back Flow

The layout of pipe work shall be such that there is no possibility of back flow towards the source of supply from any cistern or appliances, whether by siphonage or otherwise. All pipe works shall be so laid or fixed and maintained as to be and to remain completely water-tight, thereby avoiding wastage of water, damage of property and the risk of contamination of the water conveyed.

2.1.3 Contamination

There shall be no cross connection whatsoever between a pipe or fitting for conveying or containing wholesome water and a pipe or fitting for containing impure water or water liable to contamination or of uncertain quality of water which has been used for any purpose.

No piping shall be laid or fixed so as to pass into or through any sewer, scour outlet or drain or any manhole connected therewith.

2.1.4 Underground Piping

Underground piping shall be laid at such a depth that it is not likely to be damaged by traffic and other loads and frost, where applicable.

The size and depth of the trench shall be as approved by the Engineer. Back-filling shall be done with selected fine earth, unless otherwise permitted in 150 mm layers and carefully consolidated. Special care shall be taken while filling in the vicinity of the pipe to avoid damage. Before backfilling the laid pipe shall be fully tested and approved.

Where the pipe rests on rock it may be bedded on a layer of fine selected material or concrete to avoid local point support.

The trench shall be so treated by gradient and filling in the area that it does not act as a drainage channel.

2.1.5 Concealed Piping

Where desired by the Engineer or shown on the drawings the pipes shall be concealed in masonry or concrete of the structure. The LSTK Vendor shall co-ordinate with the building Contractor for leaving the chases, openings, conduits as necessary. However, LSTK Vendor will rectify if required the chases, openings and conduits, supplement and make good after laying and testing of the concealed pipelines.

2.1.6 Jointing of Pipes

Jointing of pipes shall be completely leakproof and durable. Instruction of the manufacturer shall be followed unless desired otherwise by the Engineer. However, usually recommended practices are stated below for guidance:

a) Cast Iron

i) Spigot and Socket Joints

Lead joint :The joint is made by first caulking in clean spun yarn up to half depth and filling the reminder by running in molten lead taking care that no dross enters the joint and then thoroughly caulking the lead. The lead need not extend into the joint further than the back of the groove formed in the socket. After completing the joint it shall not be allowed to move. For rectification the joint shall be completely redone.

ii) Flanged Joints : Flanged joints shall be made by jointing rings of good quality, smooth and hard compressed fibre board of thickness not less than 1.5 mm and of such width as to fit inside the circle of bolt. Diagonally opposite bolts shall be tightened in pairs and in stages so that degree of all bolts in a joint is similar. Damaged gaskets shall be replaced.

b) Steel

Plain ended steel pipes may be jointed by welding. Screwed and socketed joints shall be carefully tightened. Care shall be taken to remove any burr from the ends of the pipes. Jointing compound, if used, shall be lead free and approved by the Engineer. Once a joint has been screwed up it shall not be backed off unless threads are recleaned and new compound applied.

c) GI Pipes

Threads shall be cut with sharp tools, and before jointing all scales shall be removed from pipes by suitable means. The screw / threads of the pipe shall be cleaned out and the joint made by screwing the fittings after treating the threads with approved pipe jointing compound. Once a joint has been screwed up it shall not be backed off unless threads are recleaned and new compound applied.

d) Asbestos Cement Pipes

Socket and spigot ended pipes shall be jointed by caulking with tarred gaskets and grouted with 1:3 cement sand mortar.

e) Lead

Lead and lead alloy pipes shall be jointed with wiped solder joints.

f) Concrete

Concrete pipes may be socket and spigot ended collar or band jointed. Joints shall be effected by caulking with 1:3 cement sand mortar.

g) P. V. C.

Manufacturer's instruction shall be followed. For heating approved equipment with adequate control shall be used.

h) Tyton Joint

The manufacturer's instruction shall be strictly followed in making such joints. Tyton joints shall be made by push-on type specification stipulated by the pipe manufacturer. The tools specified by the pipe manufacturer shall be used to secure the joint fully.

2.1.7 Painting

Where mentioned in the Schedule, underground steel and cast iron pipes shall be given 2 coats of bituminous paint on the outside after laying, when painting is to be done above ground G.I. pipes shall be given a coat of zinc chromate primer, C.I. and M.S. pipes shall be given one coat of red lead or zinc chromate primer. Top coats shall be minimum 2 coats of best quality paint.

2.2.0 Storage Tank - Pressed Steel Tank

Unless otherwise mentioned, water storage tanks shall be pressed steel tanks of nominal size and capacity as mentioned in the Schedule and fabricated with all flanges external, all flanges internal, or bottom flange internal and side flanges external, as shown on drawings or schedule of items. The fabricator shall supply 6 prints of fabrication drawings to the Engineer for prior approval showing thickness of plates, method of jointing the plates, all supports, stays, gussets etc. Pads, cleats etc. required for supporting the tanks shall be supplied by the manufacturer. Inlet, overflow vent pipes, manholes etc. shall be arranged and provided as shown on drawing or mentioned in the schedule. Unless otherwise specified, the outlet pipe shall be 50 mm above the bottom of the tank and there shall be a 150 mm free board at the top of the tank.

All tanks shall be supplied with mosquito-proof covered top with manhole not less than 450 mm diameter. Tanks deeper than 1.00 Metre shall be provided with m.s. internal access ladder adjacent to the manhole. Water level indicator shall be provided if asked for. Two coats of anti-corrosive paint over a suitable primer shall be applied to both internal and external surface of tanks. Such paint if used shall not impart any taste or odour to water and be of lead free composition..

Erection of tanks shall be in accordance with detailed drawings and manufacturer's instructions. The two finishing coats of paint shall be applied to outside after erecting is complete.

2.2.1 G. I. Water Tank

G. I. water tanks shall be procured from a reputed manufacturer. The design shall be good enough to withstand the loads safely. Galvanised iron water storage tank shall be made of minimum 2 mm thick galvanised iron sheet. Plain sheets shall be fixed at the corner to angle iron frames by means 6 mm rivets at 40 mm pitch for tanks up to 1000 litres capacity and 8 mm rivets at 35 mm pitch

for tanks above 1000 litres capacity. Tanks above 1000 litres shall have 20 mm dia. galvanised / iron stay rods, one fixed to angle framing at top and two in the body of the tank for extra strength. Holes for rivetting shall be drilled and not punched. White lead shall be applied to the joints before rivetting.

In case it is desired by the Engineer that corners of tank should be welded instead of rivetted then the sheets shall be welded to form a tank will not have angle iron frame.

Tanks shall have 450 mm dia. holes at the top with hinged covers. The covers shall be made of galvanised iron sheet with angle iron frame. The cover shall be just loose but close fitting to keep out dust and mosquito and will not be airtight. It shall be complete with lockable arrangement.

Tanks shall be provided with rising main inlets of 40 mm dia. galvanised iron pipe or as shown on Drawing and 25 mm dia. G.I. overflow pipe. The rising main shall be connected to the tank with a ball valve near the top which disconnects the supply when tank is full up to the point of overflowing.

The ball valve permits the entry of water when the tank is empty and disconnects the supply when the tank is full. It consists of a hollow floating ball made of copper, plastic or hard rubber, 110 mm in diameter, attached to an arm which is so pivoted that the end near the pivot closes the orifice of the main when the ball is raised to the required height of water in the tank and opens the main as soon as the ball drops with the fall of water level as it is drawn off through the distribution pipes. The ball valve shall be fixed to the tank independent of the inlet pipe and set in such a position that the body of the ball valve cannot submerge when the tank is full up to the water line. The ball valve shall be so adjusted as to limit the level of the water line. The level of the water in the tank to 75 mm below the lip of the overflow pipe. Free surface shall be about 150 mm above the maximum water filled level.

2.3.0 Valve, Cocks, Taps

All valves, stop cocks, taps etc. shall conform to relevant Indian Standard Specification and shall be of best quality from approved manufacturers. These shall be suitable for working pressures mentioned in the Schedule. Nominal size and material shall be as per schedule.

2.4.0 Protection

Open end of each pipe shall be protected during installation by suitable covers or plugs so that the ends, threads, sockets or spigot are not damaged and no foreign material can find its way into the pipe line.

Fittings and fixtures liable to be misused or stolen during the construction phase shall be fitted only before testing and handing over.

3.0.0 TESTING AND ACCEPTANCE

3.1.0 Inspection Before Installation

All pipes, fittings and appliances shall be inspected, before delivery at the site to see whether they conform to accepted standards. The pipes and fittings shall be inspected on site before laying and shall be sounded to disclose cracks. Any defective items shall be clearly marked as rejected and forthwith removed from the site.

3.2.0 Testing of Mains After Laying

After laying and jointing, the main shall be slowly and carefully charged with water, so that all air is expelled from the main by providing a 25 mm inlet with a stop cock, allowed to stand full of water for a few days if time permits, and then tested under pressure. The test pressure shall be 5 Kg/CM^2 or double the maximum working pressure, whichever is greater. The pressure shall be applied by means of a manually operated test pump, or in the case of long mains or mains of a large diameter, by a power driven test pump, provided that the pump is not left unattached. In either case due precaution shall be taken to ensure that the required test pressure is not exceeded. Pressure gauges shall be accurate and shall preferably have been recalibrated before the test. The pump having been stopped, the test pressure shall maintain itself without measurable less for at least five minutes. The end of the main shall be closed by fitting a water-tight expanding plug and the plug shall be secured by struts to resist the end thrust of the water pressure in the mains.

3.3.0 Testing of Service Pipes and Fittings

The service pipes shall be slowly and carefully charged with water allowing all air to escape avoiding all shock or water hammer. The service pipe shall then be inspected under working conditions of pressure and flow. When all draw-off taps are closed, the service pipes shall be absolutely water-tight. All pipings, fittings and appliances shall be checked for satisfactory support and protection from damage, corrosion and frost.

4.0.0 I.S. CODES

Important relevant IS Codes for this section are listed below:-

IS:2065	:	Code for Practice for water supply in buildings
IS:1172	:	Code of basic requirements for water supply, drainage and sanitation
IS:1200 (Pt. XVI)	:	Laying of water and sewer lines including appurtenant items.
IS:1239 (Pt. I & II)	:	Specification for Mild Steel Tubes and Mild Steel Tubulars and other wrought steel pipe fittings (10 mm to 15 mm nominal diameter)

IS:1536	:	Specification for Centrifugally cast (Spun) iron pressure pipes for water, gas and sewage
IS:1537	:	Specification for vertically cast iron pressure pipes for water, gas and sewage.
IS:3589	:	Specification for steel pipe for water and sewage (200 mm to 2000 mm nominal diameter)
IS:784	:	Prestressed concrete pipes
IS:458	:	Precast concrete pipes (with or without reinforcement)
IS:783	:	Code of Practice for laying of concrete pipes
IS:1592	:	Asbestos cement pressure pipes and joints
IS:1626 (Pt. I to III)	:	Asbestos cement building pipes, gutters and fittings (Spigot and Socket types)
IS:404	:	Lead pipes
IS:4984	:	High density polyethylene pipes for potable water supplies
IS:2501	:	Copper tubes for general engineering purposes
IS:407	:	Brass tubes for general purposes
IS:1729	:	Cast iron rain water pipes and fittings
IS:804	:	Rectangular pressed steel tanks

SUB-SECTION NO. C18

TECHNICAL SPECIFICATION FOR DRAINAGE AND SANITATION

TECHNICAL SPECIFICATION
FOR
DRAINAGE AND SANITATION

CONTENTS

CLAUSE NO.	DESCRIPTION
1.0.0	SCOPE
2.0.0	INSTALLATION
3.0.0	TESTING AND ACCEPTANCE
4.0.0	CODES AND STANDARDS

TECHNICAL SPECIFICATION FOR DRAINAGE AND SANITATION

1.0.0 SCOPE

1.1.0 This section covers the layout and construction of drains for roof water, surface water and sewage together with all fittings and fixtures and inclusive of ancillary works, such as connections, manholes and inspection chambers used within the building and from the building to the connection to a public sewer or to treatment work, septic tank and soak pit dispersion trenches.

2.0.0 INSTALLATION

2.0.1 General

All pipe lines, locations of fittings and fixtures, etc. shall be as per drawings or as directed by the Engineer. Correctness of lines, plumb, orientation, symmetry and levels shall be strictly ensured. All items shall be fully secured against movement in any direction and so located as to allow easy maintenance.

All pipe lines, fittings and fixtures shall be installed leakproof. When the works under scope of this specification are linked up with works executed by others, the connections shall be such as to prevent any splashing or spilling or emission of foul odour and gases.

2.1.0 Rainwater Down comers

Rainwater downcomers shall be standard Cast Iron or Asbestos Cement Pipes. In case where specifically desired, M.S. pipes may also be used. M.S. pipes shall be painted outside withtwo coats of anticorrosive paints under a coat of primer.

Rainwater down comers shall run along and be secured to walls, columns etc. Where desired by the Engineer these may have to be installed in chases cut in the structure.

All pipes shall be well secured and supported by adequately strong brackets. The brackets may be wrought iron clevis type, split ring type or perforated strap iron type as approved by the Engineer. For vertical runs each pipe shall hang freely on its brackets fixed just below the socket. Suitable spacer blocks shall be provided against the vertical surface to which the pipe is fixed.

All bends and junctions shall be supplied with watertight cleanouts.

Roof and floor drains and yard gullies shall be installed, if required, by cutting into the structure and grouted with 1:2:4 cement concrete. All gutters shall be provided with removable gratings.

All horizontal pipes shall have a minimum fall of 1 in 100.

2.2.0 Gutters

The gutters shall be made of G.I. or A.C. All gutters shall be supplied by reputable specialized firms. Each section shall be sufficiently rigid, edges and corners straight and the slopes perfectly uniform. G.I. gutters shall have the edges strengthened by suitable means.

Unless noted otherwise the gutters shall have a minimum fall of 1 in 120. Adequate number of string supports shall be provided so that there is no unacceptable deflection even when the gutter is full. Each joint must have a support. Unless otherwise specified the supports shall be fabricated M.S. brackets. All junctions shall be thoroughly watertight. The joints may be made by riveting, bolting or soldering. All joints between successive lengths of gutters shall have on overlap of at least 5 cm. The drop in the overlap shall always being the direction of the fall of the gutter. Ends of gutters shall be closed watertight. Junction with rainwater down comers shall be made fully watertight and secured.

2.3.0 Soil and Drainage Pipes

2.3.1 Gradients

Unless otherwise specified the minimum gradients of soil and drainage pipe line shall be as follows:

100 mm nominal dia : 1 in 35

150 mm nominal dia : 1 in 65

230 mm nominal dia : 1 in 120

300 mm nominal dia : 1 in 200

2.3.2 Relation with water supply pipe lines

Unless specifically cleared by the Engineer, under no circumstances shall special drainage and soil pipes be allowed to come close to water supply pipelines.

2.3.3 Laying

Each separate pipe shall be individually set for line and for level. Where lengths of sewer or drain pipes are laid in trench, properly painted sight rails shall be fixed across the trench at a height, equal to length of the boning rod to be used, above the required invert level of the drain or sewer at the point where the sight is fixed. More sight rails shall be required at manholes, change of gradient and intermediate positions if the distance for sighting is more than 50 ft. apart. The excavation shall be boned in at least once in every 6 ft. The foot of the boning rod shall be set on a block of wood of the exact, thickness of the wall of the pipe. Each pipe shall be separately and accurately boned between sight rails.

2.3.4 Support and Protection on Pipelines

All pipes shall be laid with sockets leading uphill. Preferably the pipe shall rest on solid and even foundations for the full length of the barrel. However, the pipe manufacturer's instruction as approved by the Engineer shall be followed in the matter of support and jointing.

To achieve full and continuous support, concrete for bedding and packing is the best. Where pipes are not bedded on concrete, the floor shall be left slightly high and carefully placed so that the pipe barrels rest on undisturbed ground. If anywhere the excavation has been carried too low packing shall be done in concrete. Where laid on rock or very hard ground which cannot be easily excavated to a smooth surface, the pipes shall be laid on a cradle of fine concrete floor of gravel and crushed stone over laid with concrete or on a well consolidated gravel and crushed stone bed as desired by the Engineer. PVC or similar pipes shall be laid directly on stable soil and packed with selected soil.

The minimum support and protection for glazed stoneware pipes shall be as follows:

a) When cover is less than 2 meter below ground level and where pipes are unavoidably exposed above ground surface, the pipes shall be completely encased or surrounded with concrete.

b) Where pipes are laid on soft soil with the highest water table lying at the invert of the pipe, the sewer shall be bedded on concrete.

c) Where the pipes have to be laid on soft soil with the highest water table rising above the invert of the pipe but below the top of the barrel, the pipe sewer shall be haunched.

d) Where highest water table is likely to rise above the top of the barrel or where the pipe is laid on soft soil the pipe sewers shall be completely encased or surrounded with concrete.

Vitrified clay pipes shall be laid on a bed of 150 mm thick cement concrete of 1:3:6 nominal mix by volume.

Cast iron pipes and concrete pipes may be supported unsuitable concrete or brick support, where specified. The supports shall be unyielding and strong enough. At least one support shall be located close to ends. Spacing of intermediate supports shall be as decided by the Engineer. Pipes shall be secured to the supports by approved means.

Anchoring of pipes where necessary shall be achieved by suitable concrete encasing designed for the expected thrust.

2.3.5 Entry into structures

For entry of the pipe lines into any building or structure suitable conduits under the structure or sleeves shall be used. The conduits and sleeves shall be such as

to allow easy repairs and replacement of the pipes. When openings or chases are required to be made in the structure for entry of pipe lines, locations and sizes shall be marked and checked by the Engineer. After lying of the pipeline the openings and chases shall be mended.

2.3.6 Ducts

Where solid, waste and ventilating pipes are accommodated in ducts, access to cleaning areas shall be provided. Connection to drain shall be through a gully with sealed cover to guard against ingress of sewer gas, vermin or backflow.

2.3.7 Traps and Ventilating Pipes

Pipes carrying off the waste from water closets and waste water and overflow water from baths, wash basins, sinks to drains shall be trapped immediately beneath such fixtures. Traps shall have minimum water seal of 50 mm and shall be ventilated whenever such ventilation is necessary to maintain water seal of the trap.

Ventilating pipes shall be carried up vertically from the drain to a height of at least 600 mm above the outer covering of the roof of the building or as shown on drawings. All vertical ventilating, anti-syphonage and similar pipe shall be covered on top with a cowl. The cowl shall be made of C.I. unless desired otherwise by the Engineer.

2.3.8 Manhole and Inspection Chambers

The maximum distance between manholes shall be 30 meter unless specially permitted otherwise. In addition, at every change of alignment gradient or diameter there shall be a manhole or inspection chamber. The distance between manhole or inspection chamber and gully chamber shall not exceed 6 meters unless desired otherwise.

Manhole shall be constructed so as to be watertight under test. The bending at the sides shall be carried out in such a manner as to provide no lodgement for any splashings in case of accidental flashing of the chamber. The channel or drain at the bottom of chamber shall be plastered with 1:2 cement sand mortar and finished smooth to the grade. The channels and drains shall be shaped and laid to provide smooth flow.

Connecting to existing sewer lines shall be through a manhole.

Manholes shall be provided with standard C.I. covers. The covers shall be close fitting so as to prevent gases from coming out. Suitable heavy duty covers shall be used where necessary as decided by the Engineer.

2.3.9 Cutting of Pipes

Manufacturer's instructions shall be followed for cutting of pipes where necessary. Suitable and approved tools shall be used for the cutting so as to leave surface clean and square to the axis of the pipe.

2.3.10 Jointing

Jointing of laid pipes shall be so planned as to avoid completely any movement or strain to the joints already made. If any joint is suspected to be damaged it shall be opened out and redone.

All joints between pipes, pipe fittings and manholes shall be gas-tight when above ground and water-tight when underground. Method of jointing shall be aspen instructions of the pipe and fittings manufacturer and as approved byte Engineer. However, in the absence of any instruction available from the manufacturer the methods as detailed hereunder shall be used.

a) Cast Iron Pipes

Socket and spigot pipes shall be joined by the cast lead joints. The spigot shall be centered in the socket of the next pipe by tightly caulking in sufficient turns of tarred gasket or hemp yarn to have unfilled half the depth of socket. When the gasket or hemp yarn has been caulked tightly a jointing shall be placed round the barrel and tightened against the face of the socket to prevent airlock. Molten lead shall then be poured in to fill the remainder of the socket and caulked with suitable tools right round the joint to make up for shrinkage of the molten metal on cooling and shall be finished 3 mm behind the socket face.

Joints in cast iron pipes with special jointing arrangements like ‘Tyron’ joints etc. shall follow the instructions of the manufactures.

In special cases if flanged joints are accepted by the Engineer the joints shall be made leak-proof by inserting approved type of rubber gaskets. The bolts shall be secured in stages to avoid uneven strain.

b) Concrete Pipes

Care shall be taken to place the collar centrally over the joint.

c) Glazed Stoneware Pipes

Tarred gasket or hemp yarn soaked in thick cement slurry shall first be placed round the spigot of each pipe and the spigot shall then be placed into the socket of the pipe previously laid. The pipe shall then be adjusted and fixed in the correct position and the gasket caulked tightly so as not to fill more than 1/4 of the total depth of the socket. The remainder of the socket shall be filled with a stiff mixture of cement mortar of 1:1 proportion. Then the socket is filled, a fillet shall be formed round the joint with a trowel, forming an angle of 45 deg. with the barrel of the pipe. The newly made joints shall be protected, until set and shall be covered with damp cloth or other suitable materials.

d) Vitrified clay pipes

These shall be made from refractory clay mixed with crushed pottery and stone and burnt at a high temperature. These shall be hard, compact and glazed to make them acid resistant and impervious, and shall be obtained from approved manufacturer.

Special care shall be taken in handling these pipes. The pipes shall not be jointed until the earth has been partly refilled over the portion of the pipe between the joint holes. Before laying the second pipe, the socket of the first pipe laid shall be thinly painted all round on the inside with cement slurry (1 part of cement and 2 parts of clean, sharp sand). A ring of rope yarn (closely twisted hemp or jute) dipped in neat cement paste or tar or bitumen, shall be inserted in the socket of pipe and driven home with caulking tools. The rope shall fully encircle the spigot with a slight overlap and shall not occupy more than one-fourth of the total depth of the socket. Where the spigot end of the pipe is made for receiving the gasket, Specification for Building it shall be wrapped with two or three turns of tarred spun, as close to the end as possible, before inserting into the socket. The joint shall then be completely filled with cement mortar (1:1) which shall have very little water and levelled to form a splayed fillet at an angle of 45 degrees with the outside pipe. Special care shall be taken so that any excess mortar etc. left inside the pipe joints is neatly cleaned off immediately after each joint is made. A semi-circular wooden scrapper or a rubber disc to which a long handle is fixed could be used for this purpose.

e) Lead Pipes

No lead pipe shall be used unless specifically permitted by the Engineer. The joints in lead pipes shall be made as wiped solder joint. The minimum and the maximum length of the wiped solder joints shall be 8 cm. and 9 cm. respectively. The solders shall generally consist of two parts of lead and one part of tin.

f) Polyethylene Pipes

The joints shall be thermo-welded or bolted as per manufacturer's instructions.

g) Jointing Cast Iron Pipes with Stoneware Pipes

Where any cast iron soil pipe, ventilating pipe or trap is connected with a stoneware or semi-vitrified waste pipe or drain communicating with a sewer, the beaded spigot end of such cast iron soil pipe, waste or ventilating pipe or trap shall be inserted into a socket of such stoneware pipe or drain and the joint made with mortar consisting of one part of cement and one part of clean sharp sand after placing a ratted gasket or hemp yarn soaked in neat cement slurry round the joint and inserted in it by means of a caulking tool.

h) Jointing Stoneware with Cast Iron Pipes

Where any water closet pan or earthenware trap connected to such a pan is to be jointed with a cast iron soil pipe, the joint between the stoneware spigot and the cast iron socket shall always be of a flexible nature. Such joint shall be made with a mixture of bitumen and chopped asbestos fibre.

2.4.0 Trenches and other excavations

Width of the trench at the bottom shall be such as to provide 200 mm clearance on either side of the pipe for facility of laying and jointing.

Excavated material shall be stacked sufficiently away from the edge of the trench and the side of the spoil bank shall not be allowed to endanger the stability of the excavation. Spoil may be carted away and used for filling the trench behind the work.

Turf, top soil or other surface material shall be set aside, turf being carefully rolled and stacked for use in reinstatement.

All excavation shall be properly timbered, where necessary.

Efficient arrangement for dewatering during excavation and keeping it dry till backfilling shall be made to the satisfaction of the Engineer. Sumps for dewatering shall be located away from the pipe layout.

Where the excavation proceeds through roads necessary permissions shall be secured by the LSTK Vendor from the appropriate authorities.

Special care shall be taken not to damage underground services, cables etc. These when exposed shall be kept adequately supported till the trench is backfilled.

The backfilling shall be done only after the pipeline has been tested and approved by the Engineer. Special care shall be taken under and sides of the pipe during hand packing with selected material. At least 300 mm over the pipe shall also be filled with soft earth or sand. Consolidation shall be done in 150 mm layers. The surface water shall be prevented from getting into the filled up trench. Traffic shall not be inconvenienced by heaping up unduly the backfilling material to compensate future settlement. All future settlements shall be made good regularly to minimise inconvenience to traffic where applicable.

2.5.0 Fixtures

The LSTK Bidder shall mention in his tender the type and make of the fixtures he intends to use enclosing manufacturer's current catalogues. In the absence of any such agreement, the Engineer shall be at liberty to choose any type and make.

All fixtures and fittings shall be of approved quality and type manufactured by well known manufacturers. All items brought to the site must bear identification

marks of the type of the manufacturer. Procurements shall be made well in advance and inspected and approved immediately by the Engineer. All fixtures shall be adequately protected, covered and plugged till handed over.

All fittings, gratings, fasteners, unless specified otherwise, shall be chromium plated. The connecting lead pipes and bends shall weigh at least 3 kg. per 25 mm dia per meter length. Where PVC or similar pipes are allowed the LSTK Vendor shall produce the test reports and convince the Engineer about their durability.

Unless specified otherwise in the contract the fixtures shall be as specified hereinafter.

2.5.1 Water closet

a) Raised type

It shall include glazed vitreous china basin with siphon, open front solid plastic seat and plastic cover, low level glazed stoneware flushing cistern with valveless fittings, supply connections and necessary fittings. All fittings shall be chromium plated. Color of basin, cistern, seat and cover shall be as desired by the Engineer.

b) Squatting type

It shall include glazed vitreous china pan with integrated foot rests and high level cast iron flushing cistern with valveless fittings, supply connections and necessary fittings. All fittings shall be chromium plated. The foot rests shall be made of white glazed vitreous china with chequered surface. The flushing cistern shall be painted as desired by the Engineer.

2.5.2 Urinals

It shall consist of wall type glazed vitreous china urinals, cast iron automatic flushing cistern complete with supply connections, flush pipe, lead pipes, gratings, traps and all other necessary fittings. Automatic flushing shall be approximately once every five minutes. For a number of urinals located together may be served by one cistern of adequate capacity. All fittings shall be chrome plated.

2.5.3 Wash basin

It shall be made of glazed vitreous china. The basin shall be flat back, wall hung by painted cast iron brackets and complete with hot and cold brass faucets with nylon washers, waste chain, waste washers, PVC waste pipes with traps, perforated waste, complete with all necessary fittings. All fittings including faucets shall be chromium plated.

2.5.4 Sink

It shall be made of glazed stoneware. It shall be wall hung by painted cast iron brackets and complete with one brass faucet with nylon washers, waste chain,

waste washers, PVC waste pipes with traps, perforated waste with necessary fittings. All fittings including faucets shall be chromium plated.

2.5.5 Bathroom mirror

It shall be made of the best quality 6 mm thick glass and produced by a reputed mirror manufacturer. It shall be wall mounted with adjustable revolving brackets. The brackets, screws and other fittings shall be chromium plated.

2.5.6 Glass shelves

Glass shelves shall consist of 6 mm thick clear glass with guard rails and shall be wall mounted with brackets. All brackets, guard rails and screws shall be chromium plated.

2.5.7 Towel rail

Towel rails shall be 20 mm dia chromium plated MS pipes wall mounted with steel brackets. The brackets, screws etc. shall also be chromium plated.

2.5.8 Soap holder

It shall be made of chromium plated strong members. The holders shall be wallmounted with chromium plated screws.

2.5.9 Liquid soap dispenser

It shall be round and easily revolving with removable threaded nozzle. The body, bracket for wall mounting and screws shall be chromium plated.

2.5.10 Toilet roll holder

It shall be made of glazed vitreous china with suitable cover cum cutter. Wall mounting screws shall be chromium plated.

2.5.11 Installation

All plumbing fittings and fixtures shall be installed in most workmanlike manner by skilled workers. These shall be perfect in level, plumb, plane, location and symmetry. All items shall be securely anchored to walls and floors. All cuttings in walls and floors shall be made good by the LSTK Vendor.

2.6.0 Septic tank & effluent disposa**l**

2.6.1 Septic tank

Septic tank shall consist of the tank itself with inlet and outlets therefrom complete with all necessary earthwork and backfilling. The details of septic tank shall be as shown on drawings. This item shall also include ventilating pipe of at least 100 mm dia whose top shall be provided with a suitable mosquito proof wire mesh and cowl. Ventilating pipe shall extend to a height of about 2 meter when the septic tank is at least 15 meter away from the nearest building and to a

height of 2 meter above the top of building when it is located closer than 15 meter. Ventilating pipes can be connected to the normal soil ventilating system of the building where allowed.

2.6.2 Effluent Disposal

The effluent from the septic tank shall be disposed by allowing it into an open channel or a body of water if the concerned authority approves or into a soak pit for absorption by soil or shall be allowed to be absorbed by soil through open jointed SW pipes laid in a trench filled with broken bricks.

2.6.3 Soak pit

The soak pit shall be complete as shown on drawing. The pit shall be lined with stone, brick or concrete blocks set in cement mortar (1:6) and filled with brick bats. Inlet pipe shall be taken down to a depth of 900 mm from the top as an anti-mosquito measure.

2.6.4 Open joined SW Pipe / dispersion trenches

Minimum dia of the SW pipes shall be 150 mm nominal. The trench for laying the pipes shall be minimum 600 x600 mm. The joints of the pipes shall be left unsealed. The entire length of the pipe within the trench shall be buried in 250mm layer gravel or crushed stone of uniform size. On top of gravel/crushed stone layer is a 150 mm bed of well graded coarse aggregate. Ordinary soil is used for filling the top of trench.

2.6.5 Commissioning septic tank

After the septic tank has been proved watertight and the sewage system is checked the tank shall be filled with water to its outlet level before the sewage is let into the tank. It shall be seeded with well digested sludge obtained from septic tank or sludge digestion tank. In the absence of digested sludge a small quantity of decaying organic matter such as digested cow-dung may be introduced.

3.0.0 TESTING AND ACCEPTANCE

3.1.0 Inspection before installation

All pipes, fittings and fixtures shall be inspected, before delivery at the site to see whether they conform to accepted standards. The pipes shall again be inspected on site before lying by sounding to disclose cracks. All defective items shall be clearly marked and forthwith removed from the site.

3.2.0 Testing of Pipelines

Comprehensive tests of all pipe lines shall be made by simulating conditions of use. The method of actual tests shall be decided by the Engineer. All test data shall be recorded and submitted to the Engineer for review and instruction. The Engineer's discretion regarding tolerance shall be final.

General guidance for the tests is given below:

a) Smoke test

All soil pipes, waste pipes and vent pipes and all other pipes when above ground shall be approved gastight by a smoke test conducted under a pressure of 25 mm of water and maintained for 15 minutes after all trap seals have been filled with water. The smoke is produced by burning oily waste or tarpaper or similar material in the combustion chamber of a smoke machine. Chemical smokes are not satisfactory.

b) Water test

For pipes other than Cast Iron

Glazed ware and concrete pipes shall be subjected to a test pressure of at least 1.5 m head of water at the highest point of the section under tests. The tolerance figure of two liters per centimeter of diameter per kilometer may be allowed during a period of 10 (ten) minutes. The test shall be carried out by suitably plugging the low end of the drain and the ends of connections, if any, and filling the system with water. A knuckle bend shall be temporarily jointed in at the top end and a sufficient length of the vertical pipe jointed to it so as to provide the required test head or the top end may be plugged with a connection to a hose ending in a funnel which could be raised or lowered till the required head is obtained and fixed suitably for observation.

Subsidence of test water may be due to one or more of the following cases:

a) Absorption by pipes and joints

b) Sweating of pipes or joints

c) Leakage at joints or from defective pipes

d) Trapped air.

Allowance shall be made for (a) by adding water until absorption has ceased and after which the test proper should commence. Any leakage and the defective part of the work shall be cut out and made good.

For cast iron pipes

Cast iron sewers and drains shall be tested as for glazed ware and concrete pipes. The drain plug shall be suitably strutted to prevent their being forced out of the pipe during the test.

c) For straightness

i) By inserting at the high end of the sewer or drain a smooth ball of a diameter 13 mm less than the pipe bore. In the absence of

obstruction, such as yarn or mortar projecting through the joints, the ball with roll down the invert of the pipe end emerge at the lower end; and

ii) By means of a mirror at one end of the line and lamp at the other. If the pipe line is straight, the full circle of light may be observed. The mirror will also indicate obstruction in the barrel if the pipe line is not straight.

3.3.0 Testing Septic Tank

The septic tank shall be tested for water-tightness. It shall be filled up with water and allowed to soak for 24 hours. Then, it shall be topped up and allowed to stand again for 24 hours and loss of level recorded. The fall shall not be more than 15 mm.

3.4.0 Fixtures etc.

All fixtures and fittings shall be connected by watertight joints. No dripping shall be accepted.

4.0.0 CODES AND STANDARDS

Some of the important Codes and Standards relevant to this section are as follows. Latest editions shall always be consulted:-

IS:1172 - Code of basic requirements for water supply, drainage and sanitation.

IS:1200 - (Pt. XVI) Laying of water and sewer lines including appurtenant items.

IS:1239 - (Pt. I & II) Mild Steel Tubes and Mild Steel Tubulars and other wrought steel pipe fittings.

IS:1536 - Centrifugally cast (Spun) iron pressure pipes for water, gas and sewage.

IS:1537 - Vertically cast iron pressure pipe for water, gas & sewage.

IS:1742 - Code of Practice for building drainage.

IS:5329 - Code of Practice for sanitary pipe work above ground for buildings.

IS:2470 - (Pt. I & II) Code of Practice for design and construction of septic tank for small and large installations.

IS:4984 - High density polyethylene pipes for potable water supplies.

IS:1538 -	Cast Iron fittings for pressure pipes for water, gas & sewage.
IS:1729 -	Cast Iron rain water pipes and fittings.
IS:3989 -	Centrifugally cast (spun) iron spigot & socket soil, waste and ventilating pipes, fittings and accessories.
IS:1729 -	Cast iron / Ductile iron drainage pipes and pipe fittings for over ground non-pressure pipeline socket and spigot series
IS:1626 -	Asbestos cement building pipes, gutters and fittings (spigot& (Pt. I to III) socket types).
IS:458 -	Precast concrete pipes (with and without reinforcement)
IS:783 -	Code of Practice for laying of concrete pipes.
IS:784 -	Prestressed concrete pipes.
IS:651 -	Salt glazed stoneware pipes & fittings.
IS:4127 -	Code of practice for laying of glazed stoneware pipes.
IS:1726 -	Cast Iron manhole covers and frames intended for use in drainage works.
IS:5961 -	Cast Iron gratings for drainage purposes.
IS:5219 - (Part-I)	'P' & 'S' traps.
IS:771 - (Pt. I to VII)	Glazed fire-clay sanitary appliance.
IS:772 -	General requirements of enameled cast iron sanitary appliances.
IS:774 -	Flushing cistern for water closets & urinals (valveless siphonic type).
IS:2548 -	Plastic water closet seats & covers.
IS:2527 -	Code of Practice for fixing rain water gutters and down-pipes for roof drainage.

SUB-SECTION NO. C19

TECHNICAL SPECIFICATION FOR AREA GRADING

TECHNICAL SPECIFICATION
FOR
AREA GRADING

CONTENTS

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TECHNICAL SPECIFICATION FOR AREA GRADING

1.0.0 SCOPE

This specification shall govern all clearing, grubbing, excavating, area filling, grading and compacting soils for areas designated on the drawings. The work shall include excavation, hauling, dumping and spreading of soil, undercutting to remove unstable soil areas, compacting existing soil surfaces and bottom of excavated areas to receive fills, compacting excavated areas for subgrade, placing and compacting soils in fills, pumping to keep excavated areas dry, final grading of designated areas, disposing off unsuitable and excess excavated materials and incidentals thereof.

2.0.0 GENERAL

2.1.0 Work to be provided for by the LSTK Vendor

The work to be provided for by the LSTK Vendor, unless specified otherwise, shall include but not be limited to the following:

a) Furnish all labour, supervision, services, earth-moving machineries and equipment, tools and plants, survey instruments, transportation etc. required for the work.

b) Prepare and submit working drawings showing the approaches, slopes, berms, sumps for dewatering, space for temporary stacking of spoils, disposal area, borrow pits, fencing etc. and all other details as may be required by the Engineer.

c) To carry out and submit to the Engineer, results of soil compaction tests whenever required by the Engineer to assess the degree of compaction.

d) If blasting is resorted to, necessary licenses to be procured from the proper authorities.

2.2.0 Work to be provided for by others

No work under this specification will be provided by any agency other than the LSTK Vendor unless specifically mentioned elsewhere in the Contract.

However, the Owner reserves the right to award the whole work to one Contractor or to split up the work for awarding to two or more Contractors.

2.3.0 Codes and Standards

All work under this specification, unless specified otherwise, shall conform to the latest revision and/or replacements of the following or any other relevant Indian Standard Specifications and Codes of Practice. In case any particular aspect of work is not covered specifically by Indian Standard Specification any other standard practice as may be specified by the Engineer shall be followed :

IS : 3764 :Indian Standard for Safety Code for Excavation Work.

IS : 1200 :Indian Standard Method of Measurement of Building (Part-I)and Civil Engineering Work Part-I - Earthwork.

IS : 4701 : Indian Standard Code of Practice for Earthwork on Canals.

IS : 4081 :Safety Code for Blasting and Related Drilling Operations.

2.4.0 Conformity with Designs

The LSTK Vendor shall carry out the work as per the drawings issued to him and/or LSTK Vendor's drawings which are approved by the Engineer and/or the Engineer's instructions.

2.5.0 Materials to be used

2.5.1 General

All materials required for the work shall be of best commercial variety and as approved by the Engineer.

2.5.2 Borrow Material

Borrow material required for area filling shall be excavated from approved locations and levels and shall consist of selected material, approved by the Engineer, free from roots, vegetations, decayed organic matter, harmful salts and chemicals, free from lumps and clods. If specified, clean graded sand, free from harmful and deleterious materials from approved quarries, shall be used as fill material.

2.6.0 Quality Control

The LSTK Vendor shall establish and maintain quality control for the various aspects of the work, method, materials and equipment used. The quality control operation shall include but not be limited to the following items of work :

a) Lines, Levels and Grades :

i) Periodic Surveys
ii) Establishment of markers, Boards etc.
iii) Checking levels and slopes of the graded surface.

b) Area filling :

i) Checking the quality of fill material
ii) Checking moisture content of the fill
iii) Checking the degree of compaction.

2.7.0 Information regarding Site Conditions

Boring and sub-surface data regarding the nature of soil, rock, sub-soil water etc. shown on drawings or otherwise furnished to the LSTK Vendor shall be taken as a guidance only and variation therefrom shall not affect the terms of the Contract. The LSTK Vendor must satisfy himself regarding the character and volume of all work under this contract and expected surface, sub-surface and/or sub-soil water to be encountered. He must also satisfy himself about the general conditions of site and ascertain the existing and future construction likely to come up during the execution of the Contract so that he may evolve a realistic programme of execution.

3.0.0 EXECUTION

3.1.0 Setting Out

Within 15 days of award of Contract, the LSTK Vendor will prepare and submit to the Engineer, detailed drawings of the excavation and filling work necessary, as proposed to be executed by him, showing the dimensions as per drawings and specification, adding his proposals for slopes, approaches, dewatering sumps, berms etc. On receiving the approval from the Engineer with modifications and corrections if necessary, the LSTK Vendor will set out the work from the control points furnished by the Engineer and fix permanent points and markers for future checking. These permanent points and markers will be checked by the Engineer and certified by him after which the LSTK Vendor will proceed with the work. Engineer shall be provided with necessary men, material and instruments for such checking. It should be noted that this checking by the Engineer prior to start of the work will in no way absolve the LSTK Vendor of his responsibility of carrying out the work to true lines, levels and grades as per drawing and subsequent corrections, if any. In case any errors are noticed in the LSTK Vendor's work at any stage, the same shall be remedied by the LSTK Vendor at his own cost.

3.2.0 Initial Levels

Initial levels either in a definite grid pattern or as directed by the Engineer will be taken by the LSTK Vendor jointly with the Engineer over the original ground prior to starting actual excavation work and after setting out. These initial levels will be used for preparing cross-sections for volume measurement or for cross-checking the depths obtained from tape measurements.

3.3.0 Clearing and Grubbing etc.

The area to be excavated shall be cleared out of fences, trees, logs, stumps, bush vegetation, rubbish, slush, etc. and levelled up. Trees up-to 300 mm girth shall be uprooted. Trees above 300mm girth which are required to be cut, shall be got identified by the Engineer and then marked.

Felling of trees shall include taking out roots up-to 600 mm below ground level. After the tree is cut and roots taken out, the pot- holes formed shall be filled with good earth in 250 mm layers and compacted to acceptable degree unless directed by the Engineer otherwise. The trees shall be cut in suitable pieces as instructed by

the Engineer and then shall be transported to the Owner's store or any other space as directed by the Engineer.

Before earthwork is started, all the spoils and unserviceable materials and rubbish shall be Ash shall be spread or removed as directed by the Engineer. Useful materials, saleable timber, firewood, etc. shall be the property of the Owner and shall be stacked properly at the worksite in a manner as directed by the Engineer.

3.4.0 Classification

Materials involved in earthwork shall be classified under the following categories. No distinction will be made whether the material is dry or wet. The Engineer's decision in regard to such classification shall be final and binding on the LSTK Vendor :

a) Ordinary and hard soil

This shall include clay, silt, sand, moorum, shingle, kankar, gravel, loam, peat, ash and other similar materials in soft, hard or dense state which can generally be excavated with ordinary spade, pick axe, shovel etc. and does not require the use of wedges, pneumatic breaking equipment and/or blasting for removal. It shall also include loose rock boulders present in the soil, with dimensions not exceeding 500 mm in any direction. Breaking of consolidated brick ballast and mud concrete shall be considered equivalent to excavation work under this type of soil.

b) Soft and Decomposed Rock

This shall include rocks like chalk, slate, mica schist, laterite and other similar materials which in the opinion of the Engineer is rock, but does not require blasting for removal and could be removed with picks, hammers, crow bars, wedges, pneumatic breaking equipment etc. It shall also include boulders with dimensions greater than 500 mm but not exceeding 1000 mm in any direction. The mere fact that the LSTK Vendor resorts to blasting for his own convenience shall not mean that the rock will be classified as hard rock.

Excavation in macadam and tarred roads and pathways, brick work etc. shall be considered at the same rate as excavation of this type of soil.

c) Hard Rock

This shall include rocks occurring in large masses which cannot be removed except by blasting. Harder varieties of rock such as trap, with or without veins and secondary mineral which in the opinion of the Engineer require blasting for removal shall also be considered as hard rock. It shall also include boulders bigger than 1000 mm in any direction. Construction in concrete, both reinforced and unreinforced, which is required to be dismantled during earthwork, shall be measured under this item, unless a separate provision is made in the schedule of Quantities for the same.

3.5.0 Earthwork in Excavation

3.5.1 General

All excavation shall be done to the minimum dimensions as required for safety and working facility. Prior approval of the Engineer shall be obtained by the LSTK Vendor, in each individual case, for the method he proposes to adopt for the excavations including dimension, side slopes, dewatering, disposal, etc.

This approval, however, shall not in any way make the Engineer responsible for any consequent loss or damage. The excavation must be carried out in the most expeditious and efficient manner.

Prior to starting the excavation, the ground level at the location shall be checked jointly with the Engineer.

The rough excavation may be carried up-to a maximum depth of 150 mm above the final level. The balance shall be excavated with special care. If directed by the Engineer, soft and undesirable spots shall be removed even below the final level without any financial implication to owner.

If the excavation is done to a depth greater than that shown on the drawing, or directed by the Engineer, due to the LSTK Vendor's fault, the excess depth shall be filled up to the required level without any financial implication to owner with selected earth and compacted to 95% of modified Proctor Density or as directed by the Engineer.

The excavation shall be carried out as per the approved proposal, modified and corrected where necessary by the Engineer. The work shall be carried out in a workmanlike manner without endangering the safety of nearby structures or works roads, railway tracks, cables, pipelines etc. if any, and without causing hindrance to other activities in the area. As the excavation reaches the required dimensions, lines, levels and grades, the work will be checked by the Engineer thoroughly and the balance work will be carried out carefully to avoid any over-excavation.

On completion, the work will be finally checked and approved by the Engineer. In cases where excavation in soil, soft and decomposed rock and/or hard rock are involved, the soil or soft and decomposed rock layers, shall be removed by turn and levels of the underlying rock surfaces observed to enable measurements. Further work shall be resumed after getting clearance from the Engineer.

3.5.2 Excavation in Hard Rock

Overburden, if any, consisting of top soil, ordinary and hard soil, soft and decomposed rock as per classification of soil, which do not require blasting shall be completely stripped off and the levels of the hard rock surface shall be taken to enable measurement. Further work in hard rock shall be resumed after clearance from the Engineer.

Personnel deployed for rock excavations shall be protected from all hazards such as loose rock/boulder rolling down and from general slips of excavated surfaces. Where the excavated surface is such that it is not stable against sliding, necessary

supports, props, bracings or bulkheads shall be provided and maintained during the period of construction. Where danger exists of loose rock/boulder falling from the excavated surfaces deeper than 2 meters, steel mesh anchored to the lower edge of excavation and extending over and above the rock face, adequate to retain the dislodged material shall be provided and maintained.

In case where blasting, though otherwise required, is prohibited for any reasons, the excavation shall be carried out by chiselling, wedging or any other approved method. All loose or loosened rock in the sides shall be removed by barring, wedging, etc. The unit rate for excavation in hard rock shall include the cost of all these operations.

3.5.3 Blasting

3.5.3.1 General

Excavation shall be continued in hard rock to such widths, lengths, depths and profiles as are shown on the drawings or such other lines and grades as may be specified by the Engineer. As far as possible all blasting shall be completed prior to commencent of construction. At all stages of excavation, precautions shall be taken to preserve the rock below and beyond the lines for the excavation, in the soundest possible condition. The quantity and strength of explosive used, shall be such as will neither damage nor crack the rock outside the limits of excavation. All precautions, as directed by Engineer, shall be taken during the blasting operations and care shall be taken that no damage is caused to adjoining buildings or structure as a result of blasting operations. In case of damage to permanent or temporary structures, LSTK Vendor shall repair the same to the satisfaction of Engineer at his cost. As excavation approaches its final lines and levels, the depth of the charge holes and amount of explosives used shall be progressively and suitably reduced.

Unless otherwise stated herein, I.S. Specification IS:4081 "Safety Code for Blasting & Related Drilling Operation" shall be followed.

Specific permission of Engineer will have to be taken by LSTK Vendor for blasting rock and he shall also obtain a valid Blasting licence from the authorities concerned.

LSTK Vendor shall obtain necessary licence for storage of explosives, fuses and detonators issued to him from owner's stores or from supplier arranged by him, from the authorities dealing with explosives.

The fees, if any, required for obtaining such licence, shall be borne by LSTK Vendor. LSTK Vendor shall have to make necessary storage facilities for the explosives etc. as per rules of local, State and Central Govt. authorities and statutory bodies/ regulations.

In no case shall blasting be allowed closer than 30 meters to any structure or to locations where concrete has just been placed. In the latter case the concrete must be at least 7 days old.

LSTK Vendor shall employ a competent experienced supervisor and licensed blaster in-charge of each set of operation, who shall be held personally responsible to ensure that all safety regulations are carried out.

Before any blasting is carried out, LSTK Vendor shall intimate Engineer and obtain his approval in writing for resorting to such operations. He shall intimate the hours of firing charges, the nature of explosive to be used and the precautions taken for ensuring safety.

The blasting of rock near any existing buildings, equipment's or any other property shall be done under cover and LSTK Vendor has to make all such necessary muffling arrangements. Covering may preferably be done by M.S. plates with adequate dead weight over them. Blasting shall be done with small charges and where directed by Engineer, a trench shall have to be cut by chiselling prior to the blasting operation seperating the area under blasting from the existing structures.

When excavation has almost reached the desired level, hand trimming shall have to be done for dressing the surface to the desired level. Any rock excavation beyond an overbreak limit of 75 mm shall be filled up as instructed by Engineer, with concrete of strength not less than M 100. The cost of filling such excess depth shall be borne by LSTK Vendor and the excavation carried out beyond the limit specified above will not be paid for. Stepping in rock excavation shall be done by hand trimming.

LSTK Vendor shall be responsible for any accident to workmen, public or Owner's property due to blasting operations. LSTK Vendor shall also be responsible for strict observance of rules, laid by Inspector of Explosives, or any other authority duly constituted under the State and/or Union Government.

Storage, handling and use of explosives shall be governed by the current explosive rules laid down by the Central and the State Governments. The LSTK Vendor shall ensure that these rules are strictly adhered to. The following instruction, wherever found in variance with the above rules, shall be considered as superceded by the above rules.

No child under the age of 16 and no person who is in a State of intoxication shall be allowed to enter the premises where explosives are stored nor they shall be allowed to handle the explosives.

3.5.3.2 Storage of Explosive

Storage of explosives shall be governed by the current Explosive Rules, Explosives shall be stored in a clean, dry, well ventilated magazine to be specially built for the purpose. Under no circumstances should a magazine be erected within 400 m of the actual work site or any source of fire. A space surrounding the magazine shall be fenced in. The ground inside the fence shall be kept clear and free from trees, bushes etc. The admission to this fenced space shall be by one gate only and no person shall be allowed inside this fence without permission of the Officer-in- charge. The clear space between the fence and the magazine shall not be less than 90m. The megazine shall be perfectly well drained.

Two lightning conductors shall be provided to the magazine, one at each end. The lightning conductors shall be tested once in every year.

Fuses and detonators shall be stored in separate magazines. However, detonators can be kept in an annexe adjoining the magazine provided that their number does not exceed 25,000 and that the annexe is so constructed that not less than 60 cm masonry and 100 cm of air space shall intervene between any detonators in such annexe and the interior of the main magazine. Cases containing explosives are not to be opened in a magazine. Explosive in open cases are not to be received into a magazine. Explosives which appear to be in a damaged or dangerous condition are not to be kept in any magazine, but must be removed without delay to a safe distance and destroyed.

Artificial light is not to be allowed in any magazine. No smoking shall be allowed within 100 m of a magazine.

Magazine shoes without nails shall be used while entering the magazine.

The mallets, levers, wedges etc. for opening barrels or cases are to be of wood. Inside a magazine the cases of explosives are to be carried by hand and shall not be rolled or dragged. Explosives which have been issued and returned to the magazine are to be issued first; otherwise those which have been longest in store are to be issued first.

Cases of explosives must be kept clear of the walls and floors for free circulation of air on all sides, special care is to be taken to keep the floor free from grains of powder or portions of explosive matter fallen on the floors due to leakage of cases etc.

The magazine shall not be opened during any duststorm or thunderstorm nor any person shall be allowed in the vicinity of the magazine.

All magazines shall be officially inspected at definite intervals and a record kept of the results of such inspections.

3.5.3.3 Carriage of Explosives

Dctonators and explosives shall be transported separately to the blast site. Explosives shall be kept dry and away from the direct rays of the sun, naked lights, steam pipes or heated metal and other sources of heat. Before explosives are removed, each cage or package is to be carefully examined to ascertain that it is properly closed and shows no sign of leakage.

No person except the driver shall be allowed to travel on a vehicle conveying explosives. No carriage or vessel shall be used for transporting explosives unless all iron or steel therein with which a package containing any explosive is likely to come in contact is effectually covered with lead, leather, wood, cloth or other suitable material. No lights shall be carried on the vehicle carrying explosives.

No operation connected with the loading, unloading and handling of explosives shall be conducted after sunset.

3.5.3.4 Use of Explosives

The LSTK Vendor shall appoint an agent who shall personally superintend the firing and all operations connected therewith. The LSTK Vendor shall satisfy himself that the person so appointed is fully acquainted with the responsibilities imposed on him.

Holes for charging explosives shall be drilled with Pneumatic drills, the drilling pattern being so planned that the rock pieces after blasting will be suitable for handling.

The hole diameter shall be of such a size that cartridges can easily pass down them and undue force is not required during charging. Charging operations shall be carried out by or under the personal supervision of the shotfirer. Wrappings shall never be removed from explosive cartridges. Only wooden rods shall be used for loading and stemming shot holes. Only one cartridge at a time shall be inserted and gently passed home with the wooden tamping rod.

Only such quantities of explosives as are required for the particular amount of work to be done shall be brought to the works. Should any surplus remain when all the holes have been charged, it shall be carefully removed to a point at least 300 m from the firing point.

The explosives shall be fired by means of an electric detonator placed inside the cartridge. For simultaneous firing of a number of charges the electric detonators shall be connected with the exploder through the shot firing cable in a simple series circuit. Due precautions shall be taken to keep the firing circuit insulated from the ground, bare wires, rails, pipes or any other path of stray current and to keep the lead wires short circuited until ready to fire. Any Kinks in detonator leading wire shall be avoided.

For simultaneous firing of a large number of shot holes, use of cordtex may be done. Cordtex shall be initiated by an electric detonator attached to its side with adhesive tape, connecting wire or string.

All connections shall be made by the authorised shotfirer himself. The shot firing cable shall not be dragged along the ground to avoid possible damage to the insulation. The shot firing cable shall be tested for continuity and possible short circuiting before it is used each time.

The shot firer shall always carry the exploder handle on his person until he is ready to fire shots. The number of shots fired at a time shall not exceed the permissible limits.

Before any blasting is carried out, it shall be ensured that all workmen, vehicles and equipment on the site are cleared from an area of minimum 300 meters radius from the firing point, or as required by statutory regulations, at least ten minutes before the time of firing by sounding a warning siren. The area shall be encirled by red flags.

At least five minutes after the blast has been fired in case of electric firing or as stipulated in the regulations the authorised shotfirer shall return to the blast area

and inspect carefully the work and satisfy himself that all charged holes have exploded. Cases of misfired unexploded charges shall be exploded by drilling a parallel fresh hole not less than 600 mm from the misfired hole and by exploding a new charge. The authorised shotfirer shall be present during removal of the debris liable to contain unexploded explosives near the misfired hole. The workmen shall not return to the site of firing until at least half an hour after firing.

Adequate safety precautions as per building bye-laws, safety code, statutory regulations etc. shall be taken during blasting operations.

3.5.4 Disposal

The excavated spoils will be disposed off within the specified lead in any or a combination of some of the following manners, as directed by the Engineer :

a) By stacking separately the materials suitable for area filling and materials not suitable.

b) By stacking it temporarily for use in backfilling at a later date.

c) i) By either spreading
or
ii) Spreading and compacting at designated disposal areas.

d) By selecting the useful material and stacking it neatly in areas designated by the Engineer for use in back-filling or other purposes by some other agency.

The rate for excavation in soil should include the cost of filling and compaction in case (c) (ii). The rate for excavation in rock should include the cost of disposal as per (d).

3.5.5 Dewatering

All areas shall be kept free of water. Grading in the vicinity of excavations shall be controlled to prevent surface water running into excavated areas. The LSTK Vendor shall remove by pumping or other means approved by the Engineer, any water inclusive of rain water and subsoil water accumulated in the area without any extra cost. Method of dewatering shall be got approved by the Engineer.

3.6.0 Treatment of Slips

The LSTK Vendor will take all precautions to avoid high surcharges and provide proper surface drainage to prevent flow of water over the sides. These precautions along with proper slopes, berms, and control of ground water should cause no slips to occur. If slips ~~do~~ occurs, the same shall be removed by the LSTK Vendor without any financial implication to owner .

3.7.0 Earthwork in Filling

3.7.1 The material to be used for area filling shall be selected material, approved by the Engineer, obtained directly from excavation for area grading, from nearby areas where excavation work by the same agency is in progress, from temporary stacks of excavated spoils or from borrow pits in selected areas designated by the Engineer. The quality of the material shall conform to that mentioned in clause 2.5.2 of this specification.

Where excavated material is mostly rock, the boulders shall be broken into pieces not longer than 150 mm size, mixed with properly graded fine material consisting of murum or earth to fill up the voids and the mixtures used for filling.

If any material is rejected by the Engineer, LSTK Vendor shall remove the same forthwith from the site at no extra cost of the owner. Surplus fill material shall be deposited/disposed off as directed by the Engineer after the fill work is completed.

No earthfill shall commence until surface water discharges and streams have been properly intercepted or otherwise dealt with as directed by the Engineer.

Before commencement of area filling the existing top soil shall be removed up to a minimum depth of 150 mm, or more, as directed by the Engineer in order to clear the surface of undesirable materials. After this the filling operation shall be performed with earth in layers not exceeding 250 mm, loose thickness. Each layer shall be watered and properly compacted to 95% of modified Proctor Density unless otherwise permitted/directed by the Engineer. Earth shall be compacted with approved machine and usually manual compaction shall not be allowed unless specifically permitted by the Engineer.

Since the degree of compaction depends on the moisture content of the soil, a close watch shall be kept on this aspect and corrections done to optimise the moisture content. The adequacy of the compaction and moisture control of the soil shall be determined by performing field density tests and other tests as and when directed by the Engineer and shall conform to the stipulations laid down in IS:4701.

Field compaction test shall be carried out at different stages of filling and also after the fill to the entire height has been completed. This shall hold good for embankments as well.

The fill shall be carried out to such dimensions and levels as indicated on the drawings after the stipulated compaction. The fill will be considered as incomplete if the desired compaction has not been obtained.

If so specified, the rock as obtained from excavation may be used for filling and levelling to indicated grades without further breaking. In such an event, filling shall be done in layers not exceeding 50 cms. approximately. After rock filling to the approximate level, indicated above has been carried out, the void in the rocks shall be filled with finer materials such as earth, broken stone, etc. and the area flooded so that the finer materials fill up the voids. Care shall be taken to ensure that the finer fill material does not get washed out. Over the layer so filled, a 100 mm thick mixed layer of broken material and earth shall be laid and consolidation

carried out by a 12 tonne roller. No less than 12 passes of the roller shall be accepted before subsequent similar operations are taken up.

3.7.2 Filling in Disposal Areas

Excavated materials if not used in area filling, will be disposed off in designated disposal areas as directed or as indicated in the drawings. The earth shall not be dumped haphazardly but shall be spread in horizontal layers not exceeding 500 mm in thickness and nominal compaction done to the satisfaction of the Engineer. All clods shall be broken before placing the fill. Earthmoving machinery including dumpers, dozers and trucks shall be allowed to ply over the fill to permit compaction to take place.

In wide areas rollers may be employed and nominal compaction done to the satisfaction of the Engineer. No payment for compaction shall be made for such nominal compaction.

3.8.0 Approaches and Fencing

The LSTK Vendor shall provide and maintain proper approaches for workmen and for inspection. The roads and approaches around the area shall be kept clear at all times so that there is no hindrance to the movement of men, material and equipment of various agencies connected with the Project. Sturdy and elegant fencing is to be provided around the top edge of the excavation as well as the bottom of the fill at the surplus disposal area where dumping from a high bench is in progress, if directed by the Engineer.

3.9.0 Lighting

Full scale area lighting is to be provided if night work is permitted or directed by the Engineer. Even if no night work is in progress, red warning lights should be provided at the top in edges of the excavated area and the edges of the fill, unless otherwise permitted by the Engineer.

4.0.0 TESTING AND ACCEPTANCE CRITERIA

4.1.0 Excavation

On completion of excavation, the dimensions of the area will be checked as per the drawings after the area is completely dewatered.

The work will be accepted after all undercuts have been set right and all over excavations filled back to required lines, levels and grades by compacted earth, at the LSTK Vendor's cost.

Over excavation of the sides will be made good free of cost by the LSTK Vendor. The excavation work will be accepted after the above requirements are fulfilled & all temporary approaches encroaching inside the required dimension of the excavation have been removed.

4.2.0 Area-filling

The degree of compaction required will be as per the stipulations laid down in appropriate sections of this specification. The actual method for measuring the compaction achieved will be as decided by the Engineer. The work of area filling will be accepted after the Engineer is satisfied with the degree of compaction achieved.

5.0.0 INFORMATION TO BE SUBMITTED

5.1.0 With Tender

Following details of Machineries, transport vehicles, equipment proposed to be used for excavation, area-filling and compaction have to be submitted along with the tender :

i) Equipment, machinery & earthmoving vehicles, available with the LSTK Bidder and proposed to be used for excavation and haulage giving details regarding make, model, capacity, year of manufacture, numbers available for this contract and general condition.

ii) Equipment proposed to be used for area filling and compaction giving similar details as in item 5.1.0 (i) above.

iii) Method of transportation.

5.2.0 After Award

After award of contract the successful LSTK shall submit the following for approval and adoption :

a) Within 15 days of Award of the contract, the LSTK Vendor shall submit a detailed programme of work as proposed to be executed giving completion dates of excavation of the various areas and the time required for area-filling and compaction. The programme should also show how the excavation and area- filling quantities will be balanced, minimising temporary stacking of spoils. It is to be noted that the Engineer even after initial approval of the programme, may instruct to enhance or retard the progress of work during the actual execution, in order to match with overall construction schedule without attracting any claims from the LSTK Vendor. The initial programme being submitted by the LSTK Vendor should have sufficient flexibility to take care of such reasonable variations.

b) Within 15 days of award, the LSTK Vendor shall submit drawings showing details of slopes, approaches, sump pits, dewatering lines, borrow pits, if any, fencing etc. for approval of the Engineer for adoption.

6.0.0 RATES

6.1.0 Excavation and Disposal

The rates of earthwork for all types of soils, soft and decomposed rock and hard rock and leads as listed in the Schedule of Items will include the cost of all materials consumed, hire charges of tools and plants and equipment, cost of labour, insurance, taxes and royalties, security and safety arrangements, power, fuel, lubricants, services, accommodations, supervisions, overheads, profits etc.

The rates of excavation should also include the cost of dewatering. The LSTK Vendor will have to give a rebate for non-compaction in case the excavated material is stacked for use in back-fill by some other agency at a later date or dumped and spread in the disposal area with nominal compaction.

6.2.0 Area-Filling by Excavated Earth and Compaction

The rates to be quoted for this item should be complete in all respects including transporting earth available from excavation under Cl. 6.1.0 and include all the components of cost listed under Cl. 6.1.0. No extra will be payable for filling at any depth.

6.3.0 Area-Filling by Earth brought from Borrow Pits or Stacks left by other Agencies

In case sufficient earth of proper quality is not available from the excavated spoils, the Engineer may direct area filling to be done by bringing earth from borrow pits or selectively from stacks left by other agencies. The material in the stacks which are considered by the Engineer to be unfit for use in the fill, shall be carted away by the LSTK Vendor to the disposal area.

The rate to be quoted against the relevant item of the schedule should be complete in all respects and include all the components of cost listed under Cl.No. 6.1.0 of this specification. No extra will be payable for filling at any depth. Leads will however be paid as per Schedule of Items.

6.4.0 Dewatering

The rate for any dewatering of the area during the period of contract, original or extended, shall be deemed to have been included in the unit rate of excavation.

7.0.0 MEASUREMENT

7.1.0 Clearing and Grubbing

No separate measurement shall be done for this item for the purpose of payment in general, except for cutting of trees, having girth more than 300 mm.

7.2.0 Excavation and Disposal

Actual quantity of excavation required and approved by the Engineer shall be measured in Cu.M. No extra shall be paid for keeping the excavations dewatered

as required. Necessary disposal of the spoil for filling or stacking as described in the Schedule of Items shall be included in the quoted rate.

The measurement may be done by direct tape measurement or by cross sections derived from initial and final levels.

7.3.0 Area Filling with Earth from Stacks

Actual quantity of filling as worked out from the contour drawings or the volume of the stack with a deduction of 30% (thirty percent) for compensating the voids shall be measured in Cu.M. The measurements will be taken before any monsoon passes over the area.

7.4.0 Area-Filling with Earth from Borrow Pits and Stacks

Actual quantity of excavation in the Borrow pits, or the volume of the stack with a deduction of 30% percent for voids, in case filling is done from stacks, shall be measured in Cu.M. The lead as mentioned in the Schedule of Items shall be included in the rates quoted.

SUB-SECTION NO. C20

TECHNICAL SPECIFICATION FOR CONCRETE ROADS

TECHNICAL SPECIFICATION
FOR
CONCRETE ROADS

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TECHNICAL SPECIFICATION
FOR
CONCRETE ROADS
[PART-B]

1.0.0 SCOPE

This specification covers all work required for the construction of concrete road including box-cutting, edging, sub-base, subgrade, unreinforced/ reinforced concrete pavement include all incidental items of work not shown or specified but reasonably implied or necessary for the completion of the work.

This specification also includes all work required for drainage including road side drain, R.C.C. culverts, pipe-culverts, drainage pipes, manholes etc. and all other incidental items.

2.0.0 GENERAL

2.1.0 Work to be provided for by the LSTK Vendor

The work to be provided for by the LSTK Vendor, unless specified otherwise, shall include but not be limited to the following:

a) Furnish all labour, supervision, services, materials, equipment, tools and plants, transportation etc. required for the work.

b) Submit for approval detailed schemes of all operations required for executing the work e.g. material handling, placement, services, approaches etc.

c) To carry out and submit to the Engineer results of tests whenever required by the Engineer to assess the quality of work.

2.2.0 Work to be provided for by others

No work under this specification will be provided for by any agency other than the LSTK Vendor unless specifically mentioned elsewhere in the Contract.

2.3.0 Codes and Standards

All work under this specification, unless specified otherwise, shall conform to the latest revision and/or replacements of the following or any other relevant I.S. Specifications and Codes of Practice.

i) Specification for road and bridge works of Ministry of shipping & Transport (Roads wing) Published by the IRC.

ii) IRC: 58 Guidelines for the design of Rigid Pavements for highways

iii) IRC:SP-11 Hand Book of Quality Control for Construction of Roads and Runways.

iv) IS:456 Indian Standard Code of Practice for Plain and Reinforced Concrete.

v) IS:2212 Code of Practice for Brickwork.

vi) IS:783 Code of Practice for Laying of Concrete Pipes.

vii) IRC: 15 Standard Specification and Code of Practice for Construction of Concrete Roads.

In case any particular aspect of work is not covered specifically by Indian Standard Specification, any other standard practice as may be specified by the Engineer shall be followed.

2.4.0 Conformity with Designs

The LSTK Vendor shall carryout the work as per the drawings issued to him and/or LSTK Vendor's drawings which are approved by the Engineer and/or the Engineer's instructions.

2.5.0 Materials to be Used

2.5.1 General

All materials required for the work shall be of best commercial variety and as approved by the Engineer.

2.5.2 Quality Control

The LSTK Vendor shall establish and maintain quality control for the various aspects of the work, method, materials and equipment used.

All works performed shall conform to the lines, grades, cross sections and dimensions shown on the drawings or as directed by the Engineer. Permitted tolerances for road works are described hereinafter.

i) **Horizontal Alignments**

Horizontal alignments shall be reckoned with respect to the center line of the carriageway as shown on the drawings. The edges of the carriageway as constructed shall be correct within a tolerance of $\pm$ 25 mm therefrom. The corresponding tolerance for edges of the roadway and lower layers of pavement shall be $\pm$ 40 mm.

ii) **Longitudinal Profile**

The levels of the subgrade and different pavement courses as constructed, shall not vary from those calculated with reference to the longitudinal and cross-profile of the road shown on the drawings or as directed by the Engineer, beyond tolerances mentioned below:

Sub-grade$\pm$ 25 mm
Sub-base$\pm$ 20 mm

3.0.0 EXECUTION

3.1.0 Shoulder Construction

3.1.1 Description

This work shall consist of constructing shoulders on either side of the pavement, accordance with the requirements of this specification and in conformity with the lines, grades and cross- sections shown on the drawings or as directed by the Engineer.

3.1.2 Materials

Shoulder may be of selected earth or granular material conforming to the requirements of embankment construction or granular sub- base construction respectively.

3.1.3 Construction Operations

Except in the case of bituminous constructions, shoulders shall be constructed in advance of the laying of pavement courses. The compacted thickness of each layer of shoulder shall correspond to the compacted layer of pavement course to be laid adjacent to it. After compaction, the inside edges of shoulders shall be trimmed vertical and included area cleaned of all spilled material before proceeding with the construction of the pavement layer.

Regardless of the method of laying, all shoulder construction material shall be placed directly on the shoulder. Any spilled material dragged on to the pavement surface shall be immediately removed, without damage to the pavement and the area so affected throughly cleaned.

During all stages of shoulder construction, the required cross fall shall be maintained to drain off surface water.

3.2.0 Kerb

3.2.1 Material

Kerb, if required for construction of footpath, shall consist of precast concrete blocks with a concrete grade of M-15. The blocks shall be 100 mm wide and of suitable length. The depth of blocks unless otherwise mentioned elsewhere, shall be 375 mm considering 225 mm height of footpath from the road level

3.2.2 Laying

The Kerb shall be laid by cutting trenches 150 mm deep. The width of the trench shall be minimum and just sufficient to insert the kerbs. The inside faces of the Kerbs shall be in plumb and the gap between the block shall not be more than 10 mm.

The kerbs shall be thoroughly packed with a mixture of stone chips (50%) and moorum (50%) at the outside face. The laying and packing shall be done in a proper workmanlike manner acceptable to the Engineer.

3.3.0 Sub-base (Granular Sub-base)

3.3.1 Description

This work shall consist of laying and compacting well-graded material on prepared subgrade in accordance with the requirements of these specifications. The material shall be laid in one or more layers as shown on the drawings and according to lines, grades and cross sections shown on the drawings or as directed by the Engineer.

3.3.2 Materials

The materials to be used for the work shall be natural sand, moorum, gravel, crushed stone, crushed slag, crushed concrete, brick metal, laterite, kanker etc. or combinations thereof depending upon the grading required. The mixed materials shall be free from organic or other deleterious constituents and conform to one of the three gradings given in Table-I below

TABLE-I

Grading for Granular Sub-base Materials

Sieve designation	Percent by weight passing the seive		
	Grading 1	Grading 2	Grading 3
80 mm	100	100	100
63 mm	90-100	90-100	90-100
4.75 mm	35-70	40-90	50-100
75 micron	0-20	0-25	0-30
CBR Value (Minimum) : for fraction of material passing 20 mm sieve	30%	25%	20%

Note : The material passing 425 micron sieve for all the three gradings when tested according to IS:2720 (Part V) shall have liquid limit and plasticity index of not more than 25 percent and 6 percent respectively.

3.3.3 Physical Requirements

The fraction of material passing 20 mm sieve shall give a CBR value as specified in Table-II when tested in accordance with IS:2720 (Part XVI) after preparing the samples at maximum dry density and optimum moisture content corresponding to IS:2720 (Part VII) and soaking the same in water for 4 days.

3.3.4 Spreading and Compacting

Immediately prior to the laying of sub-base, the subgrade already finished shall be prepared by removing all vegetation and other extraneous matter, lightly sprinkled with water, if necessary, and rolled with one pass of 8-10 tonne smooth wheeled roller.

The sub-base material shall be spread on the subgrade with the help of a drag spreader, motor grader or other approved means. The thickness of loose layers shall be so regulated that the maximum thickness of the layer after consolidation does not exceed 150 mm.

Moisture content of the loose material shall be checked in accordance with IS:2720 (Part II) and suitably adjusted by sprinkling additional water from a hose line, truck mounted water tank or other approved means so that at the time of compaction it is from 1 percent above to 2 percent below the optimum moisture content corresponding to IS:2720 (Part VIII). While adding water due allowance shall be made for evaporation losses. After water has been added, the material shall be processed by mechanical or other approved means if so directed by the Engineer until the layer is uniformly wet.

Immediately thereafter, rolling shall be started with 8 to 10 tonne smooth wheeled rollers or other approved plant. Rolling shall commence at the edges and progress towards the center longitudinally except that on superelevated portions it shall progress from the lower to the upper edge parallel to the center line of the pavement. Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. During rolling the grade and camber shall be checked and any high spots or depressions which become apparent corrected by removing or adding fresh material.

Rolling shall be continued till the density achieved is at least 100% of the maximum dry density for the material determined as per IS:2720 (Part VII). The surface of any layer of material on completion of compaction shall be well closed, free from movement under compaction plant and from compaction planes, ridges, cracks or loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and re- compacted.

3.4.0 Cement Concrete (Plain and Reinforced)

3.4.1 General

All concrete work shall be according to ISI relevant Codes unless mentioned otherwise herein and the ISI Codes particularly, IS:455, IS:385, IS:1786 & IS:456 latest editions shall form a part of the present specification.

3.4.2 Materials

a) Cement : The cement used shall be ordinary portland cement/ Blast Furnace slag cement/ Portland Pozzolana cement, sulphate resistant cement of approved manufacture and shall be fresh when delivered. Consignments shall be used in the order of delivery. Damaged or partly set cement shall not be permitted to be used and shall be removed from site at once.

Admixture shall be used only if approved by the Engineer. The LSTK Vendor shall furnish to the Engineer, the manufacturer's certificate for cement for each

consignment, procured by the LSTK Vendor direct. If at any time, the Engineer feels that the quality of cement is not up to the specification, he can stop the work and send samples of cement for testing to an approved laboratory. The LSTK Vendor shall have no claim for any loss arising out of such suspension of work.

If the cement is procured by the Owner and issued to the LSTK Vendor, the LSTK Vendor shall satisfy himself at the time of taking delivery that quality and freshness of cement are up to the specified standard.

No complaint will be entertained later on from the LSTK Vendor for poor concrete work due to the poor quality of cement supplied by the Owner. All rectification work on this account shall be done entirely by the LSTK Vendor at his own expenses

b) Aggregate :

i) General

Aggregate shall consist of natural sand, crushed stone procured from a source known to produce satisfactory aggregate for concrete and shall be chemically inert strong, hard, durable against weathering, of limited porosity and free from adhering coatings, clay lumps, coal and coal residues, clinkers, slag, organic and other impurities that may cause corrosion of the reinforcements or may impair the strength and/or durability of the concrete. They shall conform to IS:383- latest edition.

ii) Sand and Fine Aggregate :

It shall be clean, sharp and coarse and free from all impurities and shall be washed and/or screened at the site if so demanded by the Engineer. Sand and fine aggregate shall correspond to IS:383- latest edition. The fine aggregate shall not contain more than 3 percent of clay or foreign matter. Fineness modulus of sand shall not be less than 2.5.

iii) Coarse Aggregate:

This shall consist of broken trap, basalt or granite or some other suitable stone from a source to be approved by the Engineer and shall meet the requirements of IS:383- latest edition. The coarse aggregate shall be machine crushed, hard, strong, durable, free from clayey films or loamy admixtures, vegetable or organic matters and shall be washed with water and/or screened if so demanded by the Engineer. The aggregate shall be well graded. The pieces shall be angular in shape and shall have granular or crystalline surface. Friable, flaky and laminated pieces, mica and shell may be present only in such quantities that will not affect adversely the strength and/or durability of concrete and to the approval of the Engineer. The maximum size of coarse agreegate shall be 38 mm for lean concrete and M10 Grade concrete and 20 mm for M15 Grade concrete.

Where permitted by the Engineer, the maximum size of the coarse aggregate may be large. All aggregate shall be uniformly graded. The amount of fine particles occuring in the Free State or as loose adherent shall not exceed 1% when determined by laboratory sedimantation tests. After 24 hours immersion

in water, a previously dried sample shall not have gained more than 10% of the weight.

c) Water :

Water shall be clean, fresh and free from organic or deleterious matter in solution or in suspension in such amounts that may impair the strength or durability of the concrete. The LSTK Vendor shall, however, satisfy himself that the quality is up to the desired standard and shall also submit an analysis from an approved analyst if so desired by the Engineer, free of charge.

d) Reinforcements :

The reinforcement shall be mild or torsteel bars conforming to the latest edition of IS:432 or IS:1786.

All reinforcing bars must be completely free from grease, oil, dirt, scales, scrapable rust, bituminous material, paint, pitted surface and manufacturing defects.

e) Tie bars.

i) Tie bars in longitudinal joints shall be deformed steel bars of strength 415 Mpa complying with IS:1786 and in accordance with the requirements given below. The bars shall be free from oil, dirt, loose rust and scale. Design of tie bar shall be as per IRC: 58.

ii) Tie bars projecting across the longitudinal joint shall be projected from corrosion for 75mm on each side of the joints by a proactive coating of bituminous paint with the approval of the Engineer. The coating shall be dry when the tie bars are used.

iii) Tie bars in longitudinal joints shall be made up into rigid assemblies with adequate supports and fixings to remain firmly in position during the construction of slab. Alternatively, tie bars at longitudinal joints may be mechanically or manually inserted into the plastic concrete from the above by vibration using a method which ensure correct placement of bars and recompaction of the concrete around the tie bars.

iv) Tie bars shall be positioned to remain within the middle third of the slab depth as indicated in the drawing and approximately parallel to the surface and approximately perpendicular to the line of joints, with the center of each bars on the intended line of the joints within a tolerance of _+ 50 mm, and with a minimum cover of 30mm below the joint groove.

f) Separation Membrane.

separation membrane shall be used between the concrete slab and the subbase. Separation membrane shall be impermeable plastic sheeting 125 micron thick laid flat

without creases. Before placing the separation membrane, the sub base shall be swept clean of all the extraneous materials using air compressor. Wherever overlap of plastic sheets is necessary, the same shall be at least 300mm and any damaged sheeting shall be replaced at the LSTK Vendors expense. The separation membrane may be nailed to the lower layer with concrete nail.

g) Joints

The location and type of joints shall be shown in the drawing. The location of the joints should be transferred accurately at the site and mechanical saw cutting of joints done as per stipulated dimensions. It should be ensured that the full required depth of cut is made from edge to edge of the pavement. Transverse and Longitudinal joints in the pavement and sub base shall be staggered so that they are not coincident vertically and are at least 1m and 0.3m apart respectively. Sawing of joints shall be carried out with diamond studded blades soon after the concrete has hardened to take the load of the sawing machine and personal without damaging the texture of the pavement. Sawing operation could start as early as 6-8 hours depending upon the season. All joints shall be designed as per IRC:58.

h) Transverse joints.

Location of construction joints/ expansion joints shall be as per drawing. Transverse joints shall be straight within the following tolerance along the intended line of joints which is the straight line transverse to the longitudinal axis of the carriageway at the position proposed by the LSTK Vendor and agreed to by the Engineer, except at the junction or roundabouts where the position shall be as described in the drawing.

i) Deviations of the filler board in the case of expansion joints from the intended line of the joint shall not greater than ± 10mm.

ii) The best fit straight line through the joints grooves as constructed shall not more than 25mm from the intended line of the joint.

iii) Deviations of the joint groove from the best fit straight line of the joint shall not be greater than 10mm.

iv) Transverse joints on each side of the longitudinal joint shall be in line with each other and of the same type and width.

i) Longitudinal joints.

The longitudinal joints shall be saw cut as per details of the joints shown in the drawing. The groove may be cut after the final set of the concrete. Joints should be sawn to at least 1/3 the depth of the +_5mm as indicated in the drawing.

j) Dowel bars

Dowel bars shall be mild steel rounds in accordance with details/ dimensions as indicated in the drawing and free from oil, dirt, loose rust or scale. They shall be straight free of irregularities and burring restricting slippage in concrete. The sliding ends shall be sawn or cropped clearly with no protrusions outside the normal diameter of the bar. The dowel bar shall be supported on cradles/dowels chairs in pre-fabricated

joint assemblies positioned prior to the construction of the slabs or mechanically inserted with vibration into the plastic concrete by a method which ensures correct placement of the bars besides full recompaction of the concrete around the dowel bars.

Unless shown otherwise on the drawings ,dowels bars shall be positioned at mid depth of the slab within a tolerance of +_20mm, and centered equally about intended lines of the joint within a tolerance of ± 25mm.

Dowel bars shall be covered by a thin plastic sheath for at least two thirds of the length from one end for dowels bars in contraction joints or half the length plus 50mm for expansion joints. The sheath shall be tough, durable and of an average thickness not greater than 1.25mm.

For expansion joints, a closely fitting cap 100mm long consisting of waterproofed cardboard or an approved synthetic material like PVC or GI pipes shall be placed over the sheathed end of each dowel bar. An expansion space at least equal in length to the thickness of the joint filler board shall be formed between the end of the cap and the end of the dowel bar by using compressible sponge. To block the entry of the cement slurry between dowel and cap it may be taped. Design of dowel bars shall be as per IRC :58.

k) Joint sealing compound.

The joint sealing compound shall be hot poured, elastomeric type or cold polysulphide type having flexibility, resistance to age hardening and durability. If the sealant is of hot poured type it shall confirm to AASHTO M282 and/or IRC:57 and cold applied sealant shall be in accordance with BS 5212 (PART 2) and/or IRC:57.

3.4.3 Storage of Materials

a) Cement :

Cement shall be stored at the works in such a manner as to prevent deterioration either through moisture or intrusion of foreign matter. Sufficient storage shall be arranged by the LSTK Vendor to ensure continuity of consumption. Cement shall be stored in easily countable stacks of minm. Cap. 2000 M.T

b) Aggregates :

Aggregates shall be stored on planking, steel plates or concrete. Different sizes shall be separated with wooden, steel, or concrete bulkheads. Care shall be taken to prevent any segregationof various sizes of particles. The aggregates must not be allowed to come in contact with dirt, clay and other injurious substances at any stage. The aggregate shall be stored in easily measurable stacks. Procurement must be at least two months in advance of consumption in dry season and four months in advance in rainy season.

c) Reinforcement :

Reinforcing steel shall be stored as far as possible under cover. It shall be protected from oil, grease, dirt, etc. The stacks shall be easily measurable.

3.4.4 Workmanship

a) Reinforcement

i) Bending :

Reinforcement bars shall be bent by machine or other approved means producing a gradual and even motion. All the bars shall be cold bent unless otherwise approved. Bars correctly bent only will be used. Bends and shapes shall comply strictly with the dimensions in the approved bar bending schedule. Bending schedule shall be prepared by the LSTK Vendor and got approved by the Engineer before bending and he shall be entirely responsible for its correctness. No reinforcement shall be bent when in position in the work without approval of the Engineer, whether or not it is partially embedded in concrete. Unless described otherwise, lapping dimensions shall conform to IS:456 - latest edition and all bending shall correspond to IS:2502- latest edition.

ii) Placing in Position :

Fixing of reinforcement shall correspond to IS:2502 - latest edition. Reinforcements shall be accurately fixed and maintained in position by such means as mild steel chairs and concrete spacer pieces, Bars intended to be in contact at passing points shall be securely bound together at all such points by No. 20G annealed soft iron wire conforming to IS:280 - latest edition. Binders and the like shall tightly embrace the bars with which they are intended to be in contact and shall be securely bound. The vertical distances between successive layers of bars shall be maintained by provision of mild steel spacer bars at such intervals that the main bars do not sag perceptibly between adjacent spacer bars.

The placing of reinforcement shall be completed well in advance of concreting immediately before concreting; the reinforcement shall be examined for accuracy of placing and cleanliness by the Engineer and corrected if it is so desired by him. The cover for concrete over the reinforcements shall be as shown or as specified on the approved drawings. Unless otherwise directed, all laps shall be minimum 52 times the diameter of the bar in case of H.T. deformed bar and 40 times diameter of the bar in case of mild steel. If the bars in a lap are not of same diameter, the smaller will guide the lap length. The laps shall be staggered.

Where concrete blocks are used for ensuring the cover and position, they shall be made of mortar not leaner than one (1) part cement to two (2) parts sand and cured for at least seven days.

b) Formwork :

The formwork shall conform to the shape, line and dimensions as shown on the plans and shall be made of timber close and tight to prevent leakage of mortar with necessary props, bracings and wedges sufficiently strong and stable so that it should

not yield on lying of concrete. Formwork shall conform to IS:456- latest edition - in respect of above and stripping time, cleaning and oiling, etc.

c) Concrete :

The following concrete shall be used as minimum grade of concrete road works.

Grade of concrete	**To be used for**
M 15	100 mm thick dry Lean concrete below concrete pavement.
M 35	Pavement Concrete of designed thickness.

i) Water cement ratio and slump shall be determined to suit strength requirements of the concrete mix.

ii) Mixing: The aggregate and sand shall be washed free from all dust and earthy matter if required by the Engineer. The above materials will then be accurately measured in boxes. The quantity of cement shall be determined by weight. The quantity of water shall be predetermined after allowing for moisture content in the aggregate. All the ingredients as proportioned shall then be mixed in a mechanical mixer till the mass is uniform in texture and consistency, but in no case the mixing time shall be less than two minutes. Hand mixing if permitted by the Engineer as a special case shall be carried out on a water tight platform using 10% extra cement at LSTK Vendor's cost and care shall be taken to ensure that the mixing is continued till the mass is uniform in colour and consistency.

iii) Placing and Compacting : Concrete shall be transported from the place of mixture to the place of final deposit within 45 minutes after water has been added and shall be compacted before initial setting commences and should not be subsequently disturbed. Method of transporting and placing shall be such as to preclude segregation. Concrete shall be thoroughly worked around the reinforcements, etc. and into all corners of formwork. For compaction of concrete, mechanical vibrators shall be used. Concrete shall not be placed in water. Mixing, transporting, placing and compacting of concrete shall conform to IS:456 latest edition.

iv) Curing: Concrete shall be cured for at least 28 days from the date of placing of concrete.

v) Testing of Concrete: Concrete shall be tested in accordance with IS:516 latest edition and accepted in accordance with IS:456 latest edition.

4.0.0 TESTING AND ACCEPTANCE CRITERIA

4.1.0 Roads

All testing, as mentioned in the body of the specification and as mentioned in Clause No. 900 of Specification for Roads and Bridge Works, 1983 published by IRC on behalf of Ministry of Shipping and Transport (Roads Wing) shall be carried out by the LSTK Vendor as per direction of the Engineer. No extra payment shall be made for such tests.

4.2.0 Masonry and Plastering

Masonry and finish to masonry and concrete shall fully comply with the drawings, specifications, approved samples and instructions of the Engineer with respect to lines, levels, thickness and any other special criteria as mentioned in the body of the specification or as shown on drawing.

4.3.0 Cement Concrete

The strength requirements and acceptance criteria shall conform to the relevant clauses of IS:456.

5.0.0 RATES

The rate for any item in the Schedule, unless specifically excluded in the contract, shall be deemed to include the cost of all materials consumed or used in the work or incidental to it as well as labour, tools, plants, equipment, templates, supports, scaffolds, approaches, security and safety measures, power, fuel, lubricants, storage, handling, transport, testing, insurances, taxes, royalties and other revenue expenses, accommodation, services, supervision, overheads, profits etc.

6.0.0 MEASUREMENTS

6.1.0 Shoulder Construction

The Shoulder Construction shall be measured as finished work in position in Cubic meters.

6.2.0 Kerb

The actual length of Kerb laid shall be measured in running meters (R.M.) and paid at the unit rate tendered. The unit rate shall include excavating trenches, transporting and laying the blocks in line and levels and filling the outside face and ramming etc.

6.3.0 Granular Sub-base

Granular subbase shall be measured as finished work in position in cubic meters (Cu.M.).

6.4.0 Reinforced concrete

Reinforced concrete shall be measured as finished work in position in cubic meters (Cu.M.) and paid at the unit rate tendered.

6.5.0 Earthwork

The actual cross section of the excavation as per approved drawing or directions of Engineer shall be taken and volume of earthwork calculated and paid at the unit rate tendered as per specification for Earthwork.

6.6.0 R.C.C. Pipes

R.C.C. pipes shall be measured on running metre (R.M.) basis and paid at the unit rate tendered. The rate shall include supply, transport, laying in position including bedding, testing for water proofing, cost of collars, jointing of the pipes and collars including grouting of the joints etc. complete as per drawing, specification and schedule of items and/or instruction of the Engineer.

6.7.0 Masonry

For width of masonry of one full brick or more, the thickness, height and length shall be measured as per drawing and volume of masonry in cubic meters (Cu.M.) shall be calculated for payment at the unit rate tendered. All openings above 0.1 Sq.M. in area shall be deducted. No extra shall be paid for lifts, cutting bricks, curved and chamfered brickwork. Similarly for masonry work of halfbrick thickness the height and length will be measured as per drawing and area calculated in square meters (Sq.M.) will be paid for at unit rate tendered.

6.8.0 Plaster

Surface area of the plaster work shall be measured in square meters (Sq.M.) after deducting all openings above 0.1 Sq.M. in area etc. and payment shall be made at the unit rate tendered including standard finish to plaster.

6.9.0 Neat Cement Finish

Surface area of the neat cement finish shall be measured in square meters (Sq.M.) after deducting all openings above 0.1 Sq.M. in area and payment shall be made at the unit rate tendered.

6.10.0 Cement Concrete

a) Actual volume of concrete work executed or as per drawings issued, whichever is less shall be measured in cubic meters (Cu.M.) and paid at the unit rates tendered. No deductions, however, will be made for embedded fixtures including reinforcements, sleeves, anchor bolts and similar items. Formwork will be paid separately.

b) Precast concrete work shall be measured in the same way as specified in the foregoing paragraph. Payment shall be done only after erection, grouting and curing of the precast units in proper position, unless otherwise provided in the contract, cost of which shall be included in the rate. All breakages and damages of the precast units shall be to the LSTK Vendor's account and shall be replaced free of charge to the Owner. Cost of formwork for precast units shall be included in the concrete rates for precast units.

c) Measurement for formwork shall be done as the actual surface in contact with the concrete in squaremetres (Sq.M) and paid at the unit rate tendered.

No payment for formwork or any other requirements in construction joints shall be made.

No extra measurement or payment shall be made for making the formwork water proof or for supports, scaffolding, centering, approaches etc.

d) Reinforcement bar or any other type of reinforcement used like Hard drawn steel wire fabric etc. for reinforced concrete shall be measured by weight in tonnes calculated on the basis of theoretical unit weight per metre. No payment shall be made for binding wires, spacer block, supports, chairs, hangers etc.

Dowels neither shown on the drawings nor instructed by the Engineer, but required for construction facilities and/or sequence, shall not be measured

SUB-SECTION NO. C21

TECHNICAL SPECIFICATION FOR GEOTECHNICAL INVESTIGATION

A. TECHNICAL SPECIFICATION

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE
2.00.00	GENERAL
3.00.00	SOIL EXPLORATION
4.00.00	PENETRATION TESTS
5.00.00	GROUND WATER INVESTIGATION
6.00.00	FIELD TESTS
7.00.00	FIELD DETERMINATION OF CALIFORNIA BEARING RATIO
8.00.00	LABORATORY TESTS ON SOIL SAMPLES/ROCK CORES
9.00.00	REPORT ON SUB SOIL INVESTIGATION

TECHNICAL SPECIFICATION FOR GEOTECHNICAL INVESTIGATION

1.00.00 SCOPE

This specification covers the soil exploration work including carrying out field tests and laboratory tests to evaluate sub-soil parameters of soil/rock and preparation of detailed report including the recommendations regarding founding level, type of foundation for different kinds of structures/machines and methods of deep excavation.

2.00.00 GENERAL

The LSTK Vendor shall perform all work under the purview of this specification along with all incidental and related work including setting out, staging, approach to test locations, LSTK Vendor's office, stores and protection of adjacent buildings, structures or services / facilities. No separate payments shall be made on such accounts. The LSTK Bidder shall therefore take into account all such relevant items while quoting his unit rates against the schedule of items.

2.01.00 Work to be provided for by the LSTK Vendor

The work to be provided for by the LSTK Vendor, unless specified otherwise shall include but not be limited to the following:

a) Furnish necessary plant and equipment, tools and tackles, instruments, necessary power, fuel, water, labour, supervisions by qualified and experienced Engineers and supervisors specialized in the type of investigation, transport of materials, men and equipment etc., services, full insurance and all other incidental items as may be necessary for timely and successful completion of the work as per tender terms, drawings, specifications and instruction of the Owner / Owner's representative.

b) Locate in the field and in layout drawing all boreholes and other field investigation items.

c) Furnish progressively and periodically field bore logs, investigation observations, test results with relevant data and features in triplicate.

d) Prepare and submit draft (in duplicate) and final (after incorporating comments, any) sub soil investigation report as per specification, schedule of items and instructructions of the Owner/Owner's representative.

2.02.00 **Work to be provided for by others**

No work under this specification will be provided by any agency other than the LSTK Vendor unless specifically mentioned elsewhere in the Contract.

2.03.00 Location and Levels

Location of all boreholes and field test points and levels of the existing ground at such locations shall be established by the LSTK Vendor at his own cost from two reference grids and one bench mark given by the Owner/ Owner's representative and these shall be subsequently plotted in the layout plan, bore logs and other relevant field test data sheets / tables to be incorporated in the report by the LSTK Vendor.

Making benchmark pillar(s) and reference line pillars (whatever are required for the work) and maintaining them up to the completion of the work shall be the responsibility of the LSTK Vendor at no extra cost to the Owner.
Location plan of bore holes & other tests as shown in the drawing are tentative and the actual locations shall be provided to the successful LSTK Vendor during placing of order.

2.04.00 Codes and Standards

The following is the general list of IS Codes to be used for the soil investigation work and preparation of report. In all cases latest revision along with amendments, if any, shall be referred to.

IS:1498 - Classification and identification of soils for General Engineering purposes.

IS: 1888 - Method of load tests on soils

IS: 1892 - Subsurface investigation for foundation

IS: 1904 - Code of practice for design and construction of foundations in soils: General Requirements

IS: 2131 - Method for standard penetration test for soils

IS: 2132 - Code of Practice for thin walled tube sampling of soils

IS: 2470 - Code of practice for installation of septic tanks
(Part-II) - Secondary treatment and disposal of septic tank effluent

IS: 2720 - Methods of tests for soils

IS: 2809 - Glossary of terms and symbols relating to Soil Engineering.

IS: 3025 - Methods of sampling and test (physical and chemical) for water and waste water

IS: 3043 - Code of Practice for earthing

IS: 4078 - Indexing and storage of drill cores

IS: 4453 - Code of Practice for sub surface exploration by pits, trenches, drifts and shafts

IS: 4464 - Presentation of drilling information and core description in foundation investigation

IS: 4968 - Method for sub surface sounding for soils
(Part-II) dynamic method using cone and bentonite slurry
.

IS: 5249 - Method of test for determination of dynamic properties of soil.

IS: 5313 - Guide for core drilling observations

IS: 5529 - In situ permeability tests - tests in over-burden (Part I)

IS: 5529 - In situ permeability tests - tests in bedrock (Part II)

IS: 6403 - Determination of bearing capacity of shallow foundations

IS: 6935 - Method of determination of water level in a borehole

IS: 7746 - In situ shear test on rock

IS: 8009 - Calculation of settlement of foundations -
(Part-I) Shallow foundations subjected to symmetrical static vertical loading

(Part-II) - Deep foundations subjected to symmetrical static vertical loading.

IS: 8763 - Guide for undisturbed sampling of sands and sandy soils

IS: 9179 - Method for preparation of rock specimen for laboratory testing

IS: 9214 - Method of determination of modulus of sub-grade reaction (k-value) of soils Infield

IS: 9259 - Specification for liquid limit apparatus for soils

IS: 9640 - Specification for split spoon sampler

IS: 10108 - Sampling of soils by thin wall sampler with stationary piston

IS:10589 - Specification for equipment for determination of subsurface sounding of soils

IS: 10837 - Specification of moulds and accessories for determination of density index (relative density) of cohesion less soils

IS: 11229 - Specification for shear box for testing of soils

IS:11315- Method for the quantitative description of discontinuities in rock (Part-II) mass Spacing

2.05.00 Time of Completion and Work Schedule

The bidder shall carefully read the instructions as outlined below, understand its implications in terms financial and time elements. He shall ensure that all instructions are fully complied with, without any extra claim whatsoever.

Geotechnical investigation work shall be completed in all respect within the agreed period of time from the effective date of Contract.

Time is the essence of the Contract. LSTK Vendor's particular attention is drawn to the fact that time schedule for completion of this Contract is firm and shall be strictly complied with. It is essential that the LSTK Vendor strictly adhere to the work schedule mutually agreed upon between him and the Owner/ Owner's representative.

The LSTK Vendor shall, within ten days from the date of award of Contract, commence work and submit to the Owner for his approval a detailed work schedule showing how he proposes to carry out the work at required rate specifically mentioning time period and date of completion and such approved schedules must be strictly adhered to by the LSTK Vendor. The schedules shall be reviewed periodically with the Owner to ensure that the completion date will be met and to institute all corrective steps such as mobilizing additional resources in terms of labour, material, equipment, tools and plant, night work etc. at no extra cost to the Owner to achieve any accelerated progress at any time to the extent required to adhere to the completion dates. The Owner reserves the right to revise the work schedule at his discretion in order to keep up to the completion schedule and to suit the project requirement and such alterations shall not be entitled to any extra payment.

2.06.0 Water and Power Requirement

The LSTK Vendor shall make his own arrangement for power and water requirement, and the rates quoted shall be inclusive of cost of such arrangement as required. No extra claim on account of arrangement for water and power shall be entertained.

3.00.00 SOIL EXPLORATION

3.01.00 Test Boring

Test Boring through different layers of soil shall be carried out by the LSTK Vendor at the locations marked in the drawing and/or at such other locations as directed by the Owner's representative in a manner described below.

Shell & Auger boring as described in IS: 1892 may be adopted. The LSTK Bidder shall furnish in his tender the complete details of the equipment and the method he proposes to follow. Minimum diameter of boring shall be 150 mm. However in case of sand, clay or intact rocks, rotary drilling method may be adopted.

During the boring operations if rock strata is not encountered, the boring shall be continued up to 20 m depth for all the bore holes except. In case rock strata is encountered within the above depths, boring operations shall be discontinued and drilling operation as mentioned in clause 3.04.00 below shall be resorted to. If the present formation level is above the natural ground with filled-up soil, the depth of boring mentioned above shall exclude such filled-up soil.

The LSTK Vendor shall describe in detail the equipment and method of boring he proposes to use. In the absence of dry boring equipment, wash boring at the discretion of the Owner's representative may be allowed, but the particular way of cleaning the casing by washing has to be approved by the Owner's representative. However, if the Owner's representative, at any

time, feels that the washing process is disturbing the samples to be taken, he may stop the work and the LSTK Vendor shall have no claim whatsoever on this score. If the LSTK Vendor can, however, improve the method to the satisfaction of the Owner's representative, he may be allowed to resume the wash boring work.

When boring cannot be advanced due to presence of hard material, it should be checked whether there is continuous strata of hard material below before resorting to drilling methods. If only a local boulder is present it should be chopped using suitable chopping bits and the debris removed and normal boring continued.

Ground water level for each borehole shall be checked during boring operation and shall be recorded in bore log. Sub-soil water samples shall also be collected from each borehole and recorded.

Wherever possible (and required by the Owner) a few completed boreholes shall be capped and a P.V.C. pipe inserted in order to preserve them for future ground water level observation. The LSTK Vendor shall use his own materials for this and the unit rate quoted shall be inclusive of the same. These bore holes after completion of observation shall be handed over to the Owner in such condition as to enable future observation of ground water level change. The other boreholes not used for observation shall be backfilled by the LSTK Vendor using sand fill as and when directed by the Owner's representative.

3.02.00 Stabilization of Boreholes

Boreholes shall be stabilized, whenever required, against caving of the sides of the drill hole and heaving of the bottom of the hole (especially in cases where the hole is carried below the ground water level), by use of drive pipe or casing or by means of drilling fluids (water or mixture of water and colloidal gel) forming thixotropic clays such as Bentonite or other suitable methods.

3.03.00 Open Trial Pits

The location of open trial pits shall be as shown in drawing and/or at such other locations as directed by the Owner's representative. If the present formation level is above the natural ground level with filled-up soil, the depth of trial pits shall be up to a depth of 3.5m below natural ground level or not below the ground water table or as directed by the Owner's representative. In no case, the depth shall be extended over 5m. The size of pits shall be 3.0m x 3.0m or as directed by the Owner's representative. Samples of undisturbed soil shall be obtained preferably at every 1.5m or where a change in strata is noticed.

The LSTK Vendor shall provide a suitable access to the bottom of the pits. Sampling in trial pits shall be done as directed by the Owner's representative.

The LSTK Vendor shall be paid at Contract unit price for each trial pit, which will include all costs for earthwork in excavation with necessary side slope and backfilling as also shoring/ sheeting for side protection, if required. If the pits exceed over 3.5m in depth, the LSTK Vendor shall be paid at unit price for the extra depths of excavation.

After completion of the test, sampling and visual examination, the pit shall be properly backfilled as directed by the Owner's representative. Unless otherwise specified, excavated soil shall be used for this purpose.

3.04.00 Rock Drilling

During boring operation, once rock strata is encountered, the normal method of boring operation as described under clause 3.01.00 earlier shall have to be stopped and drilling operation will be resorted to for determining depth and nature of rock strata, in a manner as described below.

Rotary core drilling technique with continuous core recovery should be adopted for drilling through rock. The LSTK Bidder shall indicate in his tender the type of coring bit he proposes to use. The behavior of rock mass is governed more significantly by the nature of fractures in the rock than by the type and hardness of the material composing the rock itself. Hence, good drilling technique should be adopted to obtain an intact sample truly representative of the in-situ material and for achieving highest percentage of recovery possible. Variations in the speed of rotation, the downward pressure on the core barrel, the pressure at which the drilling fluid is introduced into the hole and the length of hole drilled (run length) prior to removal of the core are major items which must be controlled by the driller. In general, coring should be initiated with short runs both because the upper portions of rock masses are commonly highly fractured and also because the elevations at which core losses occur can be more accurately determined. If conditions indicate that it is possible, the length of the runs may be determined by the length of the core barrel.

In zones which are highly fractured or where the barrel continuously becomes blocked it is essential that short runs be used even though this means removal of the entire string of drilling tools every 300 mm or less. Reduced bit pressure should be resorted to when rod vibration or chatter occurs. The pressure under which the drilling fluid should be introduced into the hole will be the minimum to be consistent with adequate removal of cuttings from the hole and proper cooling of the bit. To minimize the erosive action of the drilling fluid on the core and thereby to improve core recovery, double tube core barrels should be used. The casing and core barrel to be used shall be of designation BX or NX.

During the drilling operation for each bore-hole the LSTK Vendor shall record the rate of sinking of drill rods, ground water table elevations, if any, nature, type and sequence of rock drilled. From the recovered cores the LSTK Vendor shall determine nature of fractures and degree of weathering of rock for each borehole. The LSTK Vendor shall also note and record any appreciable loss of drilling fluid throughout the entire drilling operations for each borehole. The LSTK Vendor shall also determine the percentage recovery ratio and rock quality designation from the recovered cores for each stage of core advance and for all the bore-holes. Rock quality designation is defined as the ratio of cumulative lengths of intact pieces of core greater than 10 cm to the length of core advance.

The LSTK Vendor shall furnish all the information mentioned above fully verified and signed by the Owner's representative at site and submit them in triplicate to the Owner's representative.

The drilling operation shall be terminated at a depth where more than 75% of the core recovery is possible. If core recovery is lower and the nature of rock is weathered, drilling must be continued up to 20m for all the boreholes below the natural ground level.

In addition to the above-mentioned points the LSTK Vendor shall also take into consideration the provisions of the latest revisions of the following Codes of Practice:

a) IS: 4078 - Code of Practice for indexing and storage of drill cores.

b) IS: 4464 - Code of Practice for presentation of drilling information and core description in foundation investigation

3.05.00 Adits and Test shafts

Not applicable.

3.06.00 Sampling

Undisturbed soil sample shall be collected continuously during boring to note any change of soil formation strata. Samples of undisturbed soil shall be obtained preferably at 1.5 m interval or where a change in strata is indicated by the slurry flowing out. In no case shall the depth between successive sampling be more than 3.0 m and a sample shall be obtained on the average for every 2.0 m depth of boring, since it is intended to ascertain the characteristics of the soil at various depths. If, however, there is fair uniformity in the characteristics of the soil for certain depths the Owner's representative may limit the number of samples stipulated above.

3.06.01 Tube Sampling

For obtaining undisturbed samples in its simplest from, an open drive thin wall tube sampler (100x450 mm size) shall be attached to a rod and shall be lowered to the bottom after completely cleaning the borehole bottom by washing. The samplers to be used should have area ratio less than 13 percent and preferably less than 10 percent. The head should have check valve and ports to permit easy escape of drilling fluid or air from the sample tube as the sample enters it.

Sampling will be accomplished by jacking or driving the tube depending on the type of soil to be sampled. Upon completion of the sampling operation the sampler shall be withdrawn from the borehole and the sample of soil carefully taken out. Approximately one-inch length of soil is to be removed from each end for identification. If there is any surface water on the sample, this shall be wiped off with soaking paper, all sludge of cuttings from advancement of borehole removed and the sample immediately packed in an airtight, close fitting container marked with respective test bore numbers, elevation at which the sample was taken and other relevant information as per IS: 1892.

Representative / disturbed samples shall also be taken in different strata for visual classification, water content, grain size analysis, Atterberg limits, determination of specific gravity and compaction tests.

3.06.02 Chunk Samples

In cohesive soils, undisturbed samples of regular shapes shall be collected. The samples shall be cut and trimmed to a suitable size (0.3 x 0.3 x 0.3 m). A square area (0.35 x 0.35 m) shall be marked at the center of the leveled surface at the bottom of the pit. Without disturbing the soil inside the marked area, the soil around this marking shall be carefully removed up to a depth of 0.35 m. The four vertical faces of the soil block protruding at the center shall be trimmed slowly so that its size is reduced to 0.3 x 0.3 m. Wax paper cut to suitable size shall be wrapped uniformly and covered with two layers of thin cloth over all the 5 exposed surfaces of the soil block and sealed properly using molten wax. A firmly constructed wooden box of size 0.35m x 0.35m (internal dimensions) with the top and bottom open shall be placed around the soil block and held in such a manner that its top edge protrudes just above the surface of the block. The space between the soil block and the box shall be filled uniformly and tightly with moist saw dust. The top surface shall also be covered with sawdust before nailing the wooden lid to cover the box firmly taking care that the soil block is not disturbed. The area of contact between the bottom portion of the block and the ground shall be reduced slowly by removing soil in small quantities using small rods, so that the block can be separated from the ground slowly without

disturbance. After inverting the wooden box along with the soil block, the bottom portion shall be trimmed and covered with wax paper, cloth and sealed with molten wax. A wooden lid shall be nailed to the box after providing proper saw dust cushion below it. An arrow mark shall be made on the vertical face of the wooden box to indicate the top surface along with the coordinates and depth of sampling.

3.06.03 Sampling in rock

Sampling in rock shall be accomplished during the drilling process by employing double tube core barrels for continuous core recovery. The drilling procedure to be followed should be the one, which brings about the highest percent recovery.

3.07.00 Record of Boring

Detailed chronological record of drilling and sampling operations shall be maintained in the field log and shall be submitted to the Owner after completion of boring work at site. The final log showing pertinent subsurface information and results of field and laboratory testing shall be submitted with the soil report.

The field log should contain at least the following information:

a) Reference information like project number, title and location, exploration number and location by coordinates, inclination of the boring and if inclined the bearing or azimuth of the dip of the hole, reference level and datum.

b) Personnel information - name of drilling Contractor, driller and inspecting Engineer.

c) Equipment data - manufacturer's name and model designation.

d) Sampling and coring information:

i) General : Sample type and number, sampler dimension, depth at start and completion of sampling, length of sample, recovery ratio and complete visual description of each sample in "as retrieved" state.

ii) Drive samplers: Weight and height of drop of hammer and number of blows for each 150 mm penetration.

iii) Push samplers: Hydraulic pressure and rate of penetration.

iv) Soil or rock coring: Average rotational speed, downward hydraulic pressure and rate of penetration.

v) Rock coring: Rock quality designation (R Q D)

e) Description of material penetrated but not sampled.

f) Casing information - Size, depth at which required, length and depth of bottom of casing; weight and height of drop of hammer and number of blows for each 300 mm of penetration for driven casing, and average rotational speed and downward pressure on casing and average rate of penetration for drilled casing.

g) Seepage pressure test information - depth and duration of test.

h) Groundwater information - depth to water surface recorded daily and continued till water level has stabilized.

i) Artesian pressure information - depth at which encountered, measured head and time at which each measurement is made.

j) Elevation of top and bottom of hole and top of rock.

k) Date and time of all operations and delays (if any) with reasons.

l) Miscellaneous information to aid interpretation of sub-surface conditions.

m) Additional pertinent information.

The final log shall be a condensation of the field log refined on the basis of field and laboratory tests. The final log should present a clear, concise and accurate picture of subsurface conditions to be utilized by the Owner's representative.

4.00.00 PENETRATION TESTS

Penetration tests using various types of equipment as specified shall be conducted to measure the resistance of soil to penetration.

4.01.00 Standard Penetration Test

Standard penetration test (SPT) shall be carried out in accordance with IS: 2131 at every change in strata or at 1.5 m intervals or as directed by the Owner's representative. The LSTK Vendor shall record the number of blows for each 150 mm penetration of the standard split spoon sampler over a depth of 450 mm. The number of blows for the first 150 mm of penetration shall not be considered in evaluating the penetration resistance. Hammer used for driving the sampler rod shall be 65 kg and drops of 750 mm shall be maintained. Records of the test including depth at which driving is initiated and the number of blows for each 150 mm penetration shall be shown in the field log, the final log shall indicate the actual SPT value (sum of number of blows for last 300 mm of penetration) at appropriate depths.

4.02.00 Dynamic Cone Penetration Test

Dynamic cone penetration test (DCPT) shall be conducted to predict stratification, density, bearing capacity etc. of soils. The test shall be conducted by driving a standard size cone attached to the bottom of a string of drill rods. The test shall be conducted up to the specified depth or terminated earlier if the number of blows exceeds 35 for 100 mm penetration when the cone is driven dry and 20 for 100 mm penetration when the cone is penetrated by circulating bentoite, in order to avoid damage to the equipment.

The specification for the equipment and accessories for performing this test, test procedure, field observations and reporting or results shall conform to IS: 4968 Part - II. The driving system shall comprise of a 65 kg. drive mass having a free fall of 0.75m. The cone shall be of 62.5 mm diameter provided with vents for continuous flow of Bentonite slurry through the cone and rods in order to avoid friction between the rods and soil. The use of Bentonite slurry may not be necessary when the investigation required is up to a depth of 6m only. On completion of the test, the results shall be presented as a continuous record of the number of blows required for every 300 mm penetration of the cone into the soil in a suitable chart supplemented by a graphical plot of blow count for 300 mm penetration vs. depth.

5.00.00 GROUND WATER INVESTIGATION

Groundwater investigation shall comprise determination of groundwater levels and pressures and permeability of subsurface materials. The effect of tidal variations (if applicable for the site) on ground water level shall also be observed by noting the water level in boreholes during high and low tide periods.

5.01.00 Ground water level observation

The LSTK Vendor shall make necessary arrangements to prepare the boreholes for ground water observation. Completed boreholes should be capped and a 1½-inch P.V.C. pipe with strainer at bottom shall be inserted in order to preserve them for future ground water observation. The LSTK Vendor will take these observations during the period of investigation. At the end of the site investigation work, these boreholes shall be handed over to the Owner in such a condition that the Owner can take further observations for a period of at least a year.

Piezometers will have to be installed in boreholes as directed by the Owner. A piezometer consisting of either a simple standpipe of PVC tubing with a slotted end and surrounded by granular filter of plastic fabrics shall be used for granular soils or permeable rocks. In impermeable soils, hydraulic piezometer consisting of a porous element connected by twin small-bore plastic tubing to a remote reading station will be used.

5.02.00 In-Situ Permeability Test

In-situ permeability test shall be performed in the boreholes specified in drawing and/or at such other locations at specified depths as directed by the Owner's representative for determination of the permeability co-efficient of the soil. The type of test shall be either pump-in or pump-out test depending on the sub-soil and ground water conditions. Pump- in test shall be conducted whether ground water in the borehole exists or not. Pump-out test with piezometer installations shall be conducted to obtain data for dewatering purposes when ground water is met in the borehole.

The specification for the equipment required for the test and the procedure of testing shall be in accordance with IS: 5529, Part-I. The LSTK Vendor shall provide all necessary equipment (diesel operated). When it is required to carry out the permeability test for a particular section of the soil strata above the ground water table, bentonite slurry shall not be used while boring.

5.02.01 Pump - in Test

Pump-in test shall be conducted in the borehole/trial pit by allowing water to percolate into the soil. Choice of the method of testing shall depend on the soil permeability and prevailing ground water level. Only clear water shall be used for conducting the test. Before conducting the test, the borehole shall be cleaned. Water shall be allowed to percolate through the test section for sufficient period of time to saturate the soil before starting the observation.

a) Constant Head Method (in borehole)

This test shall be conducted in boreholes where soils have a high permeability. Water shall be allowed into the borehole through a metering system ensuring gravity flow at constant head so as to maintain a steady water level in the borehole. A reference mark shall be made at a convenient level, which can be easily seen, in the casing pipe to note down the fluctuations of water level. The fluctuations shall be counteracted by varying the quantity of water flowing into the borehole. The elevation of water shall be observed at every 5-minute interval. When three consecutive readings show constant

level of water surface above test depth, diameter of casing pipe, etc. shall be noted and recorded as per the proforma recommended in IS: 5529, Part-I, Appendix-A.

b) Falling Head Method (in borehole)

This method shall be adopted for soils of low permeability and which can stand without casing. The test section shall be sealed by the bottom of the boreholes and a packer at the top of test section. If the test has to be conducted at an intermediate section of pre-bored hole then, double packers shall be used. Access to the test section through the packer shall be by means of a pipe, which shall extend to above the ground level. Water shall be filled into the pipe up to the level marked just below the top of the pipe and water allowed to drain into the test section. The water level in the pipe shall be recorded at regular intervals as mentioned in IS: 5529, Part-I, Appendix-B. The test shall be repeated till constant records of water level are achieved.

c) Percolation test (in trial pit)

Percolation test shall be conducted in the trial pit in areas where effluent is stored / discharged in ground level tanks. The loss of water due to percolation into the soil shall be estimated by the soil absorption capacity. This test shall be conducted in trial pits as per the procedure given in IS: 2470-Part-II, Appendix-A.

5.02.02 Pump - Out Test

This test shall be adopted to determine accurate values of permeability of soil below water table. Observation pipes of 50 mm dia shall be installed at regular intervals along three radial lines extending from the borehole at 120 degrees to each other. Length of these pipes shall depend on the ground level and estimated lowering of the ground water table. The test shall be carried out by pumping out the water to a known depth and recording the water levels in the observation pipes at regular intervals of time till the water level is stabilized. The observations shall be recorded as specified in IS: 5529, Part-I, Appendix-D.

6.00.00 FIELD TESTS

In situ tests shall be performed as desired by the Owner's representative to measure properties of soil during the field investigation work.

6.01.00 Direct Plate Load Tests on Soils

The direct load tests on soil shall be carried out in the trial pits specified in drawing and/or at such other locations as directed by the Owner's representative. This test is to be carried out at 2.5m/3.5m below the natural ground level as indicated in the above drawing/as directed by the Owner's representative. The plate sizes to be used shall depend on the nature of the soil; a 45 cm square plate will be used in clayey soil and in sandy soils, three plates of size varying between 30 cm to 75 cm will be used. The test shall be carried out in a manner as to give dependable assessment of bearing capacities of the soils at particular level. The results of the test shall also be used for arriving at the modulus of sub grade reaction and deformation modulus of soil.

The LSTK Bidder shall furnish in his tender the complete detail of the equipment and method he proposes to follow.

The excavation and side protection during the test and back- filling after the test shall be carried out by the LSTK Vendor. If ground water table is at a depth higher than the specified

test depth, the ground water table shall be lowered and maintained at the test depth for the entire duration of the test. The cost of dewatering shall be borne by the LSTK Vendor.

The LSTK Vendor will submit, for approval of the Owner's representative, a detailed arrangement drawing for the tests and satisfy the Owner's representative about its adequacy in respect of strength and safety and of its being capable of giving accurate data. However, the LSTK Vendor shall have to modify the arrangement at his own cost if it is ultimately found to be deficient.

The LSTK Vendor must get the dial and pressure gauges calibrated by an approved testing laboratory before commencing the direct load tests at the site and produce the certificates of the tests to the Owner's representative. There shall be adequate number of standby gauges available at the site for quick replacement of faulty gauges. The LSTK Vendor shall bring not less than two dial gauges and one pressure gauge as standby.

In no case settlement observations by means of level and staff shall be accepted.

The tests shall be carried out as described in IS: 1888 unless otherwise specifically directed. The application of load may be by gravity or by reaction as detailed out in the above standard.

The test plate shall be preloaded with a load of 700 Kg/ sq.m. retained for a reasonable period and then replaced to take out all slacks of the arrangement. All settlement observations shall start thereafter. Unless the ultimate bearing capacity can be calculated from the available soil data, the LSTK Vendor shall assess ultimate bearing capacity of the soil under test. Increments of the load shall be of about one fifth of the ultimate bearing capacity. The increments shall continue to an extent that allows locating the 'Yield Value of the Soil' as defined in IS:1888 or up to practicable limit of testing.

While releasing the loads, the rebounds are to be observed in a similar manner as the settlement observations.

The observations shall be recorded directly in logbooks, proforma of which has to be approved by the Owner's representative, who shall also be present to check the data. The Owner's representative shall be notified well in advance of the detailed programme of the test and shall also be informed prior to start of releasing the load so that he can check the total settlement.

In addition to carrying out plate load tests, undisturbed/disturbed soil samples shall also be collected at regular intervals during excavation.

The payment shall be lump sum for each test and shall include all costs inclusive of earthwork in excavation up to 3.5m depth below natural ground level, shoring for side protection, if necessary, and back filling after the test. For the depths over 3.5m extra payments shall be made only for earthwork and shoring, if any. If water table is required to be lowered during the test, necessary diesel operated pumping arrangement will have to be provided by the LSTK Vendor himself. All expenses in this connection shall be included in his quoted rates.

6.02.00 Determination of Dry-Density of Soils

In place dry density of soil is required for assessment of bearing capacity of soils analysis for stability of natural slopes and in settlement calculations for estimating overburden pressure at different depths. The following methods depending on the scope of application in different types of soils shall be adopted as directed by the Owner's representative for determination of in-place dry density of soils.

6.02.01 Sand Replacement Method

This method is suitable for fine, medium and coarse-grained soils. Small sand pouring cylinder should be used when the soil consists of fine to medium size grains while for soils containing stones where difficulties would be encountered with this method, a large sand-pouring cylinder should be used. The sand used for filling shall be clean, uniformly graded natural sand, passing 1.00 mm IS sieve and retained on 600 micron IS sieve. It shall be free from organic matter, oven dried and stored for suitable period to allow its water content to reach equilibrium with atmospheric humidity.

Equipment and accessories, test procedure, observations and reporting of results shall conform to IS: 2720 (Part XXVIII).

6.02.02 Ring and Water Replacement Method

The specification for equipment, test procedure, observation and reporting of results for this test shall conform to IS: 2720 (Part XXXIII). The test equipment shall consist of a circular ring placed at the surface of the ground and plastic film inserted in the hole to retain the water. The method should be applied in coarse-grained soils including gravels, cobbles, boulders and rock. Density can be determined for either the total material or material smaller than specified or given size.

6.03.00 In-situ Block Shear / Wedge Shear Test

The test shall be carried out in a manner as to give a dependable assessment of shear resistance of rock, when at a shallow depth, rock is encountered.

The LSTK Bidder shall furnish in his tender the complete detail of the equipment and the method he proposes to follow.

The test shall be carried out in the trial pits marked in drawing and/or at such other locations as directed by the Owner's representative. The interpretation of test data and report shall be as per the provisions of IS: 7746. The set up without an arrangement for direct application of normal load as detailed in the above standard shall be followed.

Regarding the approval of detailed arrangement drawings for the test, adequacy of conducted test, dial gauges to be used for the test and recording of observations for the test the provisions as laid down for direct load tests on soils shall hold good.

The payment terms as indicated for clause 3.03.00 above shall hold good for this test.

6.04.00 Test for Measurement of Soil Resistivity

For designing the earthing system for the project it is necessary to find out the electrical resistivity of the soil at some representative locations of the project site.

Soil resistivity is determined in Ohm-Meter by using "WENNER's FOUR ELECTRODE METHOD" with S=0.5,2.0,6.0,8.0 and 10.0m. The test procedure and computation of soil resistivity values shall conform to IS-3043.

The location and number of the test points are shown in the plant layout. The number shall be increased if the test results obtained in different locations show a significant difference, indicating variation in soil formation.

7.00.00 FIELD DETERMINATION OF CALIFORNIA BEARING RATIO

The test shall be carried out at locations as shown on the drawing or at locations as directed by the Owner's representative. The test shall be carried out at a depth of 500 mm below the finished ground level.

The LSTK Vendor shall submit, for approval of the Owner's representative, the complete detail of the equipment and the method he proposes to use. However, the LSTK Vendor shall have to modify the arrangement at his own cost if it is ultimately found to be deficient.

The surface area to be tested shall be exposed, cleaned of all loose and dried material, levelled and then soaked till saturation with a surcharge weight of 15 kg. After soaking is complete, the test surface shall be drained of all free water and allowed to stand for at least 15 minutes before starting further operations.

The test shall be carried out strictly in accordance with the provisions as laid down is IS: 2720 (Part XXXI) latest edition. Surcharge weights of 15 kg including that of the annular weight of 5 kg shall be applied before application of load on the penetration piston. Load shall be applied on the penetration piston such that the penetration is approximately 1.25 mm/min. The load readings shall be recorded at penetrations of 0, 0.5, 1.0, 1.5, 2.0, 2.5, 3.0, 4.0, 5.0, 7.5, 10.0 and 12.5 mm. The maximum load and penetration shall be recorded if it occurs for a penetration of less than 12.5 mm.

After completion of the test, a sample of soil shall be taken from the point of penetration for moisture content determination. In place density shall also be determined.

From the plot of load penetration curve, after necessary correction, the bearing ratios shall be calculated for penetrations of 2.5 mm and 5 mm. If the bearing ratio at 2.5 mm penetration is greater than that at 5 mm penetration the former shall be taken as the bearing ratio. If bearing ratio at 2.5 mm penetration is less than that at 5 mm penetration, the test shall be repeated and if the ratio at 5 mm penetration is consistently greater than that at 2.5 mm penetration, the ratio at 5 mm penetration shall be taken.

8.00.00 LABORATORY TESTS ON SOIL SAMPLES/ROCK CORES (IF ANY)

The LSTK Vendor shall carry out the tests as listed out in Annexure-III, Schedule of Items and Quantities, and/or as decided by the Owner's representative, in laboratory. He shall furnish the name/names of laboratories where he proposes to have the tests carried out and have them approved by the Owner's representative.

The Owner shall have the right of access to LSTK Vendor's laboratory and/or any other laboratory where tests have been arranged to be carried out during the progress of this investigation.

Adequate volume of test samples of soil/rock cores shall have to be collected from site and stored, labeled and transported carefully to the approved laboratory for carrying out the tests. The method and procedure of testing to be followed shall be as per the relevant Indian Standard Codes of Practice. The results of the tests shall be submitted to the Owner's representative in triplicate duly signed by the laboratory- in-charge. In tests for rock cores L/D = 1.0 of samples must be maintained.

9.00.00 REPORT ON SUB-SOIL INVESTIGATION

9.01.00 General

a) On completion of all the field and laboratory work, the LSTK Vendor shall submit a formal report containing geological information of the region, procedure adopted for investigation, field observations, summarized test data, conclusion and recommendations. The report shall include detailed bore logs, subsoil sections, field test results, laboratory observations and test results both in tabular as well as graphical form, practical and theoretical considerations for the interpretation of test results, the supporting calculation for the conclusions drawn etc. Initially, the LSTK Vendor shall submit three (3) copies of the report in draft form for the Owner's review.

b) The LSTK Vendor's qualified geotechnical Engineer shall visit the Owner's corporate office for a detailed discussion on the Owner's comments on his draft report. During the discussions, it shall be decided as to the modifications that need to be done in the draft report. Thereafter the LSTK Vendor shall incorporate in his report the agreed modifications and after getting the amended draft report approved, five (5) hard copies of the detailed final report shall be submitted along with three (3) soft copies in the form of a CD.

c) The detailed final report based on field observations, in-situ and laboratory tests shall encompass theoretical as well as practical considerations for foundations for different type of structures envisaged in the area under investigations. The LSTK Vendor shall acquaint himself about the type of structures, foundations loads and other information required from the Owner’s representative.

9.02.00 Data to be furnished

The report shall include the enlisted items but not be limited to them.

a) Purpose and scope of investigation

b) Authorization enabling the LSTK Vendor to carry out the work at the site.

c) Project description including proposed facilities and construction materials required for the works.

d) Description of the site, which shall include:

i) Location of the site and existing facilities.

ii) Topography of the site

iii) Drainage Characteristics

e) A plot plan showing the locations and reduced levels of all field tests e.g., boreholes, trial pits, dynamic cone penetration tests, plate load tests etc., properly drawn to scale and dimensioned with reference to the established grid lines.

f) A true cross section of all individual bore holes and trial pits with reduced levels and coordinates showing the classification and thickness of individual stratum, position of ground water table, various in-situ tests conducted and samples collected at different depths and the rock stratum, if met with.

g) A set of longitudinal and transverse profiles connecting various boreholes shall be presented in order to give a clear picture of the site, how soil/rock strata are varying vertically and horizontally.

h) Geological information

i) Regional geology - geologic province, topographic position of site, processes of formation of subsurface materials at site.

ii) Description of overburden and bedrock at the site (if applicable for the site)

iii) Comments on texture and structure of rock, joints, bedding planes, fissures, weathering condition etc. (if applicable for the site)

iv) Effect of geologic features on design.

i) Past observations and historical data, if available, for the area or for other areas with similar profile or for similar structures in the nearby area.

j) Bore hole& trial pit logs on standard proforma showing the depths, extent of various soil strata etc.

k) Plot of SPT (N) value (both uncorrected and corrected) with depth.

l) Procedure of investigations employed - field tests and laboratory investigation.

m) Results of all laboratory test summarized (i) for each sample as well as (ii) for each layer along with all the relevant charts, tables, graphs, figures, supporting calculations, conclusions and photographs of representative rock cores.

n) For all tri-axial shear tests stress vs. strain diagrams as well as Mohr's circle envelopes shall be furnished. If backpressure is applied for saturation, the magnitude of the same shall be indicated. The value of modulus of elasticity E shall be furnished for all tests along with relevant calculations.

o) For all consolidation tests, the following curves shall be furnished:
e vs. log p
evs. p and
Compression vs. log t or

Compression vs. square root of t (depending upon the shape of the plot for proper determination of co-efficient of consolidation).

The point showing the initial conditions (e, P) of the soil shall be marked on the curves.

p) The procedure adopted for calculating the compression index from the field curve and settlement of soil strata shall be clearly specified. The time required for 50% and 90% primary consolidation along with secondary settlements, if significant, shall also be calculated.

q) Description of the Soil resistivity test procedure adopted along with test results and computation of soil resistivity values at various test locations. Report shall provide

information on uniformity of the soil and horizontal and vertical variation of soil resistivity values.

9.03.00 Recommendations

Recommendations shall be given area wise duly considering the type of soil, structure and foundation in the area. The recommendations shall include but not be limited to the following:

a) Type of foundations to be adopted for various structures, duly considering the sub soil characteristics, water table, total settlements permissible for structures and equipment. Minimum depth and width of foundation shall also be recommended. The provision in relevant IS codes indicated in clause 2.04.00 shall be considered.

b) For shallow foundations, the following shall be indicated with comprehensive supporting calculations:

i) Net safe allowable bearing pressure for isolated square and continuous strip footings of different sizes at different founding depths below ground level considering both shear failure and settlement criteria, giving reasons for type of shear failure adopted in the calculation.

ii) Net safe allowable bearing pressure for mat foundations at different founding depths below ground level considering both shear failure and settlement criteria.

iii) Rate and magnitude of settlement expected of the structure.

iv) Modulus of sub grade reaction, modulus of elasticity, deformation modulus from plate load test results along with time-settlement and load-settlement curves for the various footing sizes at different founding levels indicated above. There commended values shall include the effect of size, shape and depth of foundation.

c) If piling is envisaged, the following shall be indicated with comprehensive supporting calculations:

i) Type of pile and reasons for recommending the same considering soil characteristics.

ii) Suitable founding strata for pile.

ii) Estimated length and diameter of pile for various values of pile capacities. End bearing and frictional resistance shall be indicated separately.

iv) Magnitude of negative skin friction, if any, to be considered in pile design.

d) Recommendations on foundations for special structures like transformers, sub-station structures, conveyor trestles, storage bunker structures, etc.

e) Recommendations regarding bases of roads and pavements.

9.04.00 Additional Recommendations

a) Co-efficient of permeability of various sub soil and rock strata based on in-sit permeability tests.

b) Cone resistance, frictional resistance, total resistance, relation between coneresistance and SPT (N) value and settlement analysis for different footing sizes based on CPT/SPT.

c) Soil resistivity of sub-soil based on electrical resistivity tests including electrode spacing vs. cumulative resistivity curve.

d) Recommendations regarding method and slope of deep excavations.

e) Recommendations regarding stability of slopes, during excavations, etc.

f) Potential of rockslides, profile of stepped cutting if required and methods of stabilization of slides for very steep cut.

g) If expansive soil is met with recommendation on removal or retainment of the same under the structures/roads etc. shall be given. In the latter case detailed specification of any special treatment required including specification for materials to be used, construction method, equipment to be deployed etc. shall be furnished.

h) Susceptibility of sub soil strata to liquefaction in the event of earthquake and recommendation on remedial measures, if necessary.

i) Information of special significance like dewatering schemes etc. that may have a bearing on design and construction.

j) Aggressiveness of percolating water through sub-soil/rock fissures to reinforced concrete foundation/sub- structures and also recommended protective measures, if required.

k) Recommendation for the type of cement to be used and any treatment to the underground concrete structures based on the chemical composition of soil and sub-soil water.

l) Recommendation on suitability of the overburden soil as material of construction of earthen embankments and in back filling of excavated pits/trenches.

m) Recommendation on the use of rock available as construction material.

n) Recommendation on the availability of material for use as aggregates at the site.

o) Recommendation for additional investigation beyond the scope of the present work if the LSTK Vendor considers it necessary.

p) Plates:

i) General plan showing location of site, and aerial geology.

ii) Plan showing existing features, proposed facilities, contours and locations of boring and other investigations.

iii) Geologic sections and soil profiles.

q) Appendices:

i) Logs of subsurface explorations.

ii) Field test results.

iii) Laboratory test results.

SPECIFICATION NO. C-22

TECHNICAL SPECIFICATIONFORLAND SURVEY AND ESTABLISHING REFERENCE GRIDSAND BENCH MARK PILLARS

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TECHNICAL SPECIFICATION FOR LAND SURVEY AND ESTABLISHING REFERENCE GRIDS AND BENCH MARK PILLARS

1.00.00 SCOPE

This specification is intended to cover topographical surveys and preparation of plans (maps) showing all permanent features including buildings, large trees, pucca & kutchha nullas, ditches, (with or without water), nearby roads / approaches, railway track, culverts, overhead transmission & communication lines, ridges, boundary wall, fencing, demarcation line etc. of the project area as well as sectional views of the drains, ditches, creek, culverts and similar items (with all dimensions and invert levels). Carrying of the Bench Mark (existing reference BM outside the project area) to project site by levelling, establishing bench marks and grids in the field, spot level survey at specified intervals and on change points, contouring, constructing and fixing of bench mark pillars & grid pillars in the field, clearing of jungles & debris and cutting of trees (to the minimum extent as required for the work and as per instruction of the Owner) etc. shall also form a part of the scope of work. In addition, the true north, magnetic north and the angle between the grid lines (established at site) and the true north or magnetic north shall be indicated in all drawings.

It may also be necessary to interconnect the existing grid lines (with measured angles and distances) and level references as well as a few permanent buildings and permanent roads adjacent / near the specified project site area during the proposed survey work and thus incorporate the same in the survey plans / maps.

The drawing no. 14L08-DWG-M-PL-001 (Plot Plan) give location of the project and an indication of the project area to be surveyed. These drawings are preliminary and do not cover the entire scope of work. These may be modified, survey area increased / decreased, and any new drawing may be given before award of the Work or during execution of the work (keeping sufficient time for field survey work and plotting).

Permanent features and levels of a few existing items as given in the above drawings shall not be used as reference without verification by actual survey with precision instruments by the LSTK Vendor and plotted in his maps / drawings accordingly.

The grid pillars and B.M. pillars shall be maintained and checked frequently to ensure the correctness of the value of the pillar till the completion of the job and handing them over to the Owner. It shall be responsibility of the LSTK Vendor to check the pillars jointly with Owner / Engineer at the time of final handing over of the work to the Owner.

The LSTK Bidders should visit the project site, at his own cost, before quoting rates for this tender. No extra claim (in terms of extension of time or revision in rates, etc.) shall be entertained at a later date on the ground of insufficient knowledge about the site or for lack of clarifications on this specification.

2.00.00 GENERAL

2.01.00 Work to be Provided for by the LSTK Vendor

Work to be provided by the LSTK Vendor, unless specified otherwise, shall include but not be limited to the following :

a) Furnish necessary instruments and all other tools and materials including pegs, marking plates for reference grid and bench mark pillars, construction materials for pillars, labour & skilled surveyors, supervision by competent engineers, services, necessary transport, full insurance and all other incidental items as may be necessary for on-time and successful completion of the surveying and mapping work.

b) Furnish original field & level books, notes taken on special features and field drawings with readings & relevant features plotted.

c) Preparation, thorough checking & cross checking in the field and submission of completed survey plans / maps and drawings in specified scale incorporating sectional views and details as included under Section - 1.0.

d) Construction and installation of reference grids and bench mark pillars at specified locations.

2.02.00 Work to be provided for by others

No work under this specification will be provided by any agency other than the LSTK Vendor unless specifically mentioned elsewhere in the Contract.

2.03.00 Information to be Submitted by the LSTK Bidder.

2.03.01 With Tender

The LSTK Bidder shall indicate in his tender the number of different surveying instruments (with make and year of manufacture), skilled & experienced surveyors, and competent engineers that will be deployed at the site for this work. His experience during last five years in similar survey work shall be detailed in the LSTK Bidder's offer which shall also include his present commitments.

2.30.02 After Award

The LSTK Vendor shall inform and satisfy the Engineer regarding deploymet of personnel engaged by him for quality work under an agreed time-frame for completion of the work under this Contract.

He shall also prepare, discuss with Owner / Engineer and submit an agreed work programme within seven (7) days of award of the Work and during which period he shall also mobilize his instruments, tools, personnel at the project site.

The survey documents shall be submitted to the Owner / Engineer by the LSTK Vendor progressively during execution of the Work in order to enable him to review the work and, if necessary, cross-check at site along with LSTK Vendor's surveyor and engineer and point out the deficiencies / discrepancies, if any, therein. However,

the LSTK Vendor shall be still responsible for the correctness of the entire work and shall resurvey and replot any portion of the Work which may be found to be defective later on. During such checking / cross-checking as well as supervision during execution of the entire work, the LSTK Vendor shall extend all facilities including proper instruments, tools, other materials, surveyors & labour, etc. to the Owner / Engineer.

The LSTK Vendor shall engage qualified engineers, surveyors, drafting persons, etc. for executing the work under this Contract.

3.00.00 INSTRUMENTS AND CONSTRUCTION MATERIALS

3.01.00 Electronic survey Instruments (Preferably Total Station or equivalent) shall only be used by LSTK vendor.

3.02.00 Construction Materials for Reference Grid and Bench Mark Pillars

Concrete for pillars shall be of mix 1:2:4 (one cement : two coarse sand : four 20 mm down stone aggregrates). All the component materials shall be of best & acceptable quality and conforming to the provisions of the latest version of the Indian Standards.

Steel plates for engraving B.M. value and referece grids shall be of mild steel, conforming to IS : 2062.

4.00.00 EXECUTION

4.01.00 Permanent Adjustments

All permanent adjustments of the instruments shall be made before starting the work, to the satisfaction of the Owner / Engineer.

4.02.00 Contour Intervals and Scale of Drawings

4.02.01 Contour Intervals

For contouring, spot levels shall be taken at 10 m horizontal intervals or less in both directions to establish the contours at 300 mm intervals for nearly flat terrains and at 0.5 m to 1.0 m intervals for undulating hilly terrains, as per schedule of items and direction of the Owner / Engineer.

4.02.02 Scale of Drawings

Depending upon the area to be covered, survey maps shall be prepared in the scale of 1 : 500 or 1 : 1000, as indicated in Schedule of Items, and all permanent features (as indicated under Section - 1.0), grid pillars, bench mark pillars, reference grid and bench mark pillars, contours (as specified in 4.2.1 above) etc. shall be plotted.

Sectional views of the drains, ditches, culverts, roads, etc., however, can be prepared in a scale suitable for furnishing all pertinent dimensions, levels and information, and in a separate drawing sheet.

4.03.00 Submission of Drawings and Documents

The following documents shall submitted to the Owner / Engineer :

4.03.01 Original field and level books and notes taken on special features, plus a photo-copy each of the above documents.

4.03.02 Field drawings with readings and relevant features and sectional views plotted - three (3) copies for review by Owner / Engineer. (One copy will be returned to the LSTK Vendor with comments, if any).

4.03.03 Original and one (1) copy of the above field drawings (item 4.3.2 above) after field verification of the comments and incorporating the corrected features.

4.03.04 Original tracing and four (4) prints of the final survey maps and drawings showing other details, all prepared in ink and in clear legible form. Format of and title block on the drawing / map shall be as per direction of Owner / Engineer. Soft copy of the map and drawing (editable dwg and pdf formats) shall also to be submitted to owner.

4.04.00 Time of Completion

Time shall be deemed to be the essence of the Contract. The entire survey work including submission of the final survey maps and drawings as well as other documents (ref. : 4.3 above) shall be completed within a period of ..... weeks / months in the following manner :

(a) Mobilisation and firming up time schedule and survey groups ... 1 week

(b) Completion of field survey work and submission of three (3) copies of the field drawings and a photo-copy of the field & level books and the field notes,. etc. (Items 4.3.1 & 4.3.2 above). ... 2 weeks

(c) Submission of the final survey maps & drawings and other documents (item 4.3.1, 4.3.3 &4.3.4 above). ... 3 weeks

Construction and installation of grid and bench marks pillars, however, are to be subsequently completed within 2 weeks of the clearance from Owner / Engineer.

If the Owner / Engineer feels that the progress of the work is not satisfactory, he shall notify the LSTK Vendor to take necessary measures to complete the Work on time. If the LSTK Vendor fails to comply with the Owner's directive or fails to complete the Work on time, Owner will be at liberty to get the Work done by any other agency and forfeit the amount related to unfinished works and the Earnest Money / Security Deposit of the LSTK Vendor.

4.05.00 Security Rules and Statutory Regulations

The LSTK Vendor shall strictly follow at site all security rules and regulations enforced by Owner from time to time regarding movement of materials, equipment / instrument, personnel to and from site, issue of identity cards, badges, control of entry and all similar matters.

The LSTK Vendor, his employees and agents shall not disclose any information or drawings prepared by him or furnished to him by the Owner / Engineer.

He shall also follow all safety rules and regulations and shall take sufficient measures to adhere to the same.

The LSTK Vendor shall conform in all respects with the provisions of any statute, ordinance law, rules, regulations, by-laws of Central, State, Local or other duly constituted Authority. The LSTK Vendor shall assist NALCO in obtainining statutory clearances.

In respect of labour, the LSTK Vendor shall comply with all rules framed by the Government for the protection of health, wages, welfare and safety of the workers. The LSTK Vendor shall be responsible for effective insurance under the Indian Workman's Compensation Act., Third Party Liability Insurance, etc. in accordance with the Indian Law and Regulation at his own cost.

In fine, the LSTK Vendor shall keep the Owner and Engineer indemnified against all penalties and liabilities of every kind.

5.00.0 TECHNICAL SPECIFICATIONS

5.01.00 Establishing of Bench Marks

At least two permanent bench marks at each site at approved locations shall be established from the existing bench marks. While carrying the bench mark, levels shall be established on permanent objects as directed by the Engineer. Levelling survey shall be done in the forward and reverse direction and the closing error should not be more than ± 05 mm.

5.02.00 Establishing of Grid Pillars

Permanent grid pillars shall be established in either direction at every 100 m intervals or as directed. *One reference pillar and one reference grid direction shall be provided by the Owner. For carrying reference pillars, additional station points shall be established for traversing or triangulation as directed by the Engineer. The closing error for any closed traverse shall not exceed the specified limits as per clause 5.6. The maximum tolerance for any grid location shall be ± 1 mm. Generally for all angular measurements, transit of theodolite shall be done. Measurement shall be verified by cross-checking the diagonal angle as directed by the Engineer. For observing bearing from magnetic north, care should be taken that no magnetic substance to influence the bearing reading is there. The magnetic north should also be periodically verified.

Reference shall be taken from the existing permanent objects identifying from the Cadestal map for establishing the new grid line and shall be related to true north line where grids are not existing.

5.03.00 Reference Grid Pillars and Bench Marks

All reference grid pillars and permanent bench marks shall be 900 mm x 200 mm x 200 mm cement-concrete pillars with 150 mm projecting above ground. 150 mm square x 12 mm thick steel plates (with two L-shaped 20 cm long M.S. lugs welded to the plate) or 6 mm thick aluminium plates with bolts shall be embedded or bolted on top of the pillars. Grid points & lines shall be accurately punched on the plates as also the numerical values of grid lines and levels. Grid lines and levels as required shall be painted.

5.04.00 Topographical Surveying and Mapping

Positions, both in plan and elevation, of all natural and artificial features of the area in question (including permanent objects) are to be established and subsequently delineating them on survey maps by means of conventional symbols (preferably those of Survey of India maps). Necessary levelling work of the project area shall be combined with methods of establishing horizontal location so that location and sketching of contours for the area can be done at specified intervals and in specified scales on maps. Rock outcrops, springs / falls (if any) and other unusual ground formations / conditions shall be noted and locations plotted on the maps.

The field work shall be done in the following steps :-

(a) Establishing horizontal and vertical controls and locating reference grids and bench marks in the area.

(b) Levelling and plotting contours.

(c) Surveying and locating the natural, artificial and permanent features in details as described earlier.

(d) Taking of longitudinal and cross-sections of the corridors for pipe line and road / rail and drains, ditches, waterbodies, culverts, etc.

All survey work shall be related with true north and true north shall be established at site beforehand.

5.05.00 Traversing and Ground Controls

Triangulation or Traversing or a combination of the two methods shall be adopted for the purpose of establishing horizontal controls, in order to determine the exact relationships between various existing points / features on ground, so that surveys required under the present scope of work and in future may be correlated and tied together.

Before commencement of work, the plan showing base lines and the grid lines and their spacings shall be got approved by the Owner / Engineer at site. First, a traverse covering the entire survey area shall be established with reference to a permanent object / reference grid pillar already existing at Site (as instructed by the Owner / Engineer).

The closing error in traverse (primary / secondary) shall not exceed one in three thousand in terms of length or, L √N second (total) in angular measurement, whichever is less. (Where, L = the least count of the instrument and N = the number of stations).

5.06.00 Contouring

Spot level surveying at specified intervals shall be adopted for contouring the area, so that accurate contouring can be done. At places of sharp curvature or abrupt changes in direction and elevation, points selected shall be close to represent the actual ground configuration.

Levelling operation shall always start on a control station / nearby bench mark and end on the same.

5.07.00 Route Survey

Route Survey shall be conducted along a narrow strip / belt of the terrain selected after field reconnaissance or as directed by Owner / Engineer at Site. Topographical survey for existing storm drainage lines as well as for routing pipe lines, transportation and communication lines, etc. shall be conducted. Longitudinal profiles as well as cross-sections shall be taken at 50 m intervals or less in nearly flat / undulating terrains and at 20 m intervals in hilly terrains, as per direction of the owner / Engineer. All cross-sections shall be with reference to centre line of corridor showing levels at every 2 - 5 metre intervals and all breaks in the profile. The width of strip / corridor shall be as specified in the drawing or as directed by Owner / Engineer.

6.00.00 RATES

The rates for the items of land survey and establishing reference grids and bench mark pillars shall include the cost of materials consumed in this work or incidental to it, the cost of instruments, tools and plants, labour, supervision, transport, installation, taxes, insurance, royalties and revenue expenses, security and safety measures, approaches, power, fuel, services, preliminary and enabling works, camps, stores, water, etc. and overheads & profits complete. In case no specific item is provided in the schedule to cover any particular item of work, it is implied that the LSTK Vendor will include the cost of executing such work in the rates quoted for connected items in the schedule.

7.00.00 METHOD OF MEASUREMENT

Unless specified otherwise in the schedule of items, the measurement of items shall be done as follows :

7.01.00 Carrying and Establishment of Bench Mark (B.M.)

Carrying of the bench mark from nearby available permanent B.M. to site (at boundary point) shall be measured in running kilometre along the route of survey passing over all kinds of ground conditions which includes levelling, establishing bench marks, complete as per specification. Supply and installation of B.M.pillars shall be measured separately.

7.02.00 Topographic Survey

Areas of topographic survey shall be measured in Hectare which includes surveying and plotting of topographic features, physical features of all objects, areas of shallow water bodies, pucca & kutcha nallas, ditches, nearby roads / approaches, railway tracks, culverts, overhead transmission & communication lines and supports, ridges, etc., levelling and establishing grid lines complete as per specification. Supply and installation of grid pillars shall be measured separately.

7.03.00 Route Survey

Area of route survey shall be measured in Hectare for the specified corridor width of land which includes surveying and plotting of topographic features, physical features of all objects, pucca & kutcha nallas, ditches (with or without water), roads / approaches, railway tracks, overhead transmission & communication lines, and supports, ridges, etc., levelling and establishing grid lines complete as per specification. Supply and installation of grid pillars shall be measured seperately.

7.04.00 Bench Mark Pillars and Grid Pillars

Pillars shall be measured in number as per specification and schedule of items.

ANNEXURE-1

LIST OF ACCEPTABLE BRANDS AND MANUFACTURERS

Sl. No.	I t e m	Acceptable Brand & Manufacturer
1.	Decorative textured stone finish.	Vineratex of Gillanders/Heritage/ Spectrum.
2.	Vinyl Asbestos Tile.	Marblex of Bhor/Wonderfloor/ Rikvin.
3.	Glazed Ceramic Tile.	Kajaria/Regency/Johnson/NITCO/SOMANA/RAK
4.	Material for panel door.	Greenply/Kitply/Century Ply/National/ Novopan/Bhutan Board
5.	Material for flush door.	Greenply/Kitply/Century Ply/National/ Novopan/Bhutan Board
6.	Door hardware.	Godrej/Everite.
7.	Aluminium doors and partition doors, windows, louvers.	Alum-lite/INDAL/HINDALCO/BECO
8.	Glass	Indo Ashahi/Hindustan Safety/Modi/Atul / Saint Gobain /AIS
9.	a) T.W. Particle Board	Greenply/Kitply/Century Ply/National/ Novopan/Bhutan Board.
	b) Ply wood	Greenply/Kitply/Century Ply/National/ Novopan/Bhutan Board
10.	Epoxy Paint	ICI/Berger Paints/Asian Paints/ Jenson and Nicholson/Nerolac/Sika/Fosroc
11.	Synthetic Enamel Paint	ICI/Berger Paints/Asian Paints/ Jenson and Nicholson/Nerolac.
12.	Wood Primer	ICI/Berger Paints/Asian Paints/ Jenson and Nicholson/Nerolac.
13.	External Cement Paint/ Weather Coat	Super Snowcem (of Killick Nixon), Durocem (Berger), Robacem (J&N), Nerolac/ Asian/Berger/ICI
14.	Internal Surfaces Acrylic Emulsion Paint	Berger / ICI / Jenson & Nicholson / Asian Paints / Nerolac

Sl. No.	I t e m	Acceptable Brand & Manufacturer
15.	Bituminous Paint	Berger / ICI / Jenson & Nicholson / Asian Paints / Nerolac
16.	Expanded Polysterene	Thermocole (dense variety)
17.	Bituminous felt	Shalimar/Nerolac
18.	G.I. Pipes	TATA / ITC / /JINDAL
19.	C.P. Brass & Fixtures	Tiger / Essco / Jaquar
20.	White glazed stone ware fittings	Parryware / Hindustan Sanitary Ware / Neycer / GMB
21.	Mineral Hardner	'SIKA-CHAPDUR' of SikaQualcrete or equivalent of Fosroc,BASF,Pidilite
22.	Gunmetal Valves	Leader / Annapurna
23.	Stone ware pipes	Hind/Orissa
24.	Chloro rubber paint	Berger/J&N/Asian Paints
25.	Bath tub Attachments / Fittings (Wall Mixer, Telephone Shower)	'Jaquar' or equivalent.
26.	High neck Spout for Kitchen Sink.	'Jaquar' or equivalent.
27.	Waterproofing Admixer	'PLASTOCRETE-N' of Sika-Qualcrete or equivalent.
28.	Non-shrink & free flow Cementitious grout	'ANCKOR NSG' of Sika-Qualcrete or equivalent of Fosroc,BASF,Pidilite.
29.	Expansion Joint Treatment	SIKA/FOSROC

NOTE:

For approval of any alternative brand or manufacturer the manufacturer's catalogues are to be submitted along with the tender.

SECTION – III/5 : MANDATORY SPARES

MANDATORY SPARES - MECHANICAL

Sl. No.	Description	Qty
1.00	**Oil Free Screw Compressor for Wagon Unloading**	
1.01	Air Filter	2 Nos
1.02	Oil Filter	2 Nos
1.03	Bearings for Compressor	2 sets (1 set consisting of both DE and NDE bearings)
1.04	Bearings for Motor	2 sets (1 set consisting of both DE and NDE bearings)
1.05	Coupling (Compressor & Motor)	2 sets
1.06	Rotors with shaft	2 sets (1 set consisting of 2 nos rotor-shaft assembly required for one compressor)
1.07	Gears	2 sets (1 set consisting of all types of gears required for one compressor)
1.08	Cooling fan for compressor with complete set of bearings (if applicable)	1 set
1.09	Shaft for Motor	2 sets
1.10	Cooling fan for Motor with complete set of bearings (if applicable)	1 set
1.11	Valves and Instruments within the battery limit of Compressor Vendor	1 no of each type, size & range
2.00	**Oil Free Screw Compressor for Supply of Dedusting Air**	
2.01	Air Filter	2 Nos
2.02	Oil Filter	2 Nos
2.03	Bearings for Compressor	2 sets (1 set consisting of both DE and NDE bearings)
2.04	Bearings for Motor	2 sets (1 set consisting of both DE and NDE bearings)
2.05	Coupling (Compressor & Motor)	2 sets
2.06	Rotors with shaft	2 sets (1 set consisting of 2 nos rotor-shaft assembly required for one compressor)

Sl. No.	Description	Qty
2.07	Gears	2 sets (1 set consisting of all types of gears required for one compressor)
2.08	Cooling fan for compressor with complete set of bearings (if applicable)	1 set
2.09	Shaft for Motor	2 sets
2.10	Cooling fan for Motor with complete set of bearings (if applicable)	1 set
2.11	Valves and Instruments within the battery limit of Compressor Vendor	1 no of each type, size & range
3.00	**Blowers for Air Slides**	
3.01	Air Filter	2 nos for each model of blower
3.02	Bearings for blower	2 sets for each model of blower (1 set consisting of both DE and NDE bearings)
3.03	Oil Seals	2 nos of each type and size
3.04	Rotors with shaft	1 set (1 set consisting of 2 nos rotor-shaft assembly required for one blower) for each model of Blower
3.05	V-belts & pulleys (Drive & Driven)	1 set for each rating of blower-motor assembly
3.06	Gears	1 set for each model of blower (1 set consisting of all types of gears required for one blower)
4.00	**Centrifugal Fans for Dedusting Units**	
4.01	Impeller with shaft	1 set for each model of fan
4.02	Bearings for fan	2 sets for each model of fan (1 set consisting of both DE and NDE bearings)
4.03	Oil Seals	2 nos of each type and size
4.04	V-belts & pulleys (Drive & Driven)	1 set for each rating of fan-motor assembly
5.00	**Air Slides**	
5.01	Fabric for 500 TPH Air Slide	Minimum 20% of total installed quantity
5.02	Fabric for 1000 TPH Air Slide	Minimum 20% of total installed quantity

Sl. No.	Description	Qty
6.00	**De-dusting System (Bag Filter)**	
6.01	Filter Bag assembly with fixing hardware	Minimum 20% of total installed quantity for each size of bag
6.02	Pulse Valve	2 nos for each model of Bag Filter
6.03	Sequential Controller	1 no for each model of Bag Filter
7.00	**Pipe Conveyor**	
7.01	Rollers	10% of Installed quantity
7.02	Pipe forming idlers	20% of Installed quantity
7.03	Impact idler Rollers	10% of Installed quantity
7.04	Transition/Adjustable idlers	10% of Installed quantity
7.05	Pipe Conveyor Belt	10% of installed quantity for each type, size and rating
7.06	Motor	1 no of each rating
7.07	Gearbox	1 no of each model/rating
7.08	Coupling	2 nos of each type, size and rating
7.09	Belt cleaner scrapper with all accessories	10% of Installed quantity for each type and size
7.10	Load cell for belt scale	1 set of each type
7.11	Electronic Controller for belt scale	1 no of each type
8.00	**Rope Winch type Wagon hauling System (Reversible)**	
8.01	Drive Motor	1 no
8.02	Gear box	1 no
8.03	Fluid coupling	1 no
8.04	Jaw clutch	1 no
8.05	Rope tensioning Motor	1 no
8.06	Gearbox of Rope tensioning unit	1 no
9.00	**Sump Pump**	
9.01	Drive Motor	1 no
9.02	Impeller	1 no
9.03	Shaft	1 no

MANDATORY SPARES - ELECTRICAL

A. ELECTRIC MOTOR

Sl. No.	Description	Qty
1.	**HT Motor**	
a.	Driving end bearing	1no. (or 1set as applicable) for each type and rating of motor.
b.	Non-driving end bearing	1no. (or 1set as applicable) for each type and rating of motor
c.	Cooling fan internal and external	1 set for each type and rating of motor
d.	Bearing temperature gauge driving and non-driving end	1 set for each type and rating of motor
e.	Phase segregated terminal box	1 set for each type and rating of motor
f.	Neutral end terminal bushing with fasteners	1 set for each type and rating of motor
g.	Complete set of coupling	1set for each application
2.	**LT Motor**	
a.	End shield cover driving and non-driving end (above 30KW)	1 set for each type and rating of motor
b.	Driving end and non-driving end bearing	1 set for each type and rating of motor
c.	Cooling fan	1 set for each type and rating of motor
d.	Motor terminal block	1 set for each type and rating of motor
e.	Complete set of coupling	1set for each application

Note: At least one motor of each rating and frame size above 75kW shall be provided as spare.

B. HV SWITCHGEAR

Sl. No.	Description	Qty
1.	Bus bar support insulator of each type	10% of the total number.
2.	Circuit breaker closing coil	10% of the total number.
3.	Circuit breaker trip coil	10% of the total number.
4.	Breaker fixed contact assembly	1 set each for incomer and outgoing feeder breakers.
5.	Breaker tulip contact	1 set each for incomer and outgoing feeder breakers.
6.	Vacuum Bottle	10% of total number of breakers
7.	CTs of different ratings	2 nos.
8.	Circuit breaker operating mechanism complete with spring charging motor and closing and tripping springs etc. (complete replacement for one panel)	20% of total number of breakers
9.	Isolating switch, Selector switch, breaker control switch, Contactor/ Relays, Push button and Timer	10% of total number.
10.	Power and Control fuses of different ratings	10% of total number.
11.	Clustered type LED indicating lamp	10% of total number.
12	Numerical Relay	1 No. of each model / type
13	Energy Meter	1 No. of each type & rating

C. 415V MCC, 415V AC & 110V DCDB, 415V NON-SEGREGATED PHASE BUSDUCT, LOCAL CONTROL PANEL AND LOCAL PUSH BUTTON STATION

Sl. No.	Description	Qty
PMCC, ACDB. LIS, LPBS		
1.0	MCCB /MPCB/MCB	1 no.each type &rating

Sl. No.	Description	Qty
2.0	Drawout Module	1 no.each type &rating
3.0	Energy Meter : Cl. 0.5 & Cl. 1.0	1 no.each type &rating
4.0	Trip coils with resistor	2 nos
5.0	Closing coils with resistor	2 nos.
6.0	Indicating Lamp	3 nos. of each color
7.0	Push Button	2 nos. each type
8.0	Auxiliary Switch assembly	3 nos.
9.0	Operating mechanism with motor	1 no
10.0	Lyra Power contact (male& female)	5 sets of each type
11.0	Control contact (male& female)	5 sets of each type
12.0	Relays, limit switches	2 nos
13.0	Arc chute	1 no
14.0	Multifunction Meter	1 no. of each type
15.0	Protection & Metering CT	3 nos. of each type
16.0	Bus support insulator	5 nos. of each type
NON-SEGREGATED PHASE BUSDUCT		
1.0	Bus support insulator	10% of total no.
2.0	Flexible equipment terminal connector (1Φ) complete with hardware for	
2.1	Switchgear end	1 no. of each rating
2.2	Transformer end	1 no. of each rating
3.0	Expansion Bellows	2 nos.

D. LV TRANSFORMER

Bidder shall quote for the mandatory spares indicated below. In case, the bidder does not consider any item, the Bidder shall indicate it.

Sl. No.	Description	Qty
1.	Dial type thermometer	2 Nos.
2.	Oil level gauge	2 Nos.
3.	Valves of each type installed (bidders to indicate size and quantity forming one set)	1 Set
4.	Winding temperature indicator with all accessories	3 Nos.
5.	Dial type oil temperature	3 Nos.
6.	Pressure relief valve	3 Nos.
7.	H V Bushings	1 set
8.	L V Bushings	1 set
9.	Neutral bushing (LV)	1 set
10.	Silica gel breather	3 Nos.
11	Buchholz relay	1 No. of each model

E. BATTERY & BATTERY CHARGER

Sl. No.	Description	Quantity
1.	3 phase incoming switches	2 Nos.
2.	A/C contactor float chargers	2 Nos.
3.	A/C contactor float/boost chargers	2 Nos.
4.	DC contactors	2 Nos.
5.	AC contactor coils	2 Nos.
6.	DC contactor coils	2 Nos.
7.	Push buttons	2 Nos.
8.	Indication LEDs	3Nos.

Sl. No.	Description	Quantity
9.	Output ammeters	2 Nos.
10.	Load ammeters	2 Nos.
11.	Battery ammeters	2 Nos.
12.	Input voltmeters	2 Nos.
13.	Output and load voltmeters	2 Nos.
14.	Input ammeters (FC)	1 each type
15.	Input ammeters (FCBC)	1 each type
16.	Battery earth leakage ammeters	2 Nos.
17.	Input fuses (FC)	2 nos. for each changer
18.	Input fuses (FCBC)	2 Nos. for each changer
19.	Rectifier fuses (semiconductor)	2 Nos. for each changer
20.	Thermal O/L relays (FC)	1 each/rating
21.	Thermal O/L relays (FCBC)	1each/rating
22.	Charger ON switches	2 Nos.
23.	Mode selector switches	2 Nos.
24.	Voltmeter selector switches	2 Nos.
25.	Ammeter selector switches	2 Nos.
26.	Output MCCB	2 each/rating
27.	Thyristors (FC)	1 set each type
28.	Thyristors (FCBC)	1set each type
29.	Free wheeling diodes (FC)	1set each type
30.	Free wheeling diodes (FCBC)	1 set each type

Sl. No.	Description	Quantity
31	Electronic cards	1 Set
Battery Cells Spare :		
31.	Spare cells	3 cells/each rating
32.	Intercell connectors	5 Nos./each rating
33.	Inter-row connector	2 sets/rating
34.	Insulators	3 Nos.
35.	Hexagonal studs + nuts	5 Nos.

F. VVVF DRIVES

Bidder shall quote for the mandatory spares indicated below. In case, the bidder does not consider any item, the Bidder shall indicate it.

Sl. No.	Description	Quantity
1.	A complete VFD unit	1 No.
2.	A dedicated desktop & laptop with preinstalled VVFD programming and communication software with printer also in CD media with license key	1 set
3.	Communication cable & other Hardware	1 set

MANDATORY SPARES - INSTRUMENTATION

Sl. No.	Description	Quantity
1.00	**PLC**	
1.01	Central Processing Unit (CPU) Redundant Pair	One (1)
1.02	I/O , RI/O cards	Ten (10) % of each type .or each type minimum two (2) nos. whichever higher
1.03	Power supply modules	Five (5) % each type. or minimum one (1)no. each type whichever higher
1.04	Communication module, Interface module ,Output Relay card	Five (5) % of each type , or minimum one (1) no each type whichever higher
1.05	Operator /Engineer station monitor with full graphic capabilities and all associated electronics	One (1) set
1.06	Operator/Engineer terminal keyboard/Mouse with all associated electronics	Two (2) set
1.7	I/O , RI/O cards for existing PLC situated at GTC-8 & Control Room -2	Ten (10) % of each type .or each type minimum two (2) nos. whichever higher (Applicable for new supply quantity only)
1.08	Fuses	Fifty (50) % each type
1.09	MCB	One (1) each type
1.10	Removable disc drive, Hard disc & CD/DVD – ROM Drive.(Including Eng. Server)	One (1) set each type
1.11	LED modules in Electronic Panel	Twenty five (25) % each type
1.12	Interposing Relays	Five (5) % of each type or min. one (1) whichever is higher
1.13.	Data highway cable and associated connector	Cable - Connector - one lot
1.14.	Printer Ribbons /inking mechanism for colour Printer	One (1) no.
1.15.	Panel Filter Element	Twenty (20) % of total
1.16	Ethernet Switch	One (1) each type
1.17	Optical Converter	One(1) set Each Type
1.18	Color Toner Cartridge for laser Printer	One(1) Set
2.00	**FIELD INSTRUMENTS**	
2.01	Pressure gauges and temperature gauges	One (1) no. each
2.0 2	Switches such as for Pressure , Level, Temperature & Flow	One (1) no. each

Sl. No.	Description	Quantity
2.03	Temperature Elements -. RTD	Two (2) nos
2.04	Electronic transmitters such as level, pressure, Flow etc.	One (1) no. each type and range
2.05	Solenoids	Five (5) nos
2.06	Pull Chord switch	Ten (10) nos
2.07	Belt sway switch	Ten (`10) nos.
2.08	Zero speed switch	One (1) no.
2.09	Vibration measurement Pick-up/Sensor	Two (2) nos
2.10	Vibration monitor electronic card	One (1) no. each type
2.11	O-rings, Gaskets, Packing, Bushing, etc.	Two (2) sets for pneumatic actuator
2.12	Open/close Limit switch for Flap gates	Two (2) nos
2.13	LCP - Relays	Five (5) % each type or min. one each type
2.14	LCP –Fuses, MCB	Fifty (50) % each type
3.00	**CCTV System**	
3.01	Fixed Cameras	One (1) each type
3.02	PTZ (Pan, Tilt, Zoom) Camera	One (1) each type
3.03	Power supply modules	Five (5) % each type. or minimum one (1)no. each type whichever higher
3.04	Network Switch	Five (5) % each type. or minimum one (1)no. each type whichever higher

SECTION – IV : PERFORMANCE GUARANTEE AND LIQUIDATED DAMAGES

SECTION – IV

PERFORMANCE GUARANTEE AND LIQUIDATED DAMAGES

1.00.00 GUARANTEE AND TEST CONDITIONS

1.01.00 Statement of Guarantee

The LSTK Vendor shall guarantee that the plant supplied by him or his sub-contractors under this contract will operate properly and efficiently and that the plant will attain all output and energy figures stipulated in the contract. The plant supplied under this contract shall be subjected to testing to ensure that the Performance Guarantees are met.

The LSTK Vendor shall also guarantee that all materials and manufacturing methods used in the construction of machinery and plant supplied under the subject package shall be of best grade and this guarantee shall make it obligatory for the LSTK Vendor to make good or replace defective parts, as soon as possible, free of charge. The acceptance of the plant shall be subject to satisfying all relevant guarantee requirements/stipulations by the LSTK Vendor.

1.02.00 Performance Tests

Immediately after satisfactory "Completion of Commissioning", the plant/section shall be subjected to the "Test on Completion" i.e. Performance Guarantee Tests.

The tests shall be performed continuously for 72 hours within 15 days after commissioning of the plant or any individual system. All relevant procedural details of the tests will be submitted by the LSTK Vendor and shall be finalized after discussion at the time of award of contract. However, the plant/s, during the tests, shall be operated normally, as per LSTK Vendor's written operating instructions by the Owner's operating staff under direct supervision and completion responsibility of the LSTK Vendor.

Before the start of the tests, details of the test, section/system to be tested, their dates for execution, organization of labor and other requisite materials, course of work and the right and obligation of the LSTK Vendor and the Owner during the test period shall be stated and furnished by theLSTK Vendor in a program to be agreed upon and approved by the Owner.

For proof of the guaranteed figures, the measuring and control devices installed in the plant shall be used. Before the tests, the measuring instruments shall be checked for accuracy, calibrated and sealed. After completion of the test, the said instruments shall again be checked for accuracy. Any other portable measuring and control devices, if required to prove the guarantee figures, shall be arranged by the LSTK Vendorat no extra cost to the Owner and subject to acceptance of the same by the Engineer prior to the test.

During the Performance Tests, the entire plant with all the equipment therein shall be closely monitored by the Engineer and the observations shall be noted for subsequent appropriate action by the LSTK Vendor.

1.03.00 Non-fulfillment of Performance Guarantee and Repeat Test

In case the LSTK Vendor fails to prove the performance guarantees set out in the contract, he will be entitled to an additional period of Sixty (60) days, counted from the date of completion of the unsuccessful Performance Test, during which he shall, at his expense

andrisk and with the approval of the Owner, carry out with due expediency the necessary rectification, replacements and/or modifications and shall execute an additional Performance Guarantee Test. During this period, the LSTK Vendor shall retain his supervisory and other personnel at the site at his own cost.

In case the LSTK Vendor fails within the said additional sixty (60) days period to carry out all the necessary rectifications/modifications etc. and/or fails to prove during the repeat Performance Guarantee Test that the plant is capable of attaining the Performance Guarantees, then the Owner will be entitled to act according to the relevant stipulations provided in the General Conditions of Contract of this Specification.

In order to mitigate such damages, theLSTK Vendor shall make best endeavor to carry out the required rectifications, replacements and/or modifications etc. and repeat the Performance Test in the shortest possible time. In default, the Owner, will have the right, within his own capabilities, make the aforesaid rectifications/modifications etc. and to carry out the repeat Performance Tests in lieu of the LSTK Vendor, or to entrust a third party to execute the same at the LSTK Vendor's expenses and risk.

1.04.00 Performance Guarantees of Unloading &Conveying System of Alumina

The various guarantee figures, those shall have to be met by the LSTK Vendor in the Performance Guarantee Tests, have been stipulated in the following clauses.

The total duration of interruptions/stoppages, for reasons answerable by or within the control of the LSTK Vendor shall be less than 10% of the respective total test period specified for that particular plant/system.

Pipe conveyor

Equipment Number	:	PC-100/200/300
Capacity	:	1000 TPH
Accuracy	:	± 5%
Type	:	Horizontal with slope

Air slides

Equipment Number	:	AS-100/200
Average Capacity	:	480 TPH
Design Capacity	:	500 TPH
Equipment Number	:	AS-300
Average Capacity	:	960 TPH
Design Capacity	:	1000 TPH
Equipment Number	:	AS-400/401/500/501
Design Capacity	:	1000 TPH

Dust Emission

Equipment Number	:	DC-100/200/300/400
Type	:	Bag Filter type Bag Filter type
Location:		On top of On top of each Transfer &Transfer Hopper Points.
Function:		Filter the air loaded with alumina dust before venting it to the atmosphere.
Dust Load	:	Approx. 25gms/Nm^3

1.05.04 Environmental Control System

In addition to the various stipulations in the Process Systems, the following guarantee requirements shall also be required to be met pertaining to theEnvironmental Control Systems :

Mention the Environmental norms provided to you for Particulate matter (PM) levels acceptable.

A. Dust Extraction System

i) Stack emission shall be limited to 10 mg/Nm^3

ii) Dust collection efficiency of Bag filter shall not be less than 95% down to particle size of 5 micron.

iii) Extraction air quantity at each specified dust generating point shall not be less than that recommended by ACGIH.

B. Ventilation System

Desired air change rate and specified temperature rise in different ventilated spaces shall be maintained.

1.05.05 Specific Power Consumption (S.P.C.)

The following guarantee figures on specific power consumption for individual systems shall require to be provided. This shall not include auxiliary power consumption of the system, namely DE / DS system etc.

i) Unloading of Alumina System : Kwh/Dry T.

ii) Conveying System to silo : Kwh/Dry

Themeasurement shall be carried outduring Performance Testing of respective systems.

The LSTK Vendor at no extra cost to the Owner shall arrange any additional equipment required for determining the above guarantee figures.

The above figures shall take into consideration all the equipment under the respective systems as definedin Section VIII but excludingplant illumination.

10.05.06 Area–wise guarantee figures on specific power consumption shall have to be provided by the LSTK Bidder in the following format:-

AreaSpecific Power Consumption / DryTon of ore (KwH / Dry Ton of ore)
1
2
3

The measuring tolerances shall be as follows :-

Throughput	Nil
ParticleSize	Nil
Specific Energy Consumption	±3%

1.05.07 Noise

The LSTK Bidder shall also guarantee the following maximum noise level limits at the nearest operator's points vis-a vis theallowable maximum period of exposure of an operator.

Maximum [dB(A)]	Maximum Sound Exposure (hours)	Level Limit
1680		
8	85	
4	90	
295		
1100		
0.5	105	
0.25	110	
0.125	115	

The above stipulations meet the requirement of Department of Environment, Govt. of India under occupational health and safety.

SECTION – V : LIST OF PREFERRED MAKE OF EQUIPMENT

SECTION-V
LIST OF PREFERRED MAKE OF EQUIPMENT

CIVIL & STRUCTURAL

Item Name	List Of Make/Brand/Suppliers
Aluminium doors/Partition doors/Windows/ Louvers	Hindalco, Jindal
Aluminium Sheet	Balco, Hindalco, Jindal
Bathtub attachments/fittings(Wall mixer. Telephone shower)	Jaquar, Hindware, Parryware, Kohler
Bituminous felt (App)	Fosroc,STP, Sika,IWL,Pidilite
Bituminous paint	AsianPaints, Berger Paints, ICI, Jenson and Nicholson,Dulux
Cement	ACC Limited, Jaypee, OCL/Dalmia (Konark), L&T, Ultratech, Lafarge
Chloro rubber paint	Asian Paints ,Berger, Jenson and Nicholson,Dulux,ICI
CP Brass and fixtures	Essco, Jaquar, Hindware, Parryware, Kohler
Decorative Textured Stone finish	Heritage, Spectrum, Vineratex of Gillanders
Door hardware	Everite, Godrej,Ramson,Hyper,Link
Epoxy paint	Asian Paints, Berger Paints, Fosroc, ICI, Jenson and Nicholson, Nerolac,Sika,Dulux,BASF, Fosroc,STP, Pidilite
Expansion joint treatment	Fosroc, Sika, STP, Pidilite,BASF
External cement paint / Weather coat	Asian Paints, Berger Paints, Durocem(Berger),ICI, Nerolac,Robacem(J&N),Super Snowcem of Killick Nixon
GI pipes	ITC, Jindal, TATA
Glass	AIS, Modi, Saint Goben
Glazed Ceramic/Vitrified tiles	Johnson, Kajaria, Rak, Somany, Orient Bell,
Gunmetal valves	Annapurna, Leader
High neck spout for kitchen sink	Jaquar, Hindware, Parryware, Kohler
Internal surfaces/Acrylic emulsion paints	Asian Paints, Berger Paints, ICI, Jenson and Nicholson, Nerolac,Dulux
Material for flush door	Bhutan Board, Century Ply, Greenply, Kitply, National, Novopan
Material for panel door	Bhutan Board, Century Ply, Greenply, Kitply, National, Novopan

Item Name	List Of Make/Brand/Suppliers
Mineral hardener	Sika,Dr.Fixit, Fosroc , BASF, Pidilite, STP
MS Angle/Channel/Beams	ESSAR, Jindal Steel, RINL, SAIL, TATA Steel
Non-shrink & free flow cementitious grout	Sika,Dr.Fixit, Fosroc , BASF, Pidilite, STP
Plywood	Bhutan Board, Century Ply, Greenply, Kitply, National, Novopan
PVC/CPVC/UPVC pipes & fittings	Ajay, Ashirbad, Astral, Supreme,Finolex,Oriplast
Steel Rod	Jindal Steel, RINL, SAIL, TATA Steel
Stoneware pipes	Hind
Synthetic enamel paint	Asian Paints, Berger Paints, ICI, Jenson and Nicholson, Nerolac, Dulux
TW particle board	Bhutan Board, Century Ply, Greenply, Kitply, National, Novopan
Vinyl asbestos tiles	Marblex of Bhor, Rikvin,Wonder floor, Square Foot
Water proofing admixer	Sika,Dr.Fixit, Fosroc , BASF, Pidilite, STP
White glazed stone ware fittings	GMB, Hindustan Sanitaryware, Neycer, Parryware, Hindware
Wood primer	Asian Paints, Berger Paints, ICI, Jenson and Nicholson, Nerolac, Dulux

ELECTRICAL

Item Name	List Of Make/Brand/Suppliers
Air Circuit Breaker	ABB, L&T, Schneider, Siemens
Aux Relays	ABB, BCH, Eaton, Rockwell, Schneider, Siemens
Battery Bank	Amar Raja, Amaron, Cummins, Exide, Rocket, Tata Green
Battery chargers	Amar Raja, Chhabi, HBL Power systems, Hitachi - Hi Rel Electronics, Keltron Controls, Liveline Controls
Belt Sway / Pull Cord Switch	Jayshree
Bimetallic relay	ABB, BCH, Eaton, L&T, Rockwell, Schneider, Siemens
Braking Resistor - DBR	ABB, Danfoss, Kakku, Schneider, Siemens, Speed-O-Control, Rockwell
Breaker Control Switches	Kaycee, Reliable Electronic Components, Swirton Devices
Bridge Rectifiers	Ruttonshah, Railton Electronics

Cable Termination & Jointing Kit	Compaq, Mahindra Engg & Chemical Products, Multi Pressings, Raychem, REPL Engg,RPG, Yamuna Gasses & Chemicals
Cable Tray	Indiana, Legrand
Changeover Switch	Cefem (France), Socomec(France)
Connectors	Harting, Lapp, Phoenix, Weidmuller
Contactors	ABB, BCH, Eaton, L&T, Rockwell, Schneider, Siemens
Control panels	BCH, EL Steel, Rittal
Control cables	Finolex Cables Ltd., Gloster Cables, Helukabel, KEI, Lapp, Nicco Corporation, Polycab, RPG, Silec, Torrent, Universal
Control cable for Drag chain/ Festoon Trolley duty application	Helukabel, Igus, KabelSchlepp, Lapp
Control Transformer	ABB, Schneider, Siemens, Automatic Electric Ltd, Jyoti, Newtek Electricals, Precise
Control relays	ABB, BCH, Eaton, L&T, Rockwell, Schneider, Siemens
Control/Selector Switches	ABB, Havells India, Kaycee, L&T, Reliable Electronic Components, Rockwell, Schneider, Siemens
CTs/PTs	ABB, Auomatic Electric Ltd, Jyoti, Kappa, L&T, Newtek Electricals, Prayag, Precise, Schneider, Siemens, Voltas
DC Distribution Board	ABB, Amar Raja, Keltron Controls, L&T, Schneider, Siemens
DCEM brake	BCH, Electromag, Emco Precima, Industries Syndicate, Kakku, Pethe, Speed-O- Controls, Storm Craft, Stromag
DC EM External Failsafe/Emergency Brakes for Hoists of Cranes	Stromag
Distribution Transformer	ABB, Bharat Bijlee Ltd., BHEL, Crompton Greaves, EMCO, GE, Voltamp Transformers
DOL Starters	ABB, L&T, Schneider, Siemens
Drag Chain for Cranes/ Machines	Brevetti Stendalto, KabelSchlepp
ELCB/RCCB/RCD	ABB, Control & Switchgear Corporation, HPL, L&T, Rockwell, Schneider, Siemens
Emergency Stop Box/ Push Button Station/ Pendant Box	ABB, BCH, Eaton, L&T, Rockwell, Schneider, Siemens
Fuse Switch	ABB, BCH, L&T, Schneider, Siemens
Fuses	Bussmann, Cefem, Control & Switchgear Corporation, GE Power, Indo Asian Fuse
Geared motors	Bonfiglioli, Control Techniques Nidec, Flender, IC Bauer, LPS Motors, New Allenberry

Glands above M32x1.5 (Ni plated brass)	Braco, Control Well, Dowellls, Hensel, Lapp, Multi Pressings, S J Metal Industries
Glands up to M32x1.5 (Polyamide)	Braco, Control Well, Dowellls, Hensel, Lapp, Multi Pressings, S J Metal Industries
HV Cables	Cable Corporation of India, Fort Gloster, Nicco Corporation, Polycab, RPG, Torrent, Universal
HV Isolator	Dreischer Panicker, Jyoti, Siemens
HV Motors	ABB, BHEL, Crompton Greaves, GE, Kirloskar Electric, Siemens
HV Switchboard	ABB, GE, Jyoti, Siemens
Industrial Power Plugs & Sockets	BCH, Cape, Hensel, Marechal, Schneider
Integral brake motor	Control Techniques Nidec, Demag, IC Bauer, NORD, Sew Eurodrive, Siemens, Stahl
LBS	Cefem, Socomec
Light fittings	Bajaj, Crompton Greaves, Havells India, Philips, Wipro
Lighting & Power Panel	BCH, Control & Switchgear Corporation, Havells India, Indo Asian Fuse Gear, L&T, Legrand (India), Schneider, Siemens, Standard Electricals
Limit Switch	ABB, BCH, Rockwell, Schneider, Siemens
Line Reactors/ Input & Output chokes for VFD	ABB, Danfoss, Rockwell, Schneider, Siemens
Linear actuators	Auma, Bernard, Emerson, Limitorque, Prepec
Local Power Isolation Cabinet	Cefem (France), Socomec(France)
MCB	ABB, BCH, HPL, L&T, Legrand (India), Rockwell, Schneider, Siemens
MCC/Switch Gear	ABB, GE, L&T, Schneider, Siemens, Rockwell
MCCB/SFU	ABB, BCH, L&T, Schneider, Siemens
Meters	AE, IMP, L&T, Rishab, Schneider, Secure, Siemens
Motor protection relay	ABB, L&T, Rockwell, Schneider, Siemens
Motors	ABB, Bharat Bijlee Ltd., Control Techniques Nidec, Crompton Greaves, Demag, KEC, Mogensen, NGEF, Sew Eurodrive, Siemens
Mounting Clamps for Proximity Switches	Stauff, Turck

MV Motors	ABB, Bharat Bijlee Ltd., Control Techniques Nidec, Crompton Greaves, Demag, GE, Kirloskar Electric, Marathon Electric, NGEF, Sew Eurodrive, Siemens
MV Switchboard (draw out type)	ABB, Control & Switchgear Corporation, GE Power Controls, L&T, Schneider, Siemens
MV Switchboard (fixed type)	ABB, BCH, Control & Switchgear Corporation, GE Power Controls, L&T, Schneider, Siemens
MV Variable speed drive	ABB, BHEL, Danfoss, Delta, Kirloskar Electric, L&T, Rockwell, Schneider, Siemens, Yaskawa
Package Air Conditioner	Batliboi, Blue Star, Carrier, Hitachi, Voltas
Power cables	Finolex Cables Ltd., Fort Gloster, Havells India, Helukabel, KEI, Lapp, Nicco Corporation, Polycab, Radiant Cables Ltd, RPG, Silec, Torrent, Universal
Power & Control wires for internal panel wiring	Finolex Cables Ltd., Gloster Cables, Helukabel, KEI, Lapp, Nicco Corporation, Polycab, RPG, Silec, Torrent, Universal
Power cable for Drag chain/ Festoon Trolley application	Helukabel, Igus, KabelSchlepp, Lapp
Power contactor	ABB, BCH, L&T, Rockwell, Schneider, Siemens
Protection Relays	ABB, L&T, Rockwell, Schneider, Siemens
Proximity detector	LEUZE Electronics, Omron, P&F, Rockwell, Schneider, Sick, Turck
Pushbutton & Indication lamps	ABB, BCH, Bhartia Industries, L&T, Schneider, Siemens
Pushbutton/Selector switches	ABB, BCH, L&T, Schneider, Siemens
Rotary actuators	Auma, Bernard, Emerson, Limitorque, Prepec
Rotary Position Switches/ Cam Switches	Schneider
Rotary Encoder for motor	Heidenhain, BEI, Siemens, Sick, Kubler
Servo Motors	Sew Eurodrive, Siemens, Control Techniques-Nidec, Nord, Rockwell
Solenoid valve coils	ASCO, Festo, Parker
Soft starter	ABB, Danfoss, Schneider, Siemens, Rockwell
Switchgears for Electrical panels & Switchboards	ABB, L&T, Schneider, Siemens, Rockwell
Switch Fuse Unit	ABB, L&T, Schneider, Siemens
Terminal block	Connectwell, Elmax, Phoenix, Wago, Weidmuller

Timers	ABB, L&T, Minilec, Rockwell, Schneider, Siemens
Track type limit switch	BCH, Begal Technocrats, Electromag, Jayshree, Schneider, Siemens, Speed-O-Control
Transducers – Current/ Voltage/ Power/ Frequency	ABB, Masibus, Minilec
UPS	APC, Emerson, Fuji, Hitachi - Hi Rel Electronics, Numeric, Schneider
VFDs	ABB, Danfoss, Delta, L&T, Rockwell, Schneider, Siemens, Yaskawa

MECHANICAL

Item Name	List Of Make/Brand/Suppliers
Air Filter Regulator	Asco, Bosch, Festo, Legris, Norgren, Parker, SMC
Air filters	Asco, Bosch, Festo, Legris, Norgren, P&F, Parker, SMC, SPC, Ultra Filter
Air lubricators	Asco, Festo, Legris, Norgren, Parker, SMC
Air regulators	Asco, Bosch, Festo, Legris, Norgren, Parker, SMC
Anode grabs	Brochot, ECL, NKM Noell
Axial fans & propeller fans	Accel, Batliboy, BHEL, Dustven, Encon, Flaktwoods, ISEL, Reitz, Rieco, Thermax
Bag house	Andrew Yule, Claudius Peter, Coperion, Ducon, Flaktwoods, Intensiv, Rieco, Thermax
Ball valves	Audco, BDK, KSB, Legris, Tyco, Vaas
Bearings	FAG, NTN, SKF, TIMKEN
Bearings for cranes	FAG, NTN, SKF, TIMKEN
Belt scraper	BMH Concare, Hosch, Kaveri, Martin, Tega, Thejo
Butterfly valves	Aira Euro, Audco, BDK, Flow-Tek, Hi Tech, KSB, Tyco, Vaas
Cam Follower	McGill, C.R. Canada, Osborn , INA
Centrifugal blowers	Aerzen, ARC, BHEL, Flaktwoods, James Howden (UK), Reitz
Centrifugal Compressor	Aerzen, Atlas Copco, Blue Star, Ingersoll Rand, Kirloskar Pneumatics
Centrifugal pumps	Kirloskar Brothers, KSB, Mather & Platt, Sulzer, Voltas
Conveyor belts	Andrew Yule, Dunlop, Forech, Hilton, Nirlon, Phoenix
Couplings	BK, Concord, Elecon, Fenner, Greaves, KTR, Lovejoy, PIX, Wellman
Electric crane	Anupam, Armsel, Demag, FAFECO Engineers, Mukand, Reva Cranes, Sparkline Eqpt. Pvt. Ltd., WMI Kone Cranes

Electric Hoist	Anupam, Armsel, Demag, Hercules Hosts, Mukand, Reva Cranes, Stahl, WMI Kone
Elevator / lift	ECE, Kone, Omega, OTIS, Thyssen Krupp
Explosion vents	Rembe
Fans	Andrew Yule, ARC, Batliboi, BHEL, Chicago Blowers, Flaktwoods, Reitz
Fans for dedusting	Andrew Yule, Batliboi, BHEL, Dustven, Flaktwoods, Reitz, Rieco, Thermax
Fans for ventilation	Andrew Yule, Batliboi, Dustven, Flaktwoods, Reitz, Rieco, Thermax
Fasteners	GKW, LPS Bossard, Precision Auto Engineers, TVS, Unbrako
Filter bag	Albany, Andrew Textile, Batliboi, BFW, BWF, Donaldson, Dustven, Gortex, Nordic, Rieco, Testori, Thermax, TTL,
Filter cloth for bags	Albany, Andrew Textile, BFW, BWF, Donaldson, Gortex, Nordic, Testori, TTL
Fluid coupling	Elecon, Fludex (FLENDER), Fludomat, Pembril, Voith
Gate valves	Aira Euro, Audco, BDK, Crescent Valve Mfgh. Co., Flow-Tek, Hi Tech, Kirloskar Brothers, KSB, Vaas
Gearboxes	BDI, Bonfiglioli, Demag, Elecon, Flender, Lenze, New Allenberry Works, NORD, Rossi, Sew Eurodrive
Globe valves	Aira Euro, Audco, BDK, Crescent Valve Mfgh. Co., Flow-Tek, Hi Tech, Kirloskar
Hard Facing Electrodes	D&H, Diffusion, ESAB, Eutectic, Modi , L&T
Heat Exchangers	C Doctor India Pvt. Ltd., Dutson Eqpt. Pvt. Ltd.
High pressure vane/piston pumps	Denison, Eaton, Huggland, HYDAC, Parker, Rexroth, Yuken
Hydraulic check valves	Eaton, HYDAC, Parker, Rexroth
Hydraulic counter balance valves	Eaton, HYDAC, Parker, Rexroth
Hydraulic cylinders	CPOAC, Eaton, Parker, Rexroth, Veljan
Hydraulic filters	Eaton, EPE, HYDAC, Mahle, MP FILTRI, Parker, Rexroth
Hydraulic flow control valves	Eaton, HYDAC, Parker, Rexroth
Hydraulic hoses	Aeroquip, Gates, Parker, Rexroth
Hydraulic solenoid valves	Eaton, HYDAC, Parker, Rexroth
Knife gate valves	Audco, BDK, KSB, VAAS

Liner Plates	SAIL HARD , TISCRAL
Lubricating Systems	AFMC Lubrication Pvt Ltd, Dropsa, Graco, Lincoln Helios, Lubcon
Lubrication fittings	AFMC Lubrication Pvt Ltd, Dropsa, Graco, Lincoln Helios, Lubcon
Manual hoist/chain pulley	Batliboi, BRADY & MORRIS, Elemech, Hercules Hosts, Indef, Tractel tirfor
MIG weldings pool	D&H, Diffusion, ESAB, Eutectic
Needle valves	Atos, Eaton, HYDAC, Parker, Rexroth
Paints	Asian, Berger, Dulux, Kansai Nerolac, Stanvac
Pipe(MS)	Jindal, Prakash, SAIL, Surya, TATA
Pipe(SS)	Jindal, REMI, SAIL
Pipe Conveyor	FL Smidth, Macmet, Thyssen Krupp
Pipe fittings	Arbind Pipes & Fittings, EBY Industries, MS Fittings, Stewart & Llyods, Teekay Tubes Pvt Ltd., True Fab Pvt Ltd
Pneumatic check valves	Asco, Eaton, Festo, Parker, Rotex, SMC
Pneumatic Conveying	Claudius Peter, Coperion, Ducon, Gericke Gmbh, Macawber Bee kay, Moiler, Schenck
Pneumatic cylinders	Asco, Festo, LECQ, Parker, Rexroth, Rotex, Schrader, SMC
Pneumatic flow control valves	Asco, Festo, Parker, Rotex
Pneumatic hoses	Aeroquip, Festo, Gates India, Parker
Pneumatic solenoid valves	Asco, Festo, Parker, Rotex, Schrader, SMC
Polymer liner	HRK Sons, Kaveri, Quadrant Surlon, Swagath Uraethane, Tech Rubber, Tega
Polyurethane hoses	Asco, Festo, Gates, Legris, Parker
Polyurethane liner	HRK Sons, Kaveri, Quadrant Surlon, Swagath Uraethane, Tech Rubber, Tega
Pulsejet valves	Asco, Parker
Quick couplers	Aeroquip, Legris
Rope & Winch system	Hell & Patterson, Metso, Windhoff
Rotary Air Lock Feeder	Air Lanco, Delta - Ducon, DMN Westinghouse, FluidAir, Rieco, Rotolock, Scorpio
Rubber liner	HRK Sons, Kaveri, Swagath Uraethane, Tech Rubber, Tega
Sector gate/diverter gate/Rack & pinion gate	Holtzman, IDC, Macmet, Precission Processing Equipment Co., TRF, Vinar

Screw Compressor	Atlas Copco, Chicago Pneumatic, ELGI, Ingersoll Rand, Aerzen
Steel plates	IISCO, Jindal, RINL, SAIL, TISCO
Transmission chain	Diamond, Reynold, Rolcon, Rolon, SKF
Tri-lobe blowers	Aerzen, Air Industries limited, Kay International, KPT, Swam pneumatics
V-Pulley	Fenner, Contitech
V-Belts	Fenner , Gates, Contitech, PIX
Vibrating Screen	Electromag, Joest, Pennwalt, Schenck
Vibration Isolator	ARF, Dunlop, Emerald, Paulstra
Welding electrodes	D&H, Diffusion, ESAB, Eutectic, Modi
Window/ Split Air Conditioner	Arctic, Blue Star, Carrier, Hitachi, LG, Samsung, Voltas
Wire ropes	Bharat Wire ropes, Orion Ropes Pvt Ltd., Usha Martin

INSTRUMENTATION

Item Name	List Of Make/Brand/Suppliers
Air Flow transmitters	ABB, E&H, Emerson, Honeywell, Siemens
Cable glands (for Hazardous area)	Braco, Comet, Lapp
Computer & Printer table	Godrej
Control Valves	Audco, Dembla, Fisher, IL, Klein, KSB, Mascot, Siemens, Tyco, Uniflow
Differential pressure gauge	Ashcroft, Baumer, Kobold, Waaree, Wika
Digital multi meter	Fluke, Philips, Yokogawa
Flow switch	Baumer, E&H, Honeywell, IFM, Pepperel Fuch, Siemens
Flow switch for solids	Envea, Mutec
Fugitive emission (HF) Analyzer	Boreal Laser Inc - Canada, Opsis - Sweden, Unisearch - Canada
HART Configurator	E&H, Emerson, Fluke, Yokogawa
Instrument tubing, fittings & needle valves	Festo, Parker, Swagelok
Jamming detector	E&H, Kobold, Siemens, Vega
Junction box	BCH, Kindle, Rittal

Item Name	List Of Make/Brand/Suppliers
Laser gas and Dust Analyzers	Neo Monitors AS - Norway
Level switch	E&H, IFM, Kobold, Siemens, Vega
Level transmitter	E&H, Emerson, IFM, Siemens, Vega
Load cell	Avery, Garo, Garos, HBM, Philips, Precia Molen, Sartorious, Tulaman, Vishay Nobel
Manometer	Asian Industrial Valves, Bliss Anand Pvt Ltd, Phoenix, Sigma Industries
Mass flow meter	ABB, E&H, Emerson, Honeywell, Siemens, Yokogawa
Massflow meter for Solids	Envea, Mutec, Siemens
Motorised actuator control valve	Auma, Bernard, Emerson, Jordan Actuator, Rotork
Motorised damper	Auma
Network Hardware	CISCO, HP, MOXA
Network Switch	CISCO, D-Link, HP, MOXA
Orifice plates & Flanges	Baliga Lighting, Eureka Industrial Equipments, Guru Nanak Engineering works, Micro Precision Products Pvt Ltd, Start Mech Controls
PC & Laptop	Dell, HP, Lenovo
Photo Cell	P&F , Schneider ,Sick
Pile detector (Diffuse reflection type)	IFM, LEUZE Electronics, Omron, Pepperel Fuch, Schneider, Sick
PLC I/O cards	Emerson, GE, Rockwell, Schneider, Siemens
PLCs	Emerson, GE, Rockwell, Schneider, Siemens
Pressure gauge	Ashcroft, Baumer, Fluke, Kobold, Precision Mass Products, Waree, Wika
Pressure Relief Valves	Anderson Greenwood Crosby, BHEL, Safety Systems UK Ltd, Weir
Pressure switch	Baumer, Danfoss, IFM, Indfoss, Schneider, Switzer
Pressure/Flow/Differential pressure transmitter	ABB, Baumer, E&H, Emerson, Honeywell, IFM, Vega, Yokogawa
Printer(Laser /Inkjet)	Cannon, Epson, HP
Protocol converter	Anybus, Prosoft
Proximity switch	Pepperel Fuch, Telemecanique
Reflector	Swareflex , P&F

Item Name	List Of Make/Brand/Suppliers
Remote Indicator	London Electronics, Siebert
RTD	Goa Instruments, Jumo, Kobold, Sandvik, Techno Instruments, Tempcon, Tempsens, Toshniwal, Unitech Instruments
Sequential timer card for pulsing	EAPL India
Signal cables	Belden, Helukabel, Kabelschlepp, Lapp
Signal Isolator	Masibus, MTL, P&F
Smart Positioner	ABB, Siemens
SMF Battery for UPS	Amar Raja, Amaron, Exide
Temperature gauges	Bamer, Fluke, H Guru, Precision Mass Products, Waaree, Wika
Temperature transmitter	ABB, Baumer, E&H, Emerson, Honeywell, IFM, Wika
Thermal Printer	Zebra
Thermocouples	Goa Instruments, Jumo, Kobold, Sandvik, Techno Instruments, Tempcon, Tempsens, Toshniwal
Thermo wells	Altop Industries, Bourden Haennt, Elind, Junik Engineering, RK Engg, Temcon, Thermo Electra BV, Thermo Electric Co, Thermocouple products
Time attendance system	Solus Security Systems, Zenith Control Systems
Universal digital indicator and controller	Eurotherm, Honeywell, Masibus, Yokogawa
Universal Temperature indicator/ controller	Eurotherm, Fluke, Honeywell, Masibus, Omron, Yokogawa
Vibration Monitoring Equipment	Schenck
Vibration sensor	Schenck
Water flow meter	Inconel Forbes Marshal
Weighing system	Avery, Digital Weighing Systems, HBM, Philips, Precia Molen, Schenck, Vishay Nobel
Wireless Access Point and Antenna	Phoenix, Siemens
Zero speed switch	Jayshree, Schneider

Note:

a) This preferred vendor list is to be followed in conjunction with the vendor/make lists of equipment addressed in the detailed/standard specifications.

b) Any material/make/brand required to complete the project but not included in the preferred vendor list to be procured after taking prior approval from the Nalco on submission of proven track record documents..

SECTION – VI : ANNOTATION TO DOCUMENTATION

SECTION-VI

ANNOTATION TO DOCUMENTATION

1. GENERAL ARRANGEMENT DRAWINGS

The LSTK Vendor will prepare and supply General Arrangement drawings for the plant sections. These drawings shall indicate elevation, plan and end views identifying distances, clearances and space required. General Arrangement will cover core machineries and also the auxiliary machineries, required to complete the system, with load data and other details suitable for civil design. Necessary details for the machineries not in the scope of supply of the LSTK Vendor, will be supplied by the Owner. The drawings should be complete in all respects to enable the Owner to undertake design of civil engineering structures and foundations and should include ladders, platforms, side cladding wherever necessary, duct and chute supports and expansion joints, where required. The LSTK Vendorshall include all the details as listed below and any such other details that may be required for civil design.

1.1 Process Buildings

The drawing shall indicate minimum clearance required around the equipment considering safety and statutory requirement both during erection and operation. All openings in the floors for equipment, staircase, and ducts to be shown. The drawing shall also indicate the cable routing at various floors including preferred arrangement for supporting the same.

1.2 Load Data and Anchorage Details

- The drawing shall indicate live load for designing various floors. Additional live load due to storage of materials such as maintenance spares, etc., should be indicated separately.
- For equipment supported on floors, the equipment load and the dynamic factor shall be indicated. In the floor plans, the disposition of loading i.e. number and locations of bearing points of equipment on the floor and magnitude of load transferred to each point shall be clearly marked.
- Details of pockets/bolts through holes to be provided in RCC slab/beam for equipment supported on floors shall be given.
- For small size blowers and fans supported on floor slabs, the exact size of the foundation block, its height above the supporting floor level and details of anchorage as desired by the equipment supplier shall be indicated.
- Relevant load data regarding the machine foundations, shall be supplied.

1.3 Storages

The general arrangement drawings showing cross-section, elevation plan of various floors and roofs shall be furnished on the drawing.

- Diameter and total height ofthe storage includingthe total capacity of storage provided

- Bulkdensity of the material to be assumed forcapacity calculation and structural design
- Angle of repose of the material
- Maximum temperature of the material inside for whichthe shell walls and floors should be designed
- Anyresidual air pressure which is to be consideredfor design

Floor plan at various levels including roof should give all relevant load data for equipment.

1.4 Storage hoppers supported on buildings

Preference as regards to the material of constructionof hopper, RCC / Steel should be indicated. In case of structural steel hoppers, the dead weight of the hopper to be specified. For hopper supported on load cells, the load transferred per point and arrangement of fixing the load cells to the support shall be furnished.

1.5 Machine Foundations

All the load data as per the relevant IS codes, to enable the designertocarry out the dynamic analysis ofthemachine foundations shall be furnished.

1.5.1 Heavy equipment foundations

The general arrangement drawing showing the elevation and plan for the supporting block should be given.The vertical load and horizontal load carriedper point should be specified.The dynamic factor, if any, to be separately furnished.The successful LSTK Bidder shall provide the rationale for recommending the magnitude of dynamic factor. The minimum weight of foundationshouldbe indicated.

1.5.2 Foundation for Fans etc.

The general arrangement drawing of Fan shallgive sectional elevation of foundation block. In the plan the dimensions of all pockets and the load carried per pocket shall be specified. The centre of gravity of the load system shall be given separately for the equipment and its driving unit.The height of the block above +/- 00 level should bespecified. The grouting margin shall be separately specified. Any stipulationregarding the minimum weight of the foundation block shall be indicated.

1.5.3 Other Details

The following data long with other details which will influence the design of machine foundation shall be furnished.

- KW of the equipment
- Speed, direction of rotation as seen from non drive end

- Weight of rotating parts
- Likely eccentricity of rotating parts for whichthe foundation is to be designed
- Static and dynamic load, dynamic factor
- Vertical and horizontal loads at various loading points
- Centre of gravity of load system
- The size and depth of pockets including arrangements for fixing the foundation bolts, specifications of thegrout to be used
- Natural frequency of critical rotary machines likefans, mill drive, etc.

2. FABRICATION DRAWING

- Fabrication drawings should consist complete bill of material including material specifications & weights, developments, welding procedure, details of fixed and slide supports, Platform and ladders, details of linings, flanges, hardware required & all relevant details which are necessary for fabrication.
- If any Machining or special treatment is required then LSTK Vendor will supply that part of item / equipment. Also all ports , sockets etc will be in LSTK Vendor's scope of supply and will be supplied in loose for welding at site.
- Developments of all parts as required for site fabrication shall be providedby LSTK Vendor.
- LSTK Vendor shall own complete responsibility of any mismatch, discrepancy, error and omission in the drawing prepared and details provided by them. The LSTK Vendor shall borne all expenses for any additional work / rework required due to above reasons.

3. MANUALS

The LSTK Vendor shall issue comprehensive Erection & commissioning Manuals, operating and maintenance / service manual and spare part manuals for all equipment covered in the Scope of supply. LSTK Vendor shall include following in their standard manuals.

3.1 Erection Manuals are to include as a minimum

- Assembly drawings
- Final equipment GA drawing of all the equipment under scope of supply
- Erection procedures and checks
- Welding sequence and procedures including any special electrodes to be used
- Special instructions for erection

- Erection tolerances
- Assembled equipment tolerances
- Lifting procedure for safe handling
- Special tools and tackles required

3.2 The operating manuals are to include as a minimum

- Description of the System
- Brief description of each equipment with functions
- Normal Operational guidelines for machinery & process
- Controlled stop routine
- Emergency stop routine
- Normal running checks, etc.
- Lubrication schedule
- Operational parameters
- System heat balance
- Calibration procedure
- Standard operating procedures for complete system
- Trouble Shooting

3.3 The commissioning manuals are to include as a minimum

- Pre-commissioning checks and procedures
- Commissioning sequence
- Cold start routine
- Hot start routine
- Controlled stop routine
- Emergency stop routine
- Operational parameters

- System heat balance
- Standard operating procedures for complete system

3.4 Post project documents to include as a minimum

- As built process flow sheet
- As built GA drawing of all equipment and building GA
- As built control philosophy, PID and TENDER documents
- Operating and Maintenance manual

3.5 The maintenance manual is to cover as a minimum

- Normal daily/weekly/monthly checks
- Lubrication requirements
- Detailed instructions for complete dismantling and re-assembly of the machine
- Setting up and operating clearances
- Replacement of wear items
- Overhaulingprocedures for auxiliary items, e.g. hydraulic power-pack, couplings, etc.
- Acompleteparts schedule with sectionalillustrations
- Replacementprocedureforbearingsandothercritical equipment
- Detailed circuit diagram of all electronic assembly
- Troubleshootingprocedures with detailsoftestpoints, their voltage level and wave forms

3.6 The Spare part manual is to cover as a minimum

- Part List with Part No.,Nominal size/Type of spare parts, Model, Specification
- Material of Construction
- Drawings(hard copies and soft copies in editable dwg format), Catalogue etc.

4. ANNOTATION ON ENGINEERING SEVICES

- The LSTK Vendor shall submit all the GA drawings, Flow sheet, Duct routing etc for Owner's approval. These drawings shall be approved after mutually agreement on the scheme by Owner and LSTK Vendor.
- LSTK Vendor shall submit detailed master list indicating theequipment in its scope and in the scope of Owner to make the system complete.
- All the load data as per the relevant IS codes, to enable the designertocarry out the dynamic analysis of the machine foundations, shall be furnished.
- The LSTK Vendor shall prepare documentation in sufficient details and instruction to complete the work and to describe the operation of completed works.
- The scale of drawings shall be given clearly. Projection shall be of First angle method. Main data on equipment and parts shall be shown.Name and signature of the person approving the drawing shall be given.
- The size of documents and drawings shall be A0, A1, A2 and A3.For data sheet and lists, etc. size shall be A4.
- All documents and drawings shall use the metric system of measurement.All hardware shall conform to metric standards.
- TheLSTK Vendor shall issue comprehensive assembly drawing to facilitate the erection, Erection Manuals, operating and maintenance/service manual for all equipment covered in the Scope of supply at least 6-8 weeks prior to the commencement of the delivery of the equipment.
- All final data sheet, GA, Fabrication, Refractory Drawings and all other drawings and Manuals will be submitted in soft copy (editable dwg format and pdf) on multiple read & write CD/DVD. The soft copy should be archive file and should not be read only. The drawings format shouldberelevant AUTO CADrelease.
- Flow Sheet (Process and Instrumentation Diagram) shall Contain allnecessary process and non-process equipment and including all electrical, mechanical, pneumatic and hydraulic devices as well as all required measuring points,operating condition values and closed loop control circuits
- Electrical and instrumentation drawings should be complete with internal wiring details, detailed circuit diagrams of electronic modules, listing of the software wherever relevant, dimensional details of cabinets and other associated equipments, external wiring details with type of cables, size and number of conductors and other datarequired for smooth commissioning and maintenance of the system.
- For all the equipment purchased from sub-vendors, the LSTK Vendor shall be responsible to the furnishall data, parts list, drawings installation, maintenance and operating instructions.LSTK Vendor shall obtainsuch data,drawings and documents and review these for completeness and compliance with the requirements of the Owner's specifications before submitting the same to the Owner.

- All final copies of documents shall be logically groupedand sent as hard bound volume for the entire system.These shall include manufacturer's literature.

- The LSTK Vendor will not be relieved of his responsibilities in-spite of Owner's initial approval for drawings for final errors, omissions, inadequate designs, proper performance requirements, scheduled requirements and proper operation of equipment.

- All documents to be submitted by LSTK Vendor shall be clearly identified with the following identification.

    - Project name
    - Owner's and LSTK Vendor's name
    - Owner's order number and item number
    - Equipment and parts name (description)
    - Drawing and document number
    - Date of issue/Date of revision

SECTION –VII :GENERAL GUIDELINE TO LSTK VENDORS FOR DES G N / ENGINEERING OF ENERGY EFFICIENT SYSTEMS

SECTION-VII

GENERAL GUIDELINE TO LSTK VENDORS FOR DESIGN / ENGINEERING OF ENERGY EFFICIENT SYSTEMS

General

- Energy meter (Instant indicator) along with totalizer for all energy sources I.e.: Each MCC, Compressed air system, Fuel oil system, Process water line.

Process and Mechanical Engineering

- Heat recovery/waste heat system.
- Stirrer or equivalent system in holding furnaces to reduce melts loss/increase productivity, ultimately reducing energy consumption.
- Use of stack/ flue gas waste heat in combustion or pre-heating
- Optimization of Impellers for pumps, fans etc as per load
- Optimum utilization of combustion systems.
- Proper pipe sizes to minimize friction losses and pipe bends to save pumping energy.
- Energy efficient HVAC systems for buildings.
- Minimum bends in duct work, piping etc
- Inlet/discharge guide vanes along with dampers for fan load controls
- Preferably Hollow FRP impellers in place of metallic/GRP impellers for fans/blowers
- Minimize obstructions in inlet and outlet of Fans/Pumps
- Energy efficient flat/cog belts instead of V-belts for large Motor drives
- Improved technology/materials in insulation of tanks/ piping to reduce heat loss
- Improved technology/materials for thermal/refractory insulation of furnaces/ovens
- Heat exchangers with low approach temperature and reduced pressure drops.
- Selection of air-compressors with high compression efficiency and mechanical efficiency and less energy consumption, preferably multi stage compression.
- Boilers with high efficiency, improved process control, reduced heat loss and high heat recovery
- Optimum size of cooling equipment that best matches the system requirement.
- Efficient gear box preferably bevel gear instead of worm gear box

Control Engineering

- Use of energy efficient control devices.
- Process automation for minimization of energy use.
- Implementation of control strategy that is tied to key energy systems.
- Interlocks for turning off equipment (fans/ conveyors/ pumps/ heaters etc) when not in use

- PID control/ feedback control-loop in energy intensive equipment, e.g. furnaces/heating systems etc.
- Auto switching on/off of lighting systems
- Auto mode switching off of equipment during idle condition.
- Motion sensors for turning off lights/ air-conditioning
- Automatic burner control system for optimizing fuel efficiency

Electrical Engineering

- Optimization of Motors for pumps, fans and other drives as per load
- Illumination at minimum required level
- VFD/ variable speed drives for Fans, Pumps and similar equipment in case of Variable loading conditions
- Thermostats and set-back timers for heating or cooling
- Use of energy efficient cables
- Energy efficient (IE rated) electrical Motors
- Energy efficient switchgears
- All the LV/MV motors must be energy efficient type as per IS:12615 with latest amendment (IE-3)
- Energy efficient (star rated) Air Conditioning units
- Energy efficient (star rated) distribution transformers
- Energy efficient air-compressors
- Energy efficient lighting systems for shop floor & buildings

Civil Engineering

- Maximum use of day lighting and natural air ventilation systems for buildings.
- Insulation of office/building roofs
- Efficient air distribution for adequate cooling and heating in well designed structural works Solarize Inflector Window Systems in buildings

SECTION – VIII : STANDARD INSPECTION & TESTING

SECTION-VIII

STANDARD INSPECTION & TESTING

INSPECTIONS AND TESTS DURING MANUFACTURING / BEFORE DELIVERY

Introduction

Certain materials, fabricated products or Plant shall be tested and inspected on the manufacturer's premises prior to their delivery to the site.

Inspectors shall be given reasonable access to manufacturer's premises at any time provided this has been agreed upon in advance. The manufacturer shall answer any questions as far as such questions do not infringe on the proprietary know-how, or patents.

Prior to inspection of any equipment, quality assurance plan has to be submitted by LSTK Vendor and got approved from NALCO & DCPL.

Certified test reports of all inspections and tests carried out shall be made available after completion of such tests and before any packing of the Equipment or part of it can start.

Testing of Materials and Equipment

Materials

The Owner and the Owner’s Representative shall be at liberty to require appropriate test of any material used by the LSTK Vendor, if the quality and suitability of such material is in doubt and cannot be Proven by other means.

Workshop Inspection Program

The inspection and testing of Equipment and Plant at the manufacturer's premises prior to shipment is also commonly referred to as factory acceptance testing (FAT) in the Tender documents.

Workshop Inspections for Critical Equipment

The following table indicates the minimum list of Equipment subject to a workshop inspection program in the presence of the Owner's Representative. The LSTK Vendor is responsible for all workshop inspections, and shall deliver to the Owner's Representative a complete inspection report before the packing and shipping shall begin.

A final list shall be agreed between the Parties and included in the workshop inspection program.

Items to be Inspected
Mechanical Equipment
Fans
Bag houses
Pipe Conveyors
Blowers/compressors

Workshop Inspections for Standard Equipment

The Owner reserves the right to perform workshop inspections on all Equipment. If inspections are required on Standard Equipment, these inspections shall also be agreed between the Parties and incorporated into the workshop inspection program.

Workshop Inspection Documentation

All certificates and test reports, including those of manufacturers and sub-contractors shall be written in the Tender language or in English language.

Test and Inspection of Electrical Equipment and Systems

The applicable factory acceptance tests shall be carried out in compliance with the Owner's standardized procedures and reporting structure if any.

Physical Inspection and Testing

Material Inspection

The materials of which the Plant and parts thereof shall be fabricated, as well as materials for Civil Construction, shall be subjected to one of the following inspections:

The chemical and physical properties to be checked on mill sheets issued by material manufacturer.

The physical properties (e.g. all critical castings and forgings) to be determined with test pieces taken from the respective machine part, provided chemical properties are known.

Concrete pre-casting operation and product quality.

Non-Destructive Inspection

The following non-destructive tests must be carried out during fabrication of the Plant, parts thereof or Structural Steel:

Visual testing of surface aspects, irregularities, general workmanship and conformity to drawing.

Ultrasonic testing of metals by the pulse echo technique (by certified personnel).

Methods for magnetic particle testing of ferromagnetic materials and classification of magnetic particle indication (wet method only).

Methods for liquid penetration testing and classification of indication.

Methods of radiographic test and classification of radiographs for steel welds as an alternative or complement to ultrasonic testing (by specialized testing company).

Hardness Test

The hardness of products shall be measured in Brinell, Rockwell or Vickers according to the design intent using a reliable and recognized test method, e.g. Vicker, Poldi, Equotip or equivalent. If measurement is made by any other method, conversion of the measured value and measuring method shall be noted. For verification of the hardness test method a sample of the material to be tested must be available of which the hardness was determined with a stationary hardness tester.

Assembly Inspection and Tests

For the Plants to be temporarily or definitive assembled in the manufacturers' shop into sub-assemblies and/or complete assemblies to check the major dimensions and ensure the functioning, the following tests shall apply:

No-load test:

The test shall be made by use of a temporary driving unit.

Load test:

The test shall be made by use of a temporary driving unit.

In some cases, the load may not attain the full load, and all the accessories may not be installed in position.

Others:

Various other tests and inspections, the necessity of which is recognized, or called for by local national regulations or international standards, shall be carried out. These inter alia shall include:

Pressure test for pressure vessels to recognized national or international standard, and shall include official certification in compliance with the local national regulations.

Match marking after complete or partial assembly.

If shop assemblies have to be taken apart for transportation, the manufacturer shall ensure that all parts bear match marks along with provision of aligning lugs, lifting hooks/lugs, dowel pins, etc., wherever required for ease of handling in transport and assembling during erection. Such devices may be removed at Site during or after erection and the areas in question tested by non-destructive tests, if required.

Auxiliary Inspection and Test

The following inspection and tests shall be conducted:

Dimensional inspection, to be made of completed parts, partial assemblies, complete assemblies, whenever necessary, during fabrication to ensure the major dimensions and quality of the products and to provide reference data for Site erection.

Straightness test, to be conducted with aid of straight edge of process quality, e.g. at kiln tires, rollers, tooth flanks, etc.

Surface roughness test to be made on machined areas of specific quality and functions. These have to be conducted with reliable and proved instruments which are calibrated on test samples of known quality.

Inspection to ensure that Plant like, mill and kiln shells and such like fabricated components are suitably braced by welding/fixing of stiffeners of suitable size and at suitable locations, to prevent their distortion during transportation and handling at site.

Painting inspection to be conducted.

Packing inspection to be conducted.

TEST AND INSPECTIONS DURING ERECTION

Introduction

The Plant shall be tested during erection, installation and construction prior to their being used in the Works.

Comprehensive records shall be made available after completion of any inspection or tests containing the results of all tests and inspections and signed by the responsible Q/C manager.

At least 7 days before starting the load tests, the LSTK Vendor delivers to the Owner's Representative a complete record of all tests, inspections with their respective schedules, required before starting the load tests.

Certain types of intermittent inspection by governmental agencies to assure that all requirements of the codes and standards are met might become due.

The same applies to the inspection of the temporary site installations (e.g. camp) executed by governmental health and safety agencies.

Inspection of the Plant as Installed

Setting Accuracy

The inspection for accuracy of setting of the Plant and Structural Steel shall be made.

Ultrasonic or Radiographic Test

Ultrasonic or radiographic tests shall be made for highly stressed site welding, e.g. kiln shells, fuel oil storage tank, etc.

Any faulty welding detected shall be rectified and the ultrasonic or radiographic tests shall be repeated for final checking.

Note: Only certified welders are accepted to execute the welding.

Pressure Tests of Pipelines

All pressurized pipelines for water, air, oil or other liquid media or gaseous shall undergo pressure tests according to the specific requirements of each media and complying with the relevant regulations. If not otherwise specified, minimum test pressure shall be 1.5-fold of the zero-delivery pressure of pumps or compressors feeding the respective piping system.

Magnetic Particle Test or Penetration Test by 3-Component Penetration Liquid

The magnetic particle or penetration test shall be carried out on field welding seams, etc., as required, e.g. on Steel Structure, etc.

Flushing

The inside of all pipes shall be satisfactorily flushed-up to eliminate erection remains, corrosion, etc.

All hydraulic systems and reduction gear units and associated pipelines of Plant shall be satisfactorily treated in a bright-pickling bath (acid cleaning) and flushed by circulation of the flushing oil.

Operators of Test Equipment

Only certified operators are accepted to conduct the various tests.

Inspections and Tests of Electrical Systems and Installations

The electrical systems shall be entirely tested and preset before the mechanical Plant is put into operation, the objective being safe operation for people and equipment.

This process is referred to as site acceptance testing (SAT), with the function of verifying that the system installation has been completed in accordance with the specified standard of materials and workmanship.

Provisional operation of specific Equipment shall however be allowed. During for instance mounting of refractory and lining, kiln auxiliary drive may be powered by preliminary connection. Method statements for such operation shall be carried out before handover to maintain safe operation for people and equipment.

The following inspections and tests shall be carried out on the electrical equipment installed.

Alignment test of low voltage motors.

Grounding resistance shall be measured for compliance with the relevant standards.

Metering instruments shall be tested for correct connection and operation.

Analytical instruments shall be inspected and calibrated.

Measuring of damping (as per ISO/IEC on communication cables).
Simulation of PCS input via a separate I/O simulation system.
The applicable electrical installation site acceptance testing (SAT) procedures shall be carried out in compliance with the Owner's standardized procedures and reporting structure.

TESTS ON COMPLETION

Procedures for Tests on Completion

Completion of Erection of Plant

The dry run tests and system verification tests shall include static and dynamic testing of the fully erected and completed Plant and the Works. The Plant and the Works shall be tested without load as well as fully loaded.

The purpose of these tests are to thoroughly check and test the Plant and the Works installed; to verify and to examine if the Plant and the Works are complete for their purpose as required by the Contract considering also performance guarantees, and to examine the system in the light of prevailing codes and regulations.

Dry Run and Sequence Test

Upon completion of installation of the Plant, the running test shall be carried out on each motor to assure the rotational direction and condition of the motor. Subsequently, dry run test (no-load operation) shall be carried out with each individual equipment to ensure the proper functioning of the mechanical equipment. Subsequently, sequence tests shall be run

by group and by department to ensure that the process control system is properly functioning.

System Verification Test

Upon completion of the dry run test a system verification test shall be executed during which the Works shall be operated under load (with material) and all necessary calibration shall be executed.

Process Control and Electrical System's Performance and Completion Tests (PCT)

The Process Control and Electrical System's Performance and Completion Tests (PCT) shall be carried out in compliance with the Owner's standardized procedures and reporting structure.

PERFORMANCE TESTS PROCEDURES

Performance Tests and Standards

Performance tests are tests to be carried out on the Equipment to establish that the Equipment is able to perform in accordance with the performance guarantees. The tests and procedures for carrying them out are described below.

All specified warranties and data are based on the metric system and comply to the IS-standard.

The LSTK Vendor undertakes that the Plant will conform to the requirements of the standard regulation, work sheet, codes of practice, guidelines, specifications, as per IS-3483, IS-4594(Noise), IS-12075, IS-14817(Vibration) specification and regulations

Rules for prevention of accidents (Health and Safety)

IS-3483, IS-4594(Noise), IS-12075, IS-14817(Vibration) guidelines applicable to dust, noise, pressure relieve, etc.

Local laws, regulations and provisions shall be binding to the LSTK Vendor. Up-to-date CPCB regulations shall be binding for all agencies

In case local regulation requires special tests etc. these have duly to be considered and executed by the LSTK Vendor.

The relevant operation instruction and international code of practice and technology shall be adopted.

Measuring Tolerances

All measurements relevant for the determination of the performance tests results will be executed either by the relevant calibrated measuring / recording / weighing equipment or by state of the art calibrated measuring devices to be provided by the LSTK Vendor as required for the relevant measuring method. There will be no allowance for any measuring tolerances or accounting for efficiencies or losses or the like in the determination of any applicable performance tests results.

General Performance Tests Procedures

The LSTK Vendor shall prepare and submit to the Owner for approval.

The description of the procedure shall include a detailed description of the measurements to be taken during performance tests, instrument readings to be taken, sampling to be carried out and intervals thereof, as well as all calculation formulae.

The approved performance tests descriptions and procedures shall be applied for the tests and their evaluation. The performance guarantees values are to be understood to be on the basis of dry material (i.e. zero moisture). All performance guarantees values are based on the Metric (SI) System unless otherwise stated.

The Equipment capacities will be determined by weighing, either continuously by means of the relevant weighing Equipment of the relevant Department or group of the Works or by means of trucks and weigh bridges.

Fineness and Moisture Content (feed and product)

During the test period, spot samples of 1 kg will be taken every one hour from the crusher feed belt, which will be tested for particle size and for moisture.

During the test period, spot samples of 5 kg will be taken from automatic / manual sampler every one hour, which will be tested for fineness based on dry sieve analysis and moisture.

Electrical Energy Consumption

The energy consumption of medium and low voltage consumers will be measured in the relevant substation at the relevant medium voltage cubicle or at the motor control centers. In exceptional cases where this method is not possible, measuring at individual consumer feed line shall be executed with the necessary calibrated instruments to be provided by the LSTK Vendor.

The specific energy consumption figures shall be based on the readings agreed between the Parties from kWh-meters installed in the relevant substations. Consumption of electrical energy for main machinery will be calculated on each drive as machinery input and added up to a total. The power consumption thus measured includes losses in cables, transformers, distribution equipment as well as motors.

SECTION – IX : STANDARD PROJECT REPORTING AND CONTROL (PRC)

SECTION-IX
STANDARD PROJECT REPORTING AND CONTROL (PRC)

1. PROJECT CONTROL

A project control and information system (part of the project management system) shall be established and maintained by theLSTK Vendor during the entire duration of the Works.
The controlling process shall, by means of a formal program (see clause 2 (Program)) established by the LSTK Vendor measure:

- The progress towards the objectives given in the project milestones.
- The Project progress, in terms of which a basis for the determination of the magnitude of progress payments is provided (see clause 6 (Progress Assessment for Payment)).
- The progress towards the objectives given in the resource planning.

The controlling process shall **evaluate** the results and inform on necessary **actions**through formal and informal reports (see Chapter 3 (Reports)) and periodic meetings (see Chapter 4 (Periodic Meetings), i.e.:

- The measuring shall determine the degree to which progress towards objectives is being achieved.
- The evaluation shall determine the cause of, and possible means to act on and rectify significant deviations from planned performance.
- The action to be taken to correct unfavorable trends or to take advantage of unusual favorable trends.

The controlling process shall include the Owner's response after review of the LSTK Vendor's documents (see Chapter 5 (Review and Comment of Documents)).

2. PROGRAM

The LSTK Vendor shall provide a detailed program for the execution of the Works.

The formal program plan shall be established with detailed schedules for exhibiting activities and events defining the specific work to accomplish the project within the given objectives regarding time, cost and performance.

It shall be displayed by means of the "bar chart" scheduling technique.

2.1 Objectives

The project milestones (Times for Completion), shall be achieved and form the basis for elaboration of the formal program plan.

2.2 Bar Chart

The bar chart shall include such items as listing of activities, activity duration, schedule dates, progress-to-date, etc.

It shall further:

- Show the interdependencies of the activities as well as relationship between the activities.
- Show the result of early or late start of an activity.
- Allow a sensitivity analysis, e.g. shortest or longest time, average or expected time to activity completion.
- Allow linking of the activities to monetary values and resources.
- Allow tracking of time, cost, resources and performance.

The formal program shall clearly depict all relevant activities structured in work packages and broken down into sub-activities.

The LSTK Vendor shall update and alter the program in accordance with the Conditions of Contract. Updates shall be submitted monthly, including a report (see Clause 3 (Reports)) explaining the proposed remedial action(s) to be taken, e.g. to expedite the rate of progress.

2.3 Formal Program

The LSTK Vendor shall submit a detailed formal program to the Owner for approval, which shall include, but not be limited to:

- Dates for Owner's Representative participation in inspections, review and or factory tests of Plant and/or Services.
- Begin of Civil Construction.
- Assumed start of erection and installation works broken down as may be reasonably required by the Owner's Representative into sections or groups that allow an uninterrupted Erection of Plant considering coordination with other Project Works.
- Interconnection works to Owner’s Works.
- Shut down periods of the affected Department, or portions thereof, of Owner's Works and their duration.
- Tests on Completion.
- Milestone for issue of Taking Over Certificate.

The LSTK Vendor shall provide details of the manpower (according to categories) to be employed at Site (either incorporated if the program software permits, or as separate data if not).

The LSTK Vendor shall collect and integrate in the detailed Program all sub-programs and information of his Sub-Contractors.

The submission of the detailed program by the LSTK Vendor to the Owner's Representative for review and comment shall take place in two steps as follows:

a) As a draft detailed program.
b) A detailed program showing firmed-up dates for a) above.

Review and comment of the LSTK Vendor’s program by the Owner's Representative shall not relieve the LSTK Vendor from any of his obligations and responsibilities under the Contract.

3. REPORTS

3.1 Monthly Progress Report

The LSTK Vendor shall prepare a progress report monthly (available from Effective Date of the Contract) and submit it to the Owner on or before the 10th day of the succeeding month. The report shall include:

- An executive summary.
- The general project information (short summary of the project description).
- Comparisons of budgeted, actual and committed costs, including forecast to completion, with comments in case of deviations.
- Comparisons of actual and planned progress, with details of any aspects which may jeopardize the Project completion in accordance with the Contract, and the measures being (or to be) adopted to overcome such aspects.
- Achievements in the period covered and plan for forthcoming period:Descriptions of progress in each project stage.
- Safety statistics, including details of any significant incidents and activities relating to the environment and public relations.
- Public relations summary
- A quality assurance and control summary
- Key issues and actions
- Key learnings
- Records of personnel and resources
- Financial Report
- Pictorial Progress
- % Overall Progress
- % Progress of Construction
- % Material receipt at site
- Annexes

3.1.1 Executive Summary

The executive summary shall provide a quick overview of the project, summarize its status, disclose any aspects, which may jeopardize the completion of the project, and the measures being (or to be) adopted to overcome such aspects.

It shall report briefly on the most important topics only, like progress, quality, cost and time spent in comparison with the project definition on which the parties involved have agreed upon.
Specific topics that demand attention (organizational issues, personnel, finance, administration, permitting, safety, risks, technical issues, etc.) may be addressed.

3.1.2 Status Report

3.1.2.1 General Project Information

A short Project description is to be provided.

3.1.2.2 Project Costs

A short summary of the overall project cost status is to be provided, along with an appropriate S-curve.

A more detailed cost overview is to be included in the financial/project cost section of the report (refer to Clause 3.1.3 (Financial Report)).

3.1.2.3 Project Schedule and Progress

The percentage completion of the contractual scope of works shall be stated by means of S-curve diagrams for planned and actual progress, as well as a bar chart with progress line to illustrate the progress figure. In case of deviations between the planned and actual progress, explanations shall become part of the report. This part shall contain a list of tasks, which are considered critical, nearly critical or will become critical.

For design, purchase and manufacturing activities the actual progress determination shall be based on number of drawings issu
ed for review and reviewed, number of purchase orders to be placed and number of orders placed. The planned progress figures shall be expressed as percentage figures.

The planned progress calculation will, for all site activities, be based on planned man-hour/man-month consumption. The planned progress will be expressed as a percentage figure. Actual progress figures for all site activities will be assessed and expressed as a percentage figure.

Lost time due to extreme weather conditions will be part of the site activity report.

3.1.2.4 Achievements during the Reporting Period

This section shall detail all the milestones and other major achievements accomplished during the reporting period.

3.1.2.5 Plan for Forthcoming Period

This section will be a highlight of projected events for the following reporting period. This section will also include:

- Civil Construction histograms showing the planned monthly quantities of concrete to be poured (in m^3) and structural steel to be erected (in tons)
- Erection histograms showing the planned monthly quantity of Plant to be erected (in tons)

3.1.2.6 Safety Management

This section will consist of a summary of the statistics of OH&S reporting system
As a minimum it will include:

- Injury statistics.
- Statistics for incidents involving no injuries, but including damage to property and "near misses".

- Statistics for incidents involving serious damage or loss:
- This includes any damages to material or equipment, which has the potential to have a negative effect on the execution of the planned program. The report could include pictures of the mentioned equipment.
- Environmental incidents
- Damage reporting

3.1.2.7 Public Relations

This section will include a summary of all significant contacts with the general public, details of activities which have been informed to the outside world (e.g. where public has been advised of road blockage, removal of phone and power lines for abnormal load deliveries, etc.), as well as a listing of all local and national press statements made, press/radio/tv reports, etc., relating to the project activities.

3.1.2.8 Quality Assurance and Control

This section includes a summary of the progress regarding inspections, erection and construction quality checks, etc.

The report will provide a listing of significant deviations identified, details of any consequences for the project schedule and budget, and the corrective actions taken.

3.1.2.9 Key Issues and Actions

This section will highlight items of particular interest or significance for information and/or managerial decision making. This includes activities where specific Owner assistance is anticipated.

3.1.2.10 Key Learnings

A summary of Key Learnings which can be further implemented in the Works or by the Owner in other projects shall be included in the report.

3.1.2.11 Personnel and Resources on Site

This section shall contain detailed listings of the LSTK Vendor's (including any sub-contractor’s) personnel on site, as well as a listing of main equipment on site such as cranes, vehicles, earth moving equipment, etc.

3.1.3 Financial Report

This section shall detail the status of project costs, including:

- Contract value/Payments.
- Variations.

The project cost status shall be illustrated by means of suitable S-curve diagrams depicting budgeted, projected and actual expenditure.

In addition to the overall project cost status, the cost status for the individual areas such as civil and structural steel construction, mechanical and electrical erection, as well as project management shall similarly be reported.

3.1.2.4 Pictorial Progress

In accordance with defined positions a general pictorial progress of the works will be reflected. A pictorial progress for each area of specific interest will also be made. Each photo will be automatically dated to avoid confusion and mixing of pictures.

3.2 Miscellaneous Reports

The LSTK Vendor shall prepare other formal and informal reports as may from time to time be reasonably requested by the Owner and/or Owner's Representative, or deemed necessary by the LSTK Vendor.

4. PERIODIC MEETINGS

Meetings shall be held between the Owner, consultant and the LSTK Vendorperiodically during the design and construction phase.

Besides the fixed scheduled meetings, the Owner,consultantor the LSTK Vendormay request additional meetings if these are deemed necessary.

Minutes of meetings (WORD or EXCEL) shall be prepared together with a list of open points (LOP with EXCEL) and their follow up.

4.1 Site Meetings

Coordination meetings shall be held regularly during the entire duration of the Works at the Owner’s premises or at Site.

The first (kick-off) meeting shall be held within fifteen days from the Effective Date of the Contract.
Such meetings may be for the purpose of site communication and coordination, and may include, but are not limited to:

- Occupational health and safety and environmental aspects.
- Change orders and extra work.
- Corrective work required.
- Scheduling changes (coordination).
- Mediation of difficulties, conflicts.
- Value engineering (measurement and progress payment).
- Punch list meetings (deficiencies, remedial work).
- Work acceptance, certification, and transfer of responsibility.
- Coordination of all parties involved in the construction phase.

5. REVIEW AND COMMENT OF DOCUMENTS

5.1 Procedure

The LSTK Vendor shall submit to the Owner and the Owner's Representative and the Owner's Representative at Site for review and comment, information or reference, depending on the purpose intended, the documentation listed in Clause 5.2 (Documentation Requirements) below. The LSTK Vendorshall ensure that the documentation is dispatched in a continuous manner, in the sequence required by the program and within the time frames defined in Tender (Times for Completion).

The Owner's Representative shall return one set of the documentation with his written comments within fifteen (15) working days after receipt from the LSTK Vendor.

The header of the drawings and documents shall provide space for circulation remarks, originator and date, internal quality initialing and date, approval initialing and date, revision number, scope of revision and date, etc.

Time for mailing of documents is not included in the duration of the Owner's Representative's activities.

Documentation submitted to the Owner's Representative will be reviewed and returned to the LSTK Vendor with the comments described below:

1) **"Distributed"**

When the document is finally approved , it is distributed to all concern with action stamp ‘1’.

2) **"Approved"**

When the documents are approved, it is affixed with the action stamp ‘2’.

3) **"Approved except as noted. Forward final drawing"**

When documentation returned to the LSTK Vendor is stamped action 3, the LSTK Vendor shall immediately revise the documentation and resubmit to the Owner's Representative for review and comment. The work shall not proceed unless instructions to the contrary are received from the Owner's Representative.

4) **"Approved except as noted. Resubmission required"**

When documentation returned to the LSTK Vendor is stamped action 4, the LSTK Vendor shall immediately revise the documentation and resubmit to the Owner's Representative for review and comment. The work shall not proceed unless instructions to the contrary are received from the Owner's Representative.

5) **"Disapproved. See accompanying letter"**

The Owner's Representative is entitled to reject without further review, any drawings, documents or other submissions that appear, in the Owner's Representative's opinion, not to have been subjected to the LSTK Vendor's quality assurances procedures; are otherwise found to be substandard.

6) **"For information and record only"**

When documentation is returned to the LSTK Vendor stamped "Seen", the LSTK Vendor shall proceed with work indicated. "Seen" will be used for all documentation sent by the LSTK Vendor for information only, as may be required for full explanation of interdependencies and the like, and where review of the Owner's Representative is not required according to the Contract.

5.2 Documentation Requirements

5.2.1 General

All documentation that has to follow the procedure for review and comment shall be circulated between the LSTK Vendor, the Owner and the Owner's Representative by electronic data transfer on the Internet, (i.e. MS Outlook, Lotus Notes, etc.). In addition to the electronic sending, the LSTK Vendor shall send paper copies for revision. The Owner's Representative shall comment once he receives the paper copies in his office.

Attachments to such e-mails shall be limited in size to meet the Owner's system requirements, and provided in one of the following formats:

MS-Office format (*.doc, *.xls, *.ppt, *.mpp, *.mdb)
Drawing format (*.dwg, *.Auto CAD 2013 or upgraded version)
Compressed formats (*.zip)
Pictures (*.jpg, *.pdf)

Revisions (modifications) to documentation shall be marked or highlighted in the content itself (drawings: special layer; lists: special columns; other documentation: suitable marking).

The following documentation such as:

- As built documentation.
- Time schedules
- Monthly Reports
- Etc…

Shall be sent by the LSTK Vendor to the Owner in a number of **8** sets.

The format of all paper documentation (MS Office or AUTOCAD documents / plans) shall be made and delivered to the DIN Norm format (A0, A1, A2, A3 and A4).

In addition all documentation shall be made available in electronic format (CD-ROM, etc.).

The LSTK Vendor is obliged to maintain an up to date record of the actual status of each and every document, and to make such record available to the Owner and/or the Owner's Representative.

5.2.1.1 As-Built Documentation

The LSTK Vendor shall, within the time frame defined in Tender (Times for Delivery or Completion), after completion of all design work, erection and commissioning, furnish "as-

built drawings" (buildings, installations (under and above ground), equipment, etc.), flow sheets and diagrams of the equipment, as well as programs, set-ups and lists regarding process control and instrumentation, considering all modifications made during erection and commissioning.

SECTION – X : DOCUMENTS & DRAWINGS TO BE SUBMITTED ALONG WITH OFFER

SECTION - X

DOCUMENTS & DRAWINGS TO BE SUBMITTED ALONG WITH OFFER

The LSTK Bidder shall submit following listed documents and drawings along with the offer, failing which the tender will be liable to rejection. No cross-reference to any other part / page of the tender will be accepted.

1.1 Completely filled up and duly signed technical data sheets.

1.2 Completely filled up and duly signed performance guarantee parameter document with precondition, testing procedure and penalty.

1.3 Optimized Layout

1.4 General Arrangement drawings (with sectional elevation) including overall size & locating dimensions, principal dimensions & weight.

1.5 Mass Flow Diagram and Process flow sheet

1.6 Motor list and Instrument list

1.7 List of equipment which need emergency power supply and their motor rating.

1.8 Equipment list with technical details, motor rating, make and sourcing. Also it should Identifying all bought-out items under LSTK Bidders' scope.

1.9 Venting scheme for all nuisance bag filters indicating vent volumes.

1.10 Catalogs of Major Equipment showing relevant and latest technical features of the equipment/components

1.11 Size selection for all major equipment and drive system with supporting calculation.

1.12 QAP

1.13 Drawing and Document submission schedule

1.14 Sample drawings for layout, GA Drawing, Civil Construction drawing, fabrication drawings for structural supports and building, plate works (hoppers, ducts, chutes etc.) and other.

1.15 Material Delivery and Weight Schedule (indicative weight for all equipment)

1.16 List of special tools and tackles

1.17 List of recommended spares for 2 years trouble free operation with delivery time.

1.18 List of Commissioning Spares with quantity.

1.19 Deviation list if any as per tender document.

1.20 Reference list along with capacity etc. of the supplier for the similar project.

1.21 Expected program in the form of network in MS project, according to which the progress to carry out the contract along with periodic reserve deployment schedule.

SECTION – XI :LSTK VENDOR DATA REQUIREMENT

SECTION-XI

LSTK VENDOR DATA REQUIREMENT

The LSTK Bidder shall furnish the following information, data and documents:
(X : means data to be submitted by the LSTK Bidder)

Department: Packaged Equipment

S. No.	Description	With Tenders	For Review	For Records	Remarks (Final documents
1.	List of LSTK Vendordrgs./document submission schedule		X		
2.	Filled in Technical Compliance Format duly signed/stamped	X			
3.	Basic calculations for system design, equipment selection including sizing of ducts & filter units etc.		X		X
4.	Completed data sheets (LSTK Vendorshall submit his own standard data sheets for items whose data sheets are not enclosed).	X	X		X
5.	Deviation schedule in enclosed format (Annexure-I)	X			
6.	Technical literatures.	X			X
7.	System flow diagram with material balance.	X	X		X
8.	Process and instrumentation diagram.		X		X
9.	Bill of material and schedule of quantity.			X	X
10.	Overall layout and general arrangement drawing. (Preliminary layout and GAD with the tender)	X	X		X
11.	GA and X-sections drawings of component/equipment such as Pipe Conveyor, Rotary feeder, Bag Filter, Air slides, Fans etc.		X		X
12.	Duct layout drawings.		X		X
13.	Piping and control schematics for cooling water, hydraulic and pneumatic system		X		X
14.	Material of construction of all parts.			X	X
15.	List of sub-contractors for major components	X			
16.	Characteristic curves for fans, blowers and compressors.		X		X
17.	Utility consumption figures	X		X	X
18.	List of recommended two years' spares for normal operation and maintenance (with itemised price list)	X			X

S. No.	Description	With Tenders	For Review	For Records	Remarks (Final documents
19.	List of Mandatory Spares	X			X
20.	List of commissioning spares	X		X	X
21.	List of itemized special tools and tackles	X		X	X
22.	Lubricant list with specifications			X	X
23.	Start-up operation and maintenance manual showing assembly details and critical tolerances				X
24.	Quality Assurance Plans alongwith Test procedures		X*		X
25.	Mill test reports		X*		X
26.	Manufacturer's test certificate for sub-ordered items		X*		X
27.	Stage inspection and test records		X*		X
28.	Site Performance Test Procedure		X		X
29.	Final acceptance testing and performance test records		X		X
30.	Drawings, documents, data as asked for in Process Data Sheet, Electrical, Instrumentation, Civil-structure, General Civil, Static equipment, Architecture attached with this requisition.	Refer respective specifications attached.			

* - The documents required during Inspection

Notes:

1. Unless otherwise agreed, the number of copies of various drawings and documents shall be as below:

   a) With Tenders – Same as the number of copies of Tenders
   b) Post order submission – For Review/Records – six hard copies
   c) Final documents – Six hardcopies and three sets of CD-ROMs containing PDF & editable files of all final Drawings & Documents.
   d) As built drawings – One hard copy and Two sets CD-ROMs

2. LSTK Vendor shall furnish drawings and documents as per attached Standard.

3. LSTK Vendor shall furnish schedule of drawings and documents within 15 days after placement of FOI/LOI.

SECTION – XII : PROCESS DATA REQUIREMENT

SECTION - XII

PROCESS DATA REQUIREMENT

S. No.	Drawings/Documents	Along with Tenders	After Award			
			Time for submission * (weeks)	For reference	For approval	As Built
1.	Process Flow Diagram	√	4	x	√	√
2.	System Description	√	4	√	x	X
3.	Battery Limits Data/Drawing	√	x	x	√	√
4.	Raw Materials and Utilities requirements	√	x	√	x	√
5.	P&I Diagram	X	6	x	√	√
6.	Operation & Control Philosophy	√	6	x	√	x
7.	Pre-commissioning and Commissioning Procedure	X	30	x	√	x
8.	Performance Guarantee Test Procedure	X	32	x	√	x
9.	HAZOP Study Report*	X	6	X	√	√

*HAZOP study report shall be submitted once P&ID is made code. 2. Final P&ID and HAZOP study report shall be submitted together for approval.

SECTION – XIII : COMPLETENESS OF FINAL DOCUMENTATION

SECTION XIII
COMPLETENESS OF FINAL DOCUMENTATION

Name of Supplier/LSTK Vendor :

Customer :

Project :

NALCO's Job No. :

Purchase Order No./
Contract No. :

Purchase Requisition No./ : Rev. No. :
Tender No.

Name of the Work/Equipment :

Tag No. :

Supplier's/LSTK Vendor's Works :
Order No.

Certified that the Engineering Documents/Manufacturing & Test Certificates submitted by the supplier are complete in accordance with the Supplier Data Requirements of Purchase Requisition.

Signature	: ……	Signature	: ……
Date	: ……	Date	: ……
Name	: ……	Name	: ……
Designation	: ……	Designation	: ……
Department	: ……	Department	: ……

Supplier/LSTK Vendor NALCO

SECTION – XIV : COMMENT RESOLUTION SHEET

Section - XIV

COMMENT RESOLUTION SHEET

Job No._____

Project Title_____

Drawing/Document No._____

Revision No._____

S. NO.	NALCO Comment	Incorporated Resolution	Remarks

SECTION – XV :LSTK VENDOR'S DRAWING/DOCUMENT SUBMISSION SCHEDULE

Section- XV

LSTK VENDOR'S DRAWING/DOCUMENT SCHEDULE

NALCO JOB NO. :
LSTK VENDOR'S NAME :
NALCO LOI/PO NO. :
DATE :
CLIENT :

PROJECT

LSTK VENDOR'S NAME, LOGO ETC.
PL. DO NOT CHANGE LOCATION OR EXCEED THIS SPACE

SL. NO.	LSTK VENDOR'S DRAWING/DOCUEMNT NO.	REV.	SHEET NO.	TOTAL NO. OF SHEETS	DRAWING/ DOCUMENT TITLE	CATEGORY	DISCIPLINE	SCHEDULE DATE OF SUBMISSION	AFC/ FINAL ISSUE DATE	SUB CONTRACTOR	PACKAGE/ UNIT

CATEGORY CODES:
R – Drawings which are required to be reviewed by NALCO
I – Drawings which are to be submitted for NALCO record.

LSTK VendorDrawing/Document Submission Schedule								
					LSTK VendorName:			
			PR No.:		**Address:**			
			Date of LOI:					
			PO No.					
			Date of PO:		**City:**			
			Contact Person(NALCO):		**Contact Person:**			**Fax:**
NALCO Originating Department: PACKAGE EQUIPMENT					**Phone:**		**Email:**	
S. No.	Equipment Number	Drg./Doc. Nomenclature as per NALCO Contractor Data Requirement	LSTK VENDOR'S Drg./Doc. Number	LSTK VENDOR'S Drg./Doc. Title	Category Review (R)/ Records (I)	Scheduled date of 1st Submission	From Electronic (E)/Print (P)	Remarks

SECTION – XVI : DRAWING/DOCUMENT TRANSMITTAL SHEET

Section-XVI

DRAWING/DOCUMENT TRANSMITTAL SHEET								
	LSTK VENDOR'S LOGO ETC. PL. DO NOT CHANGE LOCATION OR EXCEED THIS SPACE							
PR/TENDER NO.:					**JOB NO. :**			
LSTK VENDOR'SNAME:					**PROJECT :**			
NALCO LOI/PO NO.:					**CLIENT :**			
LSTK VENDOR'S LETTER: NO.					**DATE :**			
S. NO.	**DRAWING/DOCUMENT NO.**	**REV.**	**SHEET**	**TOTAL**	**DRAWING/DOCUMENT TITLE**	**CATEGORY**	**NO. OF COPIES**	**EQUIPMENT NO.**

TENDER PART B:LSTK VENDOR'S INORMATION

SECTION –XVII : KEY INFORMATION ABOUT THE PROPOSAL

SECTION-XVII

KEY INFORMATION ABOUT THE PROPOSAL

The LSTK Bidder shall submit this proforma properly filled-in in a complete and unambiguous manner, failing which the tender will be liable to rejection. No cross-reference to any other part/page of the tender will be accepted.

SN	Items	Description
1	Name of the LSTK Bidder	
2	Complete postal address	
3	Telephone number	
4	Fax number :	
5	E-mail address	
6	Name and Designation of thecontact person	
7	Proposal Number and Date of Submission	
8	Validity of the offer from the date of submission of the LSTK Bidder	
9	Whether any alternative proposal furnished in addition to the base offer	yes/no
10	Price quoted for the complete scope of work for	
a)	Supply of equipment & accessories FOT site with Taxes & Duties and other services as required	
b)	Installation, Testing, Commissioning of supplied equipment & accessories and other services	
11	Whether any deviation taken from the Specifications	yes/no
a)	If any indicated in deviation sheet.	
12	Whether list of spare parts and special tools and tackles submitted	Yes/no
13	Whether price quoted is firm	
14	In Case of variable price what is the:	
a)	What is the ceiling?	
b)	Price variation furnished?	Yes/no
15	Whether unit rate of all items quoted	
16	Whether LSTK Bidder agrees to comply with the delivery	yes/no

SN	Items	Description
	requirement as stipulated in this specification.	
17	Experience and other details of Engineering activities	
18	Particulars of all similar capacity plants executed during the last five (5) years	
19	Approximate value of all works committed for execution during the next eighteen (18) months.	
20	Completion time from the offer of Letter of Intent	
21	Completion of major equipment delivery from the date of Letter of Intent	

SECTION –XVIII : ASSESMENT OF CAPABILITIES OF TENDER

SECTION – XVIII

ASSESMENT OF CAPABILITIES OF TENDER

(TO BE SUBMITTED ALONG WITH THE OFFER)

(Please attach separate sheets wherever space is not sufficient)

Sl. No.	Description		Particulars
1.	Name of LSTK Bidder	:	
2.	Whether sole Proprietorship / Partnership / Limited Company / Co-operative Body / Joint Venture	:	
3.	Names of Proprietor / Partners / Directors	:	
4.	Structure and Organization	:	Please See Annexure-A
5.	Address, Telephone, Fax Nos. and e-mail address of Registered Office	:	
6.	Address, Telephone and Fax Nos. of Office through which the proposed work (if entrusted) will be handled with name and designation of person-in-charge	:	
7.	Registration particulars of Partnership/Limited Company / Co-operative Body/Joint Venture	:	
8.	Whether registered for works with Govt./Quasi Govt./Public Institutions etc.	:	Give details
9.	Experience and other details of Engineering activities	:	Please see Annexure-B
10.	Experience and other details of procurement activities	:	Please see Annexure-C
11.	Experience and other details of planning activities	:	Please see Annexure-D

Sl. No.	Description		Particulars
12.	Experience and other details of manufacturing and fabrication.	:	Please see Annexure-E
13.	Experience and other details of erection & piping at site.	:	Please see Annexure-F
14.	Civil suit/litigation (if any) on the contracts executed during the last ten (10) years/being currently executed.	:	Please see Annexure-G
15.	Arbitration cases (if any) during the last ten (10) years.	:	
16.	Income tax and Sales tax clearance certificate for last three (3) years (attached copy). Special emphasis shall be given for the contracts of Alumina Conveying by Pipe Conveyor..	:	
17.	Core competence of business	:	Engineering/manufacturing/ trading/projects
18.	Name & Address of Bankers/Hypothecation/ Pledge of properties, if any	:	
19.	Turnover	:	Attach audited balance sheets.
20.	Particulars of all Contract works during the last five (5) years.	:	Please See Annexure-H
21.	Approximate value of all works committed for execution during the next thirty six (36) months.	:	
22.	Particulars of Contract Works in hand	:	Please See Annexure-I
23.	Particulars of Managerial/Engineering Personnel and Technicians in continuous employment since last three years.	:	Please See Annexure-J
24.	Particulars of Sub-contractors and Consultants employed in past	:	Please See Annexure-K

Sl. No.	Description		Particulars
25.	Is the offer submitted on behalf of a Joint Venture?	:	Please See Annexure-L
26.	Confirmation by the LSTK Bidder for completing the 1000 TPH Alumina unloading &Transport system in 26months.	:	Yes/No
27.	Capability of the LSTK Bidder to carry out commissioning Work & Performance Test.	:	Please give details.
28.	Any special expertise or technology available for carrying out work of this type.	:	
29	Any foreign collaboration proposed in part or full i) Design and Engineering ii) Supply iii) Supervision of Work & Commissioning		
30.	Number of any supplementary sheets attached.	:	
31.	Free issue material	:	Please See Annexure-M

(**SIGNATURE OF BIDDER WITH SEAL)**

Notes :

a) All questions should be answered adequately with all the Annexures filled in and requisite details in absence of this the tender is likely to be rejected. All the Annexures shall be duly signed by theBidder with his seal on it.

b) In case the offer is on behalf of a Joint Venture above information should be furnished in respect of each of the Joint Venture partners together with a notaries copy of the Joint Venture agreement and the offer shall be signed by the Lead Partner.

ANNEXURE-'A'

STRUCTURE AND ORGANIZATION

Please indicate below or attach the organization chart showing the company structure including communication and responsibilities structure of engineering group, production group, procurement group, planning group, erection group, commissioning group (project group), finance group and QA group, the positions of Directors and relevant key personnel (by name). Specifically bring out the line of reporting.

Note: In case the tender is on behalf of Joint Venture or of a consortium of Companies, the above information shall be furnished in respect of each of the Joint Venturer/Consortium of Companies.

ANNEXURE – 'B'

EXPERIENCE AND OTHER DETAILS OF ENGG. ACTIVITIES

A) Organization chart for engineering activities giving following details:

1) No. of qualified and experienced design engineers in Alumina Conveying by Pipe Conveyor at supervisory level. Please give break up for individual discipline.

2) No. of qualified and experienced design engineers in Alumina Conveying by Pipe Conveyor at working level. Please give break up for individual discipline.

B) Other pertinent in-house facilities available

ANNEXURE – 'C'

EXPERIENCE AND OTHER DETAILS OF PROCUREMENT

A) Organization chart for procurement activities giving following details:

1) No. of qualified and experienced engineers/persons at senior managerial / supervisory level.

2) No. of qualified and experienced engineers / persons at working level.

3) No. of engineers / qualified inspectors engaged / to be engaged for quality surveillance and expediting.

ANNEXURE – 'D'

EXPERIENCE AND OTHER DETAILS OF PLANNING ACTIVITIES

A) Organization chart for planning activities giving following details:

1) No. of qualified and experienced engineers/persons at senior managerial level.

2) No. of qualified and experienced engineers/persons at working level.

B) Software packages available.

ANNEXURE – 'E'

MANUFACTURE AND FABRICATION OF EQUIPMENT

A) Organization chart for manufacturing and fabrication of equipment

1) No. of engineers at senior managerial level at manufacturing works.
2) No. of engineers/persons at managerial/supervisory level at manufacturing works.
3) No. of welders (GTAW/SMAW) on regular roll at manufacturing works.
4) No. of fitters/technician on regular roll at manufacturing works.
5) No. of QA engineers/qualified inspectors at manufacturing works.

B) Attach QA procedures/manual for manufacturing activities.

ANNEXURE – 'F'

FABRICATION AND ERECTION OF EQUIPMENT AT SITE

A) Organization chart for site fabrication and erection activities.

1) No. of engineers at senior managerial level.
2) No. of engineers/persons at managerial/supervisory level.
3) No. of welders (GTAW/SMAW) on regular roll.
4) No. of fitters/technician on regular roll.
5) No. of QA engineers/qualified inspectors for carrying out site erection QA work.

B) Attach QA procedures/manual for site work activities.
C) Name and address of clients for past five years.
D) Equipment and facilities available for the present job.
E) Details of construction plant & equipment. Please give the details of the plant & equipment actually proposed to be deployed at site.

The LSTK Bidder shall furnish herein, as per format given below, details of present resources indicating available equipment, testing facility and works or other establishments available in works.

The LSTK Bidder shall furnish also the list of Construction/Erection equipment and machinery he proposes to deploy at site to carryout Civil construction, Structural Steel Fabrication and Erection, Piping and mechanical equipment erection, Electrical and Instrumentation work. The LSTK Bidder shall also indicate the Quality Control Instruments/ Equipment he wishes to deploy for the said package.

Sl. No.	Description	Type	Make	Quantity	Ownership	Remarks

ANNEXURE – 'G'

LITIGATION HISTORY

Name of the LSTK Bidder or partner in a joint venture / consortium: ----------

LSTK Bidder, including each of the partners of a joint venture/consortium, should provide information on any history of litigation or arbitration resulting from contracts executed in the last ten years or currently under execution, as required in this document. A separate sheet should be used for each partner of a joint venture consortium

.

Litigation History					
Year	**Name of Client**	**Cause of Litigation**	**Matter Under Dispute**	**Award FOR or AGAINST theBidder**	**Disputed Amount**

Has the Bidder ever defaulted or been declared in default on a contract?

Yes/No

Has the Bidder ever been debarred, suspended, or otherwise prohibited from contracting with any Federal, State, or other government agency of entity? Yes/No

Within the last ten years, has the Bidder (including individual persons thereof), including any joint venture partner, been charged with, or convicted of any serious crime of felony or for corrupt practice?

Yes/No

ANNEXURE – H

PARTICULARS OF ALUMINA HANDLING CONTRACT WORKS OF EACH EXECUTED AND VALUE OF THE WORK EXECUTED EACH YEAR IN INDIVIDUAL CONTRACT DURING LAST FIVE YEARS

Sl. No.	Name of Project and Location	Type of Work Main Features and Quantities of the Work	Name and Address of Owner (whether Govt. / Quasi Govt. /Private Body) and Name of Consultants	Contract Amount		Value of work executed in each year (for Each contract)	Completion period (stipulated & actual)			Reference to Certificates by Consultants and Owner about satisfactory completion (attach Copies)
				Original Cost	Final Cost		Stipulated	Actual		
(1)	(2)	(3)	(4)	(5a)	(5b)	(6)	(7a)	(7b)	(8)	(9))

ANNEXURE – I
PARTICULARS OF CONTRACT WORKS IN HAND

Provide information about all projects in progress, including those where the Company has received a letter of intent, but a formal contract has not yet been awarded.

Sl. No.	Name of Project and Location	Type & Description of Work	Name and Address of Contact Person / Consultant with telephone No. (whether Govt. / Quasi Govt. / Private Body and Name of Consultants)	Contract Amount and Estimated Cost of Balance Work	Percentage Completion as on date	Completion period		Name and address of the banker	Present stage of work with reasons for delay (if any)
						Stipulated	Expected		
(1)	(2)	(3)	(4)	(5)		(6a)	(6b)	(7)	(8)

Note: In case the tender is on behalf of Joint Venture or of a Consortium of Companies, the above information shall be furnished in respect of each of the Joint Venture/Consortium of Companies.

ANNEXURE – J

PARTICULARS OF MANAGERIAL / ENGINEERING AND CONSTRUCTION PERSONNEL AND TECHNICIANS EMPLOYED AND IN SERVICE SINCE LAST THREE (3) YEARS

Sl. No.	Name	Age	Qualification	Experience		Nature of work handled	Previous Employment	Projects Handled
				In Organization	Previous			
(1)	(2)	(3)	(4)	(5a)	(5b)	(6)	(7)	(8)

ANNEXURE – K

SUB-CONTRACTORS AND CONSULTANTS

Give below the name and address of the sub-contractor(s) and Consultants employed in the past.

Sl. No.	Type of Work Sublet	Name and address of Sub-Contractor

Notes:

1) Attach additional sheets to provide information regarding financial, qualified manpower and other resources of the sub-contractor and Consultants.

2) Attach list of engineering, manufacturing, erection, inspection and testing facilities which were available with sub-contractors.

ANNEXURE – L
JOINT VENTURE

If the Bidder intends to enter into a joint venture for the project, please give the following information, otherwise state 'NOT APPLICABLE'.

1) Names and addresses of joint venture partners

2) Name of the Company leading the joint venture Scope of Work

3) Name of the Junior Partner Scope of Work

4) Name and address of Bankers of the joint venture partners

Note: The Bidder should submit the original copy of Joint Venture / Consortium agreement providing joint and several liability of all partners.

SECTION –XIX : LIST OF SPECIAL TOOLS & TACKLES

SECTION – XIX

LIST OF SPECIAL TOOLS & TACKLES

The Bidder shall tabulate below the item wise list of tools furnished by him for the operation and maintenance of the equipment supplied under this specification.

SN	Description	No. of Recommended Parts	Specification	Make

SECTION – XX :LIST OF RECOMMENDED SPARES FOR 2 YEARS OF OPERATION

SECTION – XX

LIST OF RECOMMENDED SPARES FOR 2 YEARS OF OPERATION

The Bidder shall quote recommended spare parts for two (2) years' continuous operation:

SN	Description	No. of Recommended Parts	Specification	Make

SECTION – XXI : LIST OF INSURANCE SPARES

SECTION – XXI

LIST OF INSURANCE SPARES

The Bidder shall submit the list of insurance spares:

SN	Description	Quantityof spares	Specification	Make

SECTION – XXII: LIST OF COMMISSIONING & START–UP SPARES

SECTION-XXII

List of Commissioning & Start – Up Spares for Alumina Unloading and Transportation				
S. No.	Qty	Unit	Item Description	Price Included with Equipment
01)	6	Nos	Pulse Air Valves (Solenoid Operated)	
02)	Air Break Contact Coils (220V AC) for following contacts			
03)	Moving & Fixed Contacts of the following ratings			
04)	HRC Fuse Link of the following ratings			
05)	12	Nos	Indicating Lamps clustered LED type	
06)	CT operated Ammetre (Without CT)			
07)	Bi Metallic Overload Relay of the following ratings			
	6	Nos.	Total of 6 Nos. comprising of Various Ratings	
08)	Single Pole MCB of the following ratings			
	10	Nos.	Total of 6 Nos. comprising of Various Ratings	
Total Commissioning Spares				
Note:				
The items & Quantities Specified are tentative.				
LSTK Biddermay include additional items based on previous experience				

SECTION – XXIII :MECHANICAL DATA SHEETS

Section – XXIII

MECHANICAL DATA SHEETS

SL. NO.	DESCRIPTION	DATASHEET NO.
1.	Pipe Conveyors	Datasheet 1
2.	Air Slide	Datasheet 2A
3.	Air Slide Fan	Datasheet 2B
4.	Manual Hoist	Datasheet 3
5.	Air Compressor	Datasheet 4
6.	Chutes & Skirt Board	Datasheet 5
6.	Dust Collector	Datasheet : 6
7.	Diverting Gate	Datasheet 7
8.	Electric Hoist	Datasheet 8
9.	Rotary Airlock Valve	Datasheet 9
10.	Slide Gate (Pneumatic)	Datasheet 10
11	Goods Cum Passenger Elevator	Data sheet 11
11.	Belt Weigh Scale	Data sheet 12
12.	Rope Winch System for Wagon Hauling (reversible type)	Data sheet 13
13.	Sump Pump	Data sheet 14

DATA SHEET 1: PIPE CONVEYORS

Sl. No.	Description	Unit	Item Description		
1	**GENERAL**				
	Eqpt. No		**PC-100**	**PC-200**	**PC-300**
	Quantity		1 no each	1 no each	1 no each
	Application		Clause no. 2.0 of Section III of tender Part A	Clause no. 2.0 of Section III of tender Part A	Clause no. 2.0 of Section III of tender Part A
	Conveyor C/C distance horizontal (approx.)	M	As per Layout & Sectional drawing	As per Layout & Sectional drawing	As per Layout & Sectional drawing
	Effective Lift or Drop (approx.)	M	As per Layout & Sectional drawing	As per Layout & Sectional drawing	As per Layout & Sectional drawing
	Tripper Lift	M	N.A	N.A	N.A
	Horizontal radius 1 (approx.)	M	tenderer to furnish	tenderer to furnish	tenderer to furnish
	Horizontal radius 2 (approx.)	M	tenderer to furnish	tenderer to furnish	tenderer to furnish
	Vertical concave radius 1 (approx.)	M	tenderer to furnish	tenderer to furnish	tenderer to furnish
	Vertical convex radius 2 (approx.)	M	tenderer to furnish	tenderer to furnish	tenderer to furnish
	Carrying Capacity	TPH	1000	1000	1000
	Return Capacity	TPH	0	0	0
	Proposed Belt Speed	m/sec	tenderer to furnish	tenderer to furnish	tenderer to furnish
	Proposed Belt Fill Factor (max.)*	%	tenderer to furnish	tenderer to furnish	tenderer to furnish
	Material Density (Volumetric)	T/m3	1.1	1.1	1.1
	Material Density (Power)	T/m3	1.55	1.55	1.55
	Material Max Lump Size	mm			

	Moisture Content	%	Nil	Nil	Nil
	Temperature	Degree C	45	45	45
	Abrasiveness		Abrasive	Abrasive	Abrasive
2	**BELTING**		tenderer to furnish following blank details		
	Belt Width / Pipe Diameter	mm/ mm			
	Belt Type				
	Rating				
	Cover Type				
	Cover Thickness (Top / Bottom)	mm/ mm			
	Safety Factor				
3	**IDLERS**		tenderer to furnish following details		
	Number of Rolls				
	Trough Angle	degree			
	Roll Diameter	mm			
	Shaft Diameter	mm			
	Bearing Type				
	Spacing / Pitch	mm/ mm			
4	**DRIVES**		tenderer to furnish following details		
	Installed Power	kW			
	Total Absorbed Power	kW			
	Motor Rated Speed	RPM			
	Gearbox Ratio				

5	**TAKE UP**		tenderer to furnish following details		
	Take-up Travel Direction				
	Tension System				
	Take-up Location				
	Take-Up Belt Tension	kN			
	Estimated Take-up Travel	M			
6	**BRAKE**		tenderer to furnish following details		
	Coasting Time Fully Loaded	sec			
	Braking Time	sec			
	Brake Torque (Low Speed)	kN-M			
7	**CONCAVE CURVES**				
	Dist Tail to IP	M			
	Min Radius	M			
8	**HOLD BACK**		tenderer to furnish following details		
	Hold Back Type				
	Recommended Rating (Low Speed)				
9	**CONVEX CURVES**		tenderer to furnish following details		
	Dist Tail to IP				
	Min Radius				
10	**Auxiliaries**				
	Magnetic separator		N.A	N.A	N.A
	Metal Detector		N.A	N.A	N.A
	Belt weigh scale		Required	N.A	N.A

11	**Recommended make:**		As per Section – V : List of preferred make of equipment		
	Gear box				
	Geared motor				
	Fluid couplings				
	Gear couplings				
	Pin bush couplings				
	Resilient couplings				
	Belt				
* Note: Vendor to re check the specified data & confirm					

Data Sheet 2A: Air Slide

Description	Unit	Equipment No. AS-100 & AS-200		Equipment No. AS-300		Equipment No. AS-400		Equipment No. AS-401		Equipment No. AS-500		Equipment No. AS-501	
		Specified	Offered	Specified	Offered	Specified	Offered	Specified	Offered	Specified	Offered	Specified	Offered
Material		Clause no. 2.0 of section III of tender part A		Clause no. 2.0 of section III of tender part A		Clause no. 2.0 of section III of tender part A		Clause no. 2.0 of section III of tender part A		Clause no. 2.0 of section III of tender part A		Clause no. 2.0 of section III of tender part A	
Bulk density	t/m3												
Moisture content	%												
Residue on 90 micron / Blaine	% / cm2/g												
Temperature	°C												
GENERAL													
Make / Supplier													
Type / Design *													
Capacity	t/h	500		1000		1000		1000		1000		1000	
Width	mm												
Height of top casing	mm												

Length	m												
Slope	deg												
Specific air requirement	m3/m2h												
-													
POROUS LAYER													
Type / Thickness *	/ mm												
Air permeability at 30 mbar	l/dm2 min												
SPECIAL DESIGN													
Number of inlets													
Number of discharges													
Number of bends													
Type of operating gates *													
Number of inspection openings													
Number of cleaning openings													
THROTTLE VALVES													
Make / Type / Design *													
Number													
FAN / BLOWER													
Type / Design *													
Capacity	m3/h												
Pressure differential	mbar												

Fan speed	1/min												
Suction air filter type													
DRIVE													
Motor power required	kW												
Motor Power installed	kW												
Motor speed	1/min												
* Add leaflets and sketches with dimensions of the equipment mentioned													

Data Sheet 2B: Air Slide Fan

Description	Unit	Equipment No. BL-100 & BL-200		Equipment No. BL-300		Equipment No. BL-400		Equipment No. BL-401		Equipment No. BL-500		Equipment No. BL-501	
		Specified	Offered	Specified	Offered	Specified	Offered	Specified	Offered	Specified	Offered	Specified	Offered
Material		Clause no. 2.0 of section III of tender part A		Clause no. 2.0 of section III of tender part A		Clause no. 2.0 of section III of tender part A		Clause no. 2.0 of section III of tender part A		Clause no. 2.0 of section III of tender part A		Clause no. 2.0 of section III of tender part A	
Bulk density	t/m3												
Moisture content	%												
Residue on 90 micron / Blaine	% / cm2/g												
Temperature	°C												
GENERAL													
Make / Supplier													
Type / Design *													

Capacity - nominal / maximum	t/h / t/h												
Width	mm												
Height of top casing	mm												
Length	m												
Slope	deg												
Specific air requirement	m3/m2 h												
-													
POROUS LAYER													
Type / Thickness *	/ mm												
Air permeability at 30 mbar	l/dm2 min												
SPECIAL DESIGN													
Number of inlets													
Number of discharges													
Number of bends													
Type of operating gates *													
Number of inspection openings													
Number of cleaning openings													

THROTTLE VALVES													
Make / Type / Design *													
Number													
FAN / BLOWER													
Type / Design *													
Capacity	m3/h												
Pressure differential	mbar												
Fan speed	1/min												
Suction air filter type													
DRIVE													
Motor power required	kW												
Motor Power installed	kW												
Motor speed	1/min												
* Add leaflets and sketches with dimensions of the equipment mentioned													

Datasheet 3: MANUAL HOIST

SUBJECT	DESCRIPTION (UNIT)	Eqpt. No. XXX	
		SPECIFIED	OFFERED
General			
	o No. provided	As per requirement	
	o Location / Service		
	o Heaviest load to be handled (T)	2	
	o Make		
	o Type/design code	IS:3832	
	o Self-locking (Yes / No)	Yes	
	o Safe working load (kg)		
	o Lift of load hook (m)	maximum 10 m	
	o Recommended size of' I-beam (mm)		
	o Minimum permissible horizontal curvature of monorail (m)		
	o Total weight of unit inclu ding trolley (kg)		
Hooks	o Type / Design Code		
	o Material standard		
Chain	o Type / Design code		
	- Load chain		
	- Hand chain		

	o Size		
	- Load chain		
	- Hand chain		
	o Material standard		
	- Load chain		
	- Hand chain		
	o Number of chain falls supporting		
	o Hook block		
	o Max. clearance between operating floor and hand chain lower end (mm)	1200	
Trolley	o No. of pair of wheels		
	o Wheel design code		
	o Wheel base (mm)		
	o Material standard		
	- Trolley frame		
	- Wheel		
Gears	o Type / Design Code		
	o Material standard		
	o Reduction ratio		
	- Lifting		
	- Travel		
	o Lubrication		

Safety Devices	o Details		
Additional	Whether the following items have been furnished		
	o Leaflets & brochures		
	o Dimensional GA dwg.		
NOTE: 1. Manual Hoist as may be felt necessary during detailed engineering has to be provided by the tenderer without any extra cost to the purchaser			

Datasheet 4: AIR COMPRESSOR

Sl. No.	DESCRIPTION (UNIT)	SPECIFIED	OFFERED
1.	**Air Compressor**		
a)	Manufacturer		
b)	Model number & type	Screw type	
c)	Design Code		
d)	Number Required	9 (8w+1s)	
e)	Capacity of compressor (CFM)	By Tenderer	
f)	Discharge pressure [Bar(g)]	7.5	
g)	Design ambient temp (^oC)	Refer climatic condition of spec.	
h)	Design ambient relative humidity (%)	Refer climatic condition of spec.	
i)	Air temperature of compressor discharge (^oC)	Refer climatic condition of spec.	
j)	Power required at the compressor in rated condition (KW)		
2.	**Motor**		
a)	Type	TEFC Sq. Cage motor	
b)	Drive manufacturer		
c)	Rated volt of motor (V)		
d)	Frame size		

e)	Rated power (KW) of motor offered		
f)	Type of insulation	IP 55	
g)	Type of enclosure		
3.	**Air Receiver**		
a)	Type	Vertical,cylindrical	
b)	Design Code	ASME Section-VIII, Division I	
c)	No. of Reciver	2	
d)	Air receiver volume(m3)	5	
e)	Air receiver size (mm dia x HOS)		
f)	All connection, valves, traps instrument etc. furnished as required (Yes/No)		
g)	Air intake filter size(cfm)	As required	
h)	Type & make	Coalescing	
i)	Moisture separator & drier provided (Yes/No)	yes	
j)	Removing liquid water and oil aerosol	1 ppm and particles downs to 1micron	
4.	**Painting**		
a)	Type		
b)	No. of Coat		
c)	Dry film thickness (micron)		

Notes
1. Bidder will furnish separate sheet for compressor used for other application
2. All oil Filters, Ultra Filters,Refrigerator type Dryer,Air Receiver, Motor etc. are to be provided by the tenderer.

Datasheet : 5 - CHUTES & SKIRT BOARD

SUBJECT	DESCRIPTION (UNIT)	CHUTES & SKIRT BOARD	
		SPECIFIED	OFFERED
General	o Material handled	Alumina; Pls. refer clause no. 2.0 of section III of tender part A for details.	
	o Particle size (mm)	Refer Spec	
	o Moisture content (% W/W))	Refer Spec	
	- Average	nil	
	o Angle of repose (Deg)	Refer Spec	
	o Bulk density (T / cu.m)	Refer Spec	
Chute	o Material Standard	Fe410WB; IS:2062,except magnetic zones where SS-304 (non-magnetic) to be provided	
	o Thickness (mm)	10 (min.)	

Chute Liner	o Material Standard	Tiscral / Sailhard / Sailma / Hardox-400 / Bisalloy	
	o Thickness (mm)	10 (min.)	
	o Minimum Valley angle	50 deg.	
Hood	o Material Standard	Fe410WB; IS:2062	
	o Thickness (mm)	6 (min.)	
Skirt Board	o Material Standard	Fe410WB; IS:2062,	
	o Thickness (mm)	10 (min.)	
Skirt Liner	o Material Standard	Tiscral / Sailhard / Sailma / Hardox-400 / Bisalloy	
	o Thickness of Skirt Liner (mm)	10 (min.)	
	o Thickness of Rubber Strip	20mm (45 to 55 shore hardness)	
	o Thickness of skirt cover	2mm , MS	

DataSheet 6: Dust Collector

Description	Unit	Specified	Offered	Specified	Offered	Specified	Offered	Specified	Offered
INLET CONDITION									
Max.gas flow rate per Bag Filter	$m^3/hr.$								
Gas temperature(Max.)	deg.C	45		45		45		45	
Max dust concentration	gm/Nm3	25		25		25		25	
Static pressure at bag filter inlet	mm wg								
Type of dust									
Gas Velocity at inlet	m/s								
OUTLET CONDITION									
Dust concentration	mg/Nm^3	10		10		10		10	
GENERAL									
Type									
No. of Modules per Bag filter									
Equipment no.		**DC-100**		**DC-200**		**DC300**		**DC400**	
No. of filter bags per Bag Filter	nos.								
Bag arrangement									
Filtration area per Bag Filter	sq.m								
Air to cloth ratio -Gross	$m^3/m^2.min$	1.5		1.5		1.5		1.5	

Air to cloth ratio -Net	$m^3/m^2/min$								
Can Velocity	m/s								
Hopper Valley Angle (min)	Deg.								
Filtration efficiency	%	95		95		95		95	
Pressure drop across filter	mm WC								
casing design pressure	mm WC								
Insulation Recommended	yes / no								
HOPPER									
Type									
Number per Bag Filter									
Plate Thickness									
Housing	mm								
Hopper	mm								
Tubesheet	mm								
Inspection door size	mm								
Walk in Plenum height	mm								
Acess door location / size	mm								
Supporting Structure	yes / no								
Access Ladder and platform	yes / no								
BAG DETAILS									

Material									
Diameter	mm								
Length	mm								
Fabric weight	gm/m2								
Maximum temperature bag can withstand	Deg.C								
Type of Fastening									
Expected life of fabric	Years								
Guarantee life of fabric	Years								
CAGE DETAILS									
Wires									
Material									
TUBE SHEET									
Material									
Thickness	mm								
PULSE VALVES									
Type									
Make									
CLEANING ARRANGEMENT									
Type									
Quantity of solenoid valves	nos								

Air Volume required	scfm								
Pressure required	Kg/cm^2g								
Time range of pulsation (Adjustable)	ms								
Time range of off period (Adjustable)	s								
Pulse air control by timer	yes / no								
Pulse air control by pressure difference	yes / no								
Differential pressure gauge / switch type									
Solenoid Valve size	mm								
No of bags per blow pipe									
Permissible moisture									
Permissible oil content									
THERMAL INSULATION									
MALTERIAL HANDLING EQUIPMENT									
Type									
Size	mm * mm								
FLOOR SPACE REQUIREMENT (Approximate)	mm * mm								
Explosion safety (if applicable)									
Material to be handled									
Dust explosion class acc. VDI standard: St1/ St2/ St3									

Deflagration Index (K_{st})	bar*m/s								
Maximum explosion pressure (P_{max})	bar								
Explosion safety measures *									
Explosion vents	yes / no								
Quantity per compartment									
Type									
Make									
Size	mm x mm								
Location									
Pstat range	bar - bar								
Total filter venting area	m2								
Limit switches	yes/no								
DUST EXTRACTION									
Equipment No.		**RV-100**		**RV-200**		**RV-300**		**RV-400**	
Type / Design*									
Make									
Size - diamater / length	mm /mm								
Size - Height / Width	mm /mm								
Capacity	t/h								
Installed motor power	kW								

Weight Details									
Total weight of the bag-filter	T								
Total weight of the fan and drive	T								
ID FAN									
Equipment No.		**EF-100**		**EF-200**		**EF-300**		**EF-400**	
Capacity	M3/Hr.								
Static pressure	mm WG								
Temperature	Deg C								
Dust load	mg/NM3								
Static efficiency	%								
Shaft power at minimum ambient temp. of 10 Deg C									
Recommended motor	kW/P								
RPM of Motor									
Type of fan									
Type of inlet damper									
Type of LT Motor									
Fan orientation									

d

Datasheet 7: Diverting Gate (Pneumatic Type)

Description	Unit	Equipment No. DG-100	
		Specified	Offered
General			
Application			
Type (Regulating / On-Off)	R / O	O	
Make/Model No.			
Capacity	tph	1000	
Diverter angle	deg.		
Quantity	nos.	1	
Location		At Transfer Point (TP-1)	
Duty (continuous/intermittent)		intermittent	
Orientation / Mounting arrangement			
Material Properties			
Material to be handled		Clause no. 2.0 of section III of tender part A	
Nature of material			
Bulk density - Sizing / Capacity	ton / m^3		
Bulk density - Volume / Power	ton / m^3		
Particle Size			
Moisture Content	%		
Temperature (Normal/Maximum)	^oC		
Flowability			
Angle of Repose	Deg C		
Angle of Surcharge	Deg C		
Is GA drawing enclosed with the offer?	Y / N		
Constructional Details			
Overall diverter size	mm		
Inlet chute opening size	mmxmm		
outlet chute opening size	mmxmm		

Operating Mechanism			
Operating time- full operation	sec		
Casing details			
Material of construction / Thickness	/ mm		
Hardness	BHN		
Casing liner details			
Material of construction / Thickness	/ mm		
Hardness	BHN		
Liner fixing arrangement			
Flap details			
Material of construction / Thickness	/ mm		
Hardness	BHN		
Flap liner details			
Material of construction / Thickness	/ mm		
Hardness	BHN		
Liner fixing arrangement			
MOC of Lever			
Shaft details			
Material of construction / diameter	/ mm		
Shaft sealing details	BHN		
Sealing arrangement between diverter body and flap			
Type			
Material			
Efficiency	%		
Actuator		Pneumatic	
Pneumatic Arrangement			
Type			
Make/Model			
Mounting			
Operating Pressure	kg/cm^2		

Compressed air reuierment	m^3/stroke		
Max. no. of cycle / hr			
Cylinder Bore			
Stroke length			
Volume per cycle	cfm		
Air pressure required	kg/cm^2		
Proximity Switches (Non-Contact)			
- Type			
- No			
- Make / Model			
WEIGHT OF EQUIPMENT			
Total weight	kg		

Datasheet 8: Electric Hoist

Description	Unit	Equipment No. EH-1		Equipment No. EH-2		Equipment No. EH-3		Equipment No. EH-4	
		Specified	Offered	Specified	Offered	Specified	Offered	Specified	Offered
Location		Unloading Station		Compressor/ blower room		Transfer House TP-01		Transfer House TP-02	
LOAD DATA									
Required capacity	t	2		3		4		4	
Required lift	m								
Travel distance to hoistway	m								
GENERAL									
Make / Supplier									
Type / Design *									
Lifting capacity	t								
Lifting height	m								
Straight or curved girder	S / C								
Total weight	t								
TRAVELLING									
Girder - type / design **									
Motorized / manual drive	Mot / Man								
Speed - normal / creep drive	m/min / m/min								
Motor power installed	kW								
Hoist travel brake *									
Min. distance of hook from each end stop	mm / mm								

HOIST									
Chain hoist	yes / no								
Number of chain line									
Chain breaking strength	kN								
Wire rope hoist	yes / no								
Number of rope line									
Rope diameter	mm								
Wire rope breaking strength	kN								
Type / Design *									
Speed - normal / creep drive	m/min / m/min								
Motor power	kW								
Load break type *									
Safety limit switches *									
Min. distance - hook to bottom of girder	mm								
CONTROLS									
Festoon cable and track *									
Pendent / Cabin	P / C								
Control box *									
Cable attached to -Bridge / Trolley	B / T								
Overload protection	yes / no								
* Add leaflets and sketches with dimensions of the equipment mentioned									
** Add design calculation sheets as required									

Datasheet 10: Rotary Airlock Valve

Description	Unit	Equipment No. RV-101		Equipment No. RV-102		Equipment No. RV-202	
		Specified	Offered	Specified	Offered	Specified	Offered
FEED		Clause no. 2.0 of section III of tender part A		Clause no. 2.0 of section III of tender part A		Clause no. 2.0 of section III of tender part A	
Material		Alumina		Alumina		Alumina	
Bulk density	t/m3						
Moisture content	%						
Particle size max. / residue on 90 micron	mm / %						
Temperature	°C						
GENERAL							
Make / supplier							
Type / design *							
Inlet / outlet dimension	mm / mm						
Capacity - volumetric maximum	m3/h						
Capacity	t/h	1000		1000		1000	
Filling degree at nominal capacity	%						
Rotation speed	rpm						
Feeder body heatable	yes / no						
ROTOR							
Diameter	mm						
Width	mm						
Number of blades							

Thickness of blade	mm						
Blade / tip replaceable	yes / no						
Active volume	l						
Shaft diameter	mm						
Shaft heatable	yes / no						
DRIVE							
Type / Design *							
Motor power required	kW						
Installed motor power	kW						
Speed	rpm						
GEAR BOX							
Make / Supplier							
Type / Design *							
COUPLING	-						
Make / Supplier							
Type / Design *							
Explosion safety (if applicable)							
Classification of working ex-zone							
Explosion pressure safety	bar						
* Add leaflets and sketches with dimensions of the equipment mentioned							

Datasheet 10-Slide Gate (Pneumatic)

Description	Unit	Equipment No.PG-001 & PG-002		Equipment No.PG-003 & PG-004	
		Specified	Offered	Specified	Offered
Type		Pneumatic		Pneumatic	
Location		Transfer House TP-02		Transfer House TP-03	
Application					
PROCESS DATA		Clause no. 2.0 of section III of tender part A		Clause no. 2.0 of section III of tender part A	
Material Sealing Efficiency	%				
Capacity in terms of Material Flow	tph				
Maximum Allowable Temperature	0C				
Design temprature	0C				
Characteristics of Material Handled		Clause no. 2.0 of section III of tender part A		Clause no. 2.0 of section III of tender part A	
- Bulk Density for volume/power/civil	t/m^3				
- Moisture(Max.)	%				
- Particle Size					

EQUIPMENT DETAILS					
Type					
Make/Model					
Shut gate Size	mm				
Overall size of Gate	mm x mm				
Face to Face Height of Slide Gate	mm				
- Time taken for opening fully	min				
- Time taken for closing fully	min				
- Maximum no. of operations permitted/hr					
Material of Construction					
- Body (Frame)					
- Flap (Blade)					
- Spindle					
- Roller					
-Cylinder Crank					
- Sealing Material around the Flap/Blade					
- Wiper Blade for Cleaning Flap/Blade					

Material Thickness	mm				
- Body (Frame)	mm				
- Flap (Blade)	mm				
- Guide Pin for Flap	mm				
- Guide Roller Dia	mm				
Seal Element					
Sealing Arrangement for Blade					
Type					
Maximum withstanding temperature for seal					
whether displacement pockets is provided for cutting the slide plate through column of material ?	Y/N				
Pneumatic Arrangement					
Type					
Make/Model					
Mounting					
Operating Pressure	kg/cm^2				
Compressed air reuierment	m^3/stroke				
Max. no. of cycle / hr					
Cylinder Bore					

Stroke length					
Volume per cycle	cfm				
Air pressure required	kg/cm^2				
Proximity Switches (Non-Contact)					
- Type					
- No					
- Make / Model					
WEIGHT OF EQUIPMENT					
Total weight	kg				

Datasheet 11-Goods Cum Passenger Elevator			
Technical Specification Description	**Unit**	**Equipment No. EL-01**	
		Specified	**Offered**
Location		Near to Transfer Point (TP-3) / silo no. 5	
Type of elevator		Rack & Pinion	
Quantity		1	
Payload Capacity	kg		
Rated speed (with slow speed of 50%)	m/min		
Total travel	m		
Nos. Landing		Ground + 2	
Top level of landing		EL +168.340	
Cage Internal size	mm X mm X mm		
Car frame		Car structure shall be of steel with special painting or of stainless steel.	
Car enclosure		Sides of the car shall be lined with heavy guage stainless steel sheet plate properly braced & reinforced. Body floor shall be of MS Steel construction with chequered plate top, side panels shall be of SS 304 and roof shall be of SS over MS frame.	
Type of car/landing doors		Horizontally collapsible type door.	
Landing/car door operation		Manual.	
Nos. of Drive		Selective collective automatic operation as per clause no. 3.41.3 of IS 14665 (Part 2/Sec1):2000 with or without attendant.	
Motor Rating	kw		
Motor speed	rpm		

Elevator operation		Selective collective automatic operation as per clause no. 3.41.3 of IS 14665 (Part 2/Sec1):2000 with or without attendant.	
Method of control		Through three phase two-speed squirrel cage induction motor.	
Ambient temperature (max)	deg C	45	
Control voltage		110 V AC	
Signals		Call buttons with Tell-Tale lights at all floor and car position indicator in car and at all landings.	
Emergency exit provision		Yes	
Design & testing standard		IS 14665 (Part, I, II & III)	
Total weight of Equipment	kg		
Note : Total travel and no. of landings shall be confirmed during detail engineering			

Datasheet 12-Belt Weigh Scale			
Description	**Unit**	**Equipment No. BW-001**	
		Specified	**Offered**
Type		Electronic ; multi-idler belt weigher.	
Capacity		1000 tph	
Material handled		Alumina.	
Bulk density		1.1 t/m3	
Flow		Free flow.	
Weighing range		**10% - 110% of nominal capacity.**	
Temp. range of operation		+ 5 deg.C to + 70 deg.C.	
Duty		Continuous.	
Calibration		Test chains / standard weight.	
Accuracy		**± 0.5% FS or better for installation and verification (static).**	
		± 1.0% FS or better for normal running (dynamic).	
Weight sensor		Strain gauge type load cell.	
a) Capacity		Suitable for maximum flow rate.	
b) Safe overload		**Upto 150% of specified range**.	
c) Safe operating temp.		+ 5 deg.C to + 7 deg.C.	
d) Enclosure protec. class		Hermetically sealed / IP-67.	
e) **Accuracy**		**± 0.1% FSD.**	
Speed sensor		**Tacho generator.**	
Local console cabinet		Free standing type.	
Enclosure class		Full sealed against dust & moisture (IP-54).	
Electronic circuits		Plug in type printed circuit board in standard 10" rack.	

P C boards		Grouped functionally with test sockets for all 'key' function.	
Monitoring and controlling facilities			
a) Rate (TPH)		Digital display.	
b) Totalizer (Tonnes)		Electronic digital display.	
c) Fault annunciation		LED display.	
d) Tare		Potentiometer adjustment.	
e) Switch		Mains ON/OFF with indicating lamp.	
f) Signal outputs		For remote display of rate & quantity -	
		a) 4-20 mA isolated signal for Feed Rate & Speed.	
		b) Pulse output for totalizer.	
		c) Potential free contacts for alarms.	
Integrator/Totalizer			
Type		Electronic type (with battery back up).	
Display		6 digit, 7 segment display.	
Input to integrator unit		4-20 mA DC.	
Reset		Manual.	
Readable distance		3m (minimum).	
Mounting		Flush.	
Dimension		Standard Miniature Case.	
Accuracy		± 1least significant digit.	
Operating ambient temp.	deg C	45	
Connection between tray & totaliser		Prefab cable with quick connecting plug & socket adequate cable length to permit full withdrawal of totaliser from tray with cables connected.	

Accessories		i) Mounting tray.	
		ii) Engraved phenolic nameplate with Tag No. service etc.	
Preferred feature		i) Multiplication & division facility for unit conversion.	
		ii) Power supply ON / FAILURE, LED visible from front.	
Power supply		AC – 240V, 50 Hz. Or 24V DC Recharge-able internal battery for 150 to 300 hrs. operation shall be provided.	

Datasheet 13-Rope Winch System for Wagon Hauling (Reversible type)			
Description	**Unit**	**Specified**	**Offered**
No. of wagon Hauling System		Two (2)	
Type of each System:		Rope Winch type wagon hauling System (Reversible)	
Hauling capacity for each system at a time		12 nos. BTAP loaded alumina wagons	
Rope Pull	ton	To be furnished by Tenderer	
Rope Speed	m/min	16 (approx)	
Rope Specification:-			
MOC		Steel (Fibre Core)	
Dia	mm	By tenderer	
construction		By tenderer	
Strength	N/mm 2	By tenderer	
Code		IS : 2266	
Length	m	By tenderer	
Motor rating & rpm for each winch drive system:		By tenderer	
Jaw Clutch(Input after motor):-		By tenderer	
Make			
model			
Raing			
Fluid Coupling (Input):-		By tenderer	
Type			
Make			
model			
Raing			
Brake:-		By tenderer	
Type		DCEM	
Make			
model			

Rating of braking torque	kg-m		
Gear Box:-		By tenderer	
Type			
Make			
Model			
Reduction ratio			
Duty		Reversible	
Winch Drum:-		By tenderer	
Drum Dia	mm		
Drum Length	mm		
Drum Plate Thickness	mm		
Safety switches, if any		By tenderer	
ROPE TENSIONING ARRANGEMENT:-		By tenderer	
Type of tensioning arrangement:		Automatic (motorised)	
Take-up drive motor rating			
Coupling:-		By tenderer	
Type			
Make			
model			
Rating			
Brake:-		By tenderer	
Type		DCEM	
Make			
model			
Rating of braking torque	kg-m		
Brake Drum Dia	mm		
Gear Box:-		By tenderer	
Type			
Make			
Model			
Reduction ratio			
Duty		Reversible	

Take-up winch Drum:-			
Drum Dia	mm		
Drum Length	mm		
Drum Plate Thickness	mm		
Safety switches, if any		By tenderer	

Datasheet 14-Sump Pump			
Description	Unit	Equipment No. P-1 & P-2	
		Specified	Offered
GENERAL INFORMATION			
Maximum Ambient Temperature	deg.C	45	
Hours of Operation	Hours/Day	24	
Minimum Nos. Required		2 (1w + 1s)	
Location		Inside tunnel at unloading station.	
SUMP PUMP REQUIREMENTS			
Type		Vertical Non-clog type, capable for handling of slurry (alumina dust) / seepage water.	
Number of Stages		Single.	
Fluid Type to be Handled		Slurry with 20% concentration of solids (alumina dust).	
Discharge Capacity (Minimum)	m3/hr.	20	
Piping with valves fittings		The pipe line should be so designed that no vent. drain & valves are required. Each pump shall have independent discharge line.	
Pipe & Fittings		As per IS:1239, Heavy grade.	
Total Head	m	15 approx. (As reqd. to discharge in Surface Drain).	
Auto/Manual selector switch & Local Panel Provided or not			
Drive Type		Motor.	
Type of liquid level sensors for automatic starting/stopping		Float type.	
Type of Strainer at the impeller inlet		Basket type strainer at impeller inlet shall be provided.	
Type of Bearing		Bush/Ball/Roller as applicable.	

Method of Lubrication		Oil/Grease.	
Method of Coupling		Flexible/Semi-flexible.	
Motor		As per standard Motor Specification.	
MATERIAL OF CONSTRUCTION			
Shaft		SS-316.	
Impeller		Alloy-CI.	
Casing		CI Grade-260 of IS-210.	
Shaft Sheave		SS-410.	
Welding Plate		Alloy-CI.	
All other submerged part including nuts and bolts		SS or Non-corrosive/equivalent.	

NOTES

1. Head of Pumps shall be decided by Bidder on piping layout. The same shall be subject to approved by Purchaser.
2. Pumps to be used as 100% stand-by.
3. The above capacity of pumps are indicative and minimum only. The selection will be subject to Purchaser's approval and if during detailing stage the capacity requires to be increased the same should be done by the contractor without any extra cost.

SECTION – XXIV: ELECTRICAL FEEDER LIST

SECTION – XXIV

ELECTRICAL FEEDER LIST

(TO BE FURNISHED ALONG WITH TENDER)

TABLE-I

Sl. No.	Equipment No.	Equipment Description	No.-of Motor per Equipment /Total qty.	Motor Power in KW (each)	Total Motor Power in KW	Remarks
1.a		Rope Winch System for wagon Hauling (2-Nos)				
1.b		Automatic Rope Tensioning Arrangement (2 Nos.)				
2		Pneumatic Unloading System from wagons to Under ground pit through Air Slides (1set)				
3.a	KA100 to 108	Air Compressors (For 8 Nos. working + 1 sand by)				
3.b	BL100 , 200& 300	Blower for air slides (For 3nos.)				
3.c	FN100 &200	Pressurization Fan for Blower Room. (2 nos.)				
4	P-1 & 2	Sump Pump (1w +1s)				
4	EL-01	Goods cum passenger lift (Rack and Pinion type, located near silo no. 5)				
5	PC-100	Pipe Conveyor (1 No.)				
6	PC-200	Pipe Conveyor (1 No.)				
7	PC-300	Pipe Conveyor (1 No.)				
7	DE-1	De-dusting system complete unit near unloading station (1 No.)				
8	DE-2	De-dusting system complete unit in Transfer House TP-1(1 No.)				
9	DE-3	De-dusting system complete unit in Transfer House TP-2(1 No.)				
10	DE-4	De-dusting system complete unit in Transfer House TP-3(1 No.)				
10	FN-400	Blower for air slide				
11	FN-401	Blower for air slide				
12	FN-500	Blower for air slide				
13	FN-501	Blower for air slide				
14	EH-1,2,3,4 &5	Electric Hoist (5 nos.)				
15	BW-1	Belt weigher (1 no.)				
Note: In addition to above, Bidder has to indicate the auxiliary drives, Control and illumination also. If any other Feeders are required, Bidder to specify.						

SECTION – XXV : DEVIATIONS

SECTION – XXV

DEVIATIONS

The Bidder shall furnish an exhaustive list of deviations if there is any, in his proposal as per the following format.

(TO BE FILLED IN BY BIDDER**)**

(Add more sheets if required)

Spec /Doc No.	Clause No.	Page No.	Item/ Clause	MR requirement	Deviation Taken	Remarks/ Justification of it's Need

SECTION – XXVI : REFERENCE LIST

SECTION – XXVIII

REFERENCE LIST

The LSTK Bidder shall tabulate below a list of jobs already executed by him as regards to the supply and/or turnkey execution of similar packages/projects for last 7 years. The list shall contain all relevant information on type, capacity, client, project/order values, scheduled and actual time of execution and any other pertinent information as may be considered worth mentioning for the purpose of assessing his capability. LSTK Vendorshould arrange visit to his latest installation during stage of tenderingding and also at execution phase (if required).

SN	Name of Customer	The order reference	Order date	Actual duration of execution	Year of Supply	Capacity	Technical details	Contact person

ANNEXURE III : SPECIAL CONDITIONS OF CONTRACT

ANNEXURE-III
SPECIAL CONDITIONS OF CONTRACT

1.1 The Intent of this specification is to Design supply, construction, fabrication, erection and commissioning services for execution of projects according to most modern and proven techniques and codes. The omission of specific reference to any method and equipment or material necessary for the proper and efficient services towards installation of the Plant shall not relieve the contractor of the responsibility of providing such services, facilities to complete the project awarded to him. The quoted rate shall deem to be inclusive of all such contingencies. Major technical drawings and datasheets are to be approved by the Nalco prior commencement of manufacturing or construction.

1.2 It is essential that, contractors desirous of participating in the tender should visit and assess the site to have hands on requirement of the scope of work. The contract which is intended to be executed on LSTK basis is inclusive of all materials for execution of the work. Site assessment is important considering the fact that this is a revamping job and requires integration with existing equipment.

1.3 It is not the intent to specify herein all details of material. Any item related to this work not covered, but necessary to complete the system will be deemed to have been included in the scope of the work and to be finalized during detail engineering as specified in the scope of work. Customization required for successful completion of the project during progressive execution of the contract has to be undertaken by the contractor and shall be deemed as a part of the scope of work.

1.4 During the course of erection, testing and commissioning work, certain rework/modification / rectification / repairs / fabrication etc. may be necessary on account of existing system/ already commissioned and / or units also on account of design changes and manufacturing incompatibilities and site operation / maintenance requirements. Contractor shall carryout such rework / modification / rectification / fabrication / repairs etc, promptly and expeditiously and the same shall be deemed to be part of the scope of work.

1.5 The work shall be executed in the running/ operating plant & in conjunction with numerous other operations at site. The bidder and his personnel shall co-operate with the existing operating setup and proceed in a manner that shall not affect the operation in anyway.

1.6 The contractor shall carry out the work in accordance with instructions/ drawings/ specification/ standard practices/ national and international norms.

1.7 Good quality and accurate workmanship for proper performance of equipment / systems shall be guaranteed by the contractor on every stage of supplies and works.

1.8 Preservation of all components at all stages of pre-assembly/ erection/testing and commissioning till completion of trial run of unit.

1.9 On Completion of work all the temporary buildings, structures, pipe lines, cable etc. shall be dismantled and levelled and the contractor at his cost shall remove debris as per instruction of Nalco. In the event of his failure to do so, the expenditure towards clearance of the same will be recovered from the contractor.

1.10 Within one month of final handing over of the system, the contractor has to dismantle the site office/ware house, disconnect electricity/water supply, take back the container (if brought from own source) from plant premises. Then only, their final bill shall be considered for payment.

1.11 The Contractor shall deploy experienced Engineers, Supervisors all the skilled workmen like High Pressure Welders (gas, TIG and arc) Carbon, alloy steel welders, Gas cutters, electricians, Riggers, Serangs, rectors, carpenters, fitters etc. in addition to other skilled semi-skilled and unskilled workmen required for all the works of handling and transportation from site storage to erection site, transportation, erection, testing and commissioning contemplated under this specification. Only fully trained and competent men with previous experience of the job shall be employed. They shall hold valid certificates wherever necessary.

1.12 The contractor's supervisory staff shall execute the work in the most substantial and workman like manner in the stipulated time. Accuracy of work, good workmanship and aesthetic finish are essential part of this contract. The contractor shall be responsible to ensure that assembly and workmanship conform to the design/ specifications/ instruction and expected level of the client/ customer.

1.13 If the contractor or his workmen or employees shall break, deface, injure or destroy any part of a building, road, kerb, fence, enclosure, water pipes, cables, drains, electric or telephone posts or wires, trees or any other property or to any part of erected components etc. The contractor has to reinstate the same at his own expense.

1.14 The work covered under this scope of work is of highly sophisticated nature requiring best quality / proven workmanship engineering and construction management. It should also ensure successful and timely commercial operation

of equipment installed. The contractor must have adequate quantity of precision tools, construction aids in possession. Contractor must also have adequate trained qualified and experienced supervisory staff and skilled personnel.

1.15 All the necessary statutory certificates and licenses required to carry out this scope of work are to be arranged by the contractor then and there at no extra cost.

1.16 The contractor shall deploy adequate number of qualified safety personnel at site to supervise day-to-day construction safety. The contractor shall be responsible for taking all safety precautions during the construction and leaving the site safe at all times. When the work is temporarily suspended he shall protect all construction materials, equipment and facilities from causing damage to existing property interfering with the operations of the station when it goes into service. The contractor shall comply with all applicable provisions of the safety regulations clean-up programme and other precautionary measures, which the NALCO has in effect at the site.

1.17 All electrical installation covered in contractors scopes are to be inspected/approved by the electrical inspector/statutory authority. Contractor is responsible for getting the Electrical inspector approval. Necessary completion/test certificate for the Electrical equipment like DC systems, UPS etc if addressed in the scope of work shall be supplied by the contractor and shall be arranged by him.

1.18 It shall be the responsibility of the contractor to apply touch up painting on all equipment before erection. It shall be contractor's responsibility to arrange for required labour, brush and other consumables like cotton waste, cloth etc. for carrying out preservative painting. The quoted rates shall be inclusive of above work. The contractor shall effectively protect the finished work from action of weather and from damage or defacement and shall cover the finished parts, then and there for their protection.

Provision of all types of labor, Supervisors, Engineers, safety personnel, watch and ward as required tools and tackles, instruments as required, consumables as required under various clauses of tender specification for handling transportation, erection, testing and commissioning.

1.19 Special Conditions of Contract shall be read in conjunction with the standard terms and conditions(STC) of NIT , General Conditions of Contract, Schedule of Rates, Specification of work, Drawings and any other document forming part of this contract wherever the context so requires.

1.20 Notwithstanding the sub-divisions of the document into these separate sections and volumes, every part of each shall be deemed to be supplementary to and complementary to every other part and shall be read with and into the contract so far as it may be practicable to do so.

1.21 The materials, design and workmanship shall satisfy the applicable standards, specifications contained herein and codes referred to. Where the Technical Specifications stipulate requirements in addition to those contained in the Standard Codes and Specifications, those additional requirements shall also be satisfied.

1.22 Wherever it is mentioned in the specifications that the Contract shall perform certain work or provide certain facilities, it is understood that the Contractor shall do so at his own cost and the Contract Price shall be deemed to have included cost of such performances and provisions, so mentioned.

1.23 The offer submitted by the bidder shall be accompanied by a tentative time schedule showing individual time period for each activity like Design, Engineering, supply, erection, commissioning, PG Test and Hand Over.

1.24 After issue of LOI/brief order/PO & SPO, the contractor shall visit the site within 15 days of acceptance of the order for kick-off meeting. The modality of execution of the project shall be deliberated by the contractor with Nalco project team.

1.25 The successful tenderer shall submit a detailed project schedule within one month from effective date of order. This project schedule will be in the form of PERT/CPM network prepared system wise containing major milestones in all phases of execution of contract. Each event/activity will also have earliest completion date, latest completion date and float in number of days/weeks. The final project schedule as mutually agreed upon would form the basic document from which schedules for design, engineering, procurement, construction and commissioning will be arrived at. These schedules will be prepared discipline or system wise. The final project schedule shall also form the basis for review of schedules, short-term programme and progress reporting for the entire run of the contract. The frequency/periodicity of programming and reporting will be mutually agreed upon. Progress reporting shall be done by the Contractor on mutually agreed formats.

1.26 The weekly or fortnightly progress review meeting shall be conducted at site with the contractor's site-in-charge/Engineers during erection and commissioning period. The actual progress during the week vis-à-vis scheduled activities shall be discussed for action to be taken for achieving targets. The

contractor shall update/reschedule the site activities based on material and manpower availability to meet the overall completion period.

1.27 The Contractor shall have independent account codes from concerned Regional Provident Fund Commissioner for Provident Fund and Independent account code from Regional Director ESI for ESI. Fulfilling all statutory stipulations towards PF & ESI is mandatory for the bidders.

1.28 Before starting of work, the Contractor shall obtain a license from the concerned authorities under the Contract Labour (Abolition and Regulation) Act 1970, and furnish copy of the same to the Nalco.

1.29 Contractor shall observe all Codes specified in respective specification, all national and local laws, ordinances, rules and regulations and requirements pertaining to the work and shall be responsible to fulfil all such norms.

1.30 Contractor shall have at all times during performance of the work, post a technically competent person to supervise the work at the work premises. Any instruction given to such a person by the Manager-in-charge or his/her authorised representative shall be construed as having been given to the Contractor.

1.31 Nalco reserves the right to inspect all phases of Contractor's operations to ensure conformity to the specifications. Nalco will have engineers, inspectors or other duly authorized representatives, made known to the Contractor, present during progress of the work and such representatives shall have free access to the work at all times. The presence or absence of Nalco representative does not relieve the Contractor of the responsibility for quality control in all phases of the work. In the event that any of the work being done by the Contractor is found by Nalco representatives to be unsatisfactory or not in accordance with the drawings, procedures and specifications, the Contractor shall, upon verbal notice of such discrepancy or deficiency, take immediate steps to revise the work in a manner to conform to the relevant drawings, procedures and specifications.

1.32 The Contractor shall carry out required supervision and inspection as per Quality Assurance Plan and furnish all assistance required by Nalco in carrying out inspection work during this phase. The Nalco will have engineers, inspectors or other authorized representatives present who are to have free access to the work at all time. If Nalco representative notifies the Contractor's authorized representative of any deficiency, or recommends action regarding compliance with the specifications, the Contractor shall make every effort to carry out such instructions to complete the work conforming to the

specifications and approved drawings in the fullest degree consistent with best industry practices.

1.33 The Contractor shall without prejudice to his overall responsibility to execute and complete the works as per specifications and time schedule progressively deploy adequate qualified and experienced personnel together with skilled/unskilled manpower and augment the same as decided by Manager-in-charge or his/her authorised representative depending on the exigencies of work to suit the construction schedule without any additional cost to Nalco. The works under this contract are to be carried out in areas declared as plant limits, adjacent / adjoining to the existing operating plant. As such, Contractor is required to abide by all safety and security regulations of the Nalco enforced from time to time.

1.34 The Contractor has to apply for photo entry passes/Biometric passes for his workers & staff in a prescribed Performa available with Nalco for persons requiring entry in to Plant premises as required. Identity card issued by the Security Section should always be carried/ displayed by the Contractor's employee or person while working inside the Plant. Permits are to be obtained separately for use of vehicles/ trailers etc. at work site. The following requirements are to be met to obtain vehicle permit:

1.35 To bring materials/ equipment/ tools/ tackles etc., to Construction site the work, the Contractor has to produce challan/ proper documents to the Nalco security personnel at gate. The materials shall be checked thoroughly by the security personnel at Gate and recorded in their register before allowing any materials to the site. It is Contractor's responsibility to see that the recorded entry No., date, signature of Nalco's authorized representative with stamp are there on the challan/ supporting documents before taking any materials into work site. In addition to above, entry of the material will be permitted only during the stipulated working hour, and more so, if consignee is available to receive the said material.

1.36 The work shall be carried out inside the plant as per safety practices enforced by Nalco safety department and instructions of Manager-in-charge or his/her authorised representative issued from time to time. Many times it may happen that the working hours shall be drastically reduced or increased to meet certain safety requirements and the Contractor shall meet these requirements without any financial implications. To obtain work permit, height permit, confined area permit and to satisfy all conditions laid down therein, shall be the responsibility of the Contractor. No claim for idling of machinery, plant, manpower etc., for safety reasons or non-issuance of work permit by In-charge, Safety department shall be considered. The Contractor shall abide by all safety regulations of the plant and ensure strict adherence to the safety instructions issued by Nalco

from time to time. Any deviation to this laid down procedure would lead to stoppage of work for which contractor shall be responsible.

1.37 NALCO being an ISO 14001 Company, the Contractor shall comply with all the provisions of ISO 14001 (EMS Criteria) for proper disposal of debris, unused oils, lubricants etc. in consultation with Manager-in-charge or his/her authorised representative. The contractor shall also abide by other stipulations of ISO 14001 as laid down by the said system. The Contractor shall from time to time clear and remove all rubbish and constructions, equipment, unused materials, etc. resulting in the execution of the work. The disposal of rubbish will have to be done only in the areas earmarked by Nalco as per the direction of the Manager-in-charge or his/her authorised representative. All streets and driveways in the work area shall be kept clear and unobstructed at all times. Working site should be always kept cleaned up to the entire satisfaction of Manager-in-charge or his/her authorised representative. Before handing over of any work to Nalco, the Contractor in addition to other formalities to be observed as detailed in the document shall clear the site to the entire satisfaction of Manager-in-charge or his/her authorised representative.

1.38 Construction shall be carried out as per drawings (excluding fabrication drawings) /specifications issued/ approved by Manager-in-charge or his/her authorised representative issued from time to time during the course of execution of work. The quoted rates shall be deemed to include cost of preparation and submission of fabrication drawings (if any) for review and approval of Manager-in-charge or his/her authorised representative. It is however, clearly agreed by the Contractor that review and approval of the drawings by Manager-in-charge or his/her authorised representative shall not absolve the Contractor of his responsibility to carry out the work as per specifications.

1.39 The contractor shall submit the Quality Assurance Plan (QAP) containing the overall quality management and procedures which is required to be adhered to during the execution of contract. Separate QAP for supply items and works portions to be prepared agency-wise prior to commencement of supply and works respectively. The Contractor shall establish document and maintain an effective quality assurance system.

1.40 All inspection and test on supply items if any shall be made as required by specifications forming part of this contract. Various stages of inspection and testing shall be identified after receipt of Quality Assurance Plan (QAP) from the Contractor / manufacturer. Inspection calls shall be given for association of Manager-in-charge or his/her authorised representative as per mutually agreed programme and Proforma with 15 days margin, giving details of equipment and attaching relevant test certificates and internal inspection report of the

Contractor. All drawings, general arrangement and other contract drawings, specifications, catalogues etc., pertaining to equipment offered for inspection shall be got approved by Manager-in-charge or his/her authorised representative and copies shall be made available to Manager-in-charge or his/her authorised representative beforehand for undertaking inspection. The Contractor shall ensure full and free access to the Manager-in-charge or his/her authorised representative at the Contractor or their sub-Contractor's premises at any time during contract period to facilitate him to carry out inspection and testing assignments. The Contractor shall provide all instruments, tools, necessary testing and other inspection facilities to the Manager-in-charge or his/her authorised representative free of cost for carrying out inspection. Where facilities for testing do not exist in the Contractor's laboratories, samples and test pieces shall be drawn by the Contractor in the presence of the Manager-in-charge or his/her authorised representative and duly sealed by the letter and sent for tests in Government approved Test House or any other testing laboratories approved by the inspection Engineer at the Contractor's cost. The Contractor shall comply with the instructions of the Inspection Engineer fully and with promptitude. The Contractor shall ensure that the equipment / assemblies / component of the plant and equipment required to be inspected are not assembled and despatched before inspection. The Contractor shall ensure that the parts once rejected by the Inspection Engineer are not used in the manufacture of the plant and equipment. Where parts rejected by the Inspection Engineer have been rectified or altered, such parts shall be segregated for separate inspection and approval, before being used in the work. On satisfactory completion of final inspection and testing, the final accepted equipment shall be stamped suitably and inspection Certificate shall be issued for all accepted items. For stage inspection and for rejected items, only inspection memo shall be issued indicating there in the details of observations and remarks. The Contractor shall carry out the various tests as enumerated in the technical specifications of the Tender Document and the technical documents that will be furnished to him during the performance the works and no separate payment shall be made unless otherwise specified. The despatch clearance will be issued to the contractor/seller on the basis of the inspection report.

1.41 The contractor/seller shall despatch the equipment only after issuance of despatch clearance. Prior to despatch of the equipment/machines/components, the basis of despatch clearance shall be approved by Nalco. The document which defines the basis of despatch is known as "Inspection Categorization plan"(ICP). This document shall contain description of the equipment, the place of inspection, agency for inspection and basis of inspection i.e. QAP document. A typical ICP is divided into 3 categories as follows:

Cat. I: For these items, QAP shall be approved by Nalco. Pre-despatch inspection to be carried out by Nalco at the manufacturers works. Based on physical inspection despatch clearance shall be given by Nalco.

Cat II: For these items, QAP shall be approved by Nalco. Pre-despatch inspection shall be carried out by the contractor/seller at the manufacturer's works and inspection report will be sent to Nalco. Based on this inspection report, despatch clearance shall be given by Nalco.

Cat III: For these items, QAP shall be approved by vendor/sub-vendor. Test and/ calibration certificates of these procured items shall be submitted by the vendor/sub-vendor to the contractor/seller. After due verification by the contractor/seller, the report to be submitted to Nalco. Based on this inspection report, despatch clearance shall be given by Nalco.

1.42 The construction work shall be carried out based on a pre-defined Field Quality Plan (FQP). The FQP shall be submitted by the contractor prior to commencement of site construction activities and get the approval of the Manager-in-charge or his/her authorised representative The jobs carried out by the contract shall be subject to inspection at any time by the Manager-in-charge or his/her authorised representative. The Contractor shall carry out all instructions given during inspection and shall ensure that the work is being carried out according to the technical specifications of this tender, the technical documents and the relevant codes of practice furnished to him during the performance of the work. The nature of testing to be done, periodical intervals at which such testing are to be done, etc. as per the latest editions of relevant IS codes shall be determined by the Manager-in-charge or his/her authorised representative. The Contractor shall provide for purposes of inspection access ladders, lighting and necessary instruments at his own cost for inspection of work any work not conforming to the execution drawings, specifications or codes shall be rejected forthwith and the Contractor shall carry out the rectification at his own cost.

1.43 The erection protocols for individual items shall be prepared by the contractor and get prior approval of Manager-in-charge or his/her authorised representative. All results of inspection and tests will be recorded in the erection protocol and the reports shall be part of the completion documents. The mechanical completion certificate shall be issued by the Manager-in-charge or his/her authorised representative on the basis of the signed protocols. However, the inspection and acceptance of the work shall not relieve the Contractor from any of his responsibilities under this contract.

1.44 If any defects noticed in the work are attributable to Contractor, these shall be attended by the Contractor at his own cost as and when they are brought to their notice by the Manager-in-charge or his/her authorised representative. Nalco shall have the right to have these defects rectified at the risk and cost of the Contractor if he fails to attend to these defects within specified time frame.

1.45 The contractor shall submit Site Acceptance Test (SAT) procedure for individual equipment/ assembly/ system prior to commissioning the same. The same shall be approved by the Manager-in-charge or his/her authorised representative. The final inspection shall be carried out by Nalco in association with the contractor on the basis of the SAT and the commissioning certificate shall be issued by the Manager-in-charge or his/her authorised representative on that basis of the SAT report.

1.46 It shall be entirely the Contractor's responsibility to provide, operate and maintain all necessary construction equipment, scaffoldings and safety gadgets, cranes and other lifting tackles, tools and appliances to perform the work in a professional and efficient manner and complete all the jobs as per time schedule.

1.47 Drains, pipes, cables, overhead wires and similar services encountered in the course of the works shall be guarded from injury by the Contractor at his own cost, so that they may continue in full and uninterrupted use to the satisfaction of the Nalco thereof, or otherwise occupy any part of the site in a manner likely to hinder the operation of such services. Should any damage be done by the Contractor to any mains, pipes, cables or lines, roads (whether above or below ground etc.), whether or not shown on the drawings the Contractor shall make good or bear the cost of making good the same without delay.

1.48 Co-ordination among the contractors/sub-contractors shall be the responsibility of the prime contractor. Where embedding of conduits in concrete slabs, walls etc. is involved, the Contractor shall ensure that the work of civil and other works shall not be held due to non-completion of the part of electrical work.

1.49 The contractor shall obtain approvals from the concerned electrical inspectorate for installation drawings and engineering of the electrical system and equipment covered under the contractor's scope. Any modification asked for by the electrical inspectorate shall have to be carried out by the contractor at his own cost without affecting time schedule.

The contractor shall arrange the actual inspection of work by the Electrical Inspector. Necessary coordination and liaison work in this respect shall be the responsibility of the contractor.

Statutory fees paid, if any for all such inspections and approvals by authorities shall be in the scope of Owner.

Any change/additions required to be made to meet the requirements of the statutory authorities shall be carried out by contractor free of charge.

The Inspection and acceptance of work as above shall not absolve the Contractor from any of his responsibilities under this contract. Obtaining clearance for energizing the complete electrical facilities covered under this tender, and approval of installation and drawings from the Chief Electrical Inspectorate/CEA/SEB/ Power Supply Company shall be responsibility of the contractor.

Any other statutory approval of works required for the electrical installation (such as Factory Inspector etc.) is also included in contractor's scope.

1.50 While selection of the technology, equipment, and process contractor has to ensure that, latest technology & engineering practices are followed and complied with emphasis of safety, statutory & regulatory requirements as specified in national & international standard.

1.51 All design basis, calculations, drawings, layout, & specifications etc. are to be ratified / verified by the contractor. Major drawing and documents are to be approved by Nalco prior to use. A document control index (DCI) is to be prepared within one month from effective date of contract by the contractor indicating description documents/drawings with corresponding schedule submission date and submitted to Nalco for record.

1.52 The Contractor to ensure full compatibility of the proposed system with the existing layout/ system & processes.

1.53 While selecting of the equipment, protection, enclosures, safety devices, drives etc.; emphasis has to be laid down on existing site conditions and operational practices.

1.54 Since the project has to be constructed in the vicinity of operating plant, contractor executing the project has to cushion unavoidable delays on account of operational constraints in construction/ commissioning activities. There may be requirement of taking shut down of the existing running plant for carrying out installation of any equipment or integration with existing system. In such cases, a micro planning for activities during shut down shall be worked out by the contractor after discussion with Nalco personnel minimum 15 days prior to proposed shutdown. Adequate number of personnel, tools, tackles and other resources are to be organised by the contractor during the shutdown period to minimize the shutdown hours. Normally, Nalco takes 16 hours planned shutdown in a week for carrying out scheduled PM jobs. It is always advisable to carry out some portion of work on weekly PM days to avoid stoppage of

production. Such assessment is to be assessed prior commencement of the project.

1.55 Appropriate provision of access points like walkway, staircase, ladders etc. for operational and maintenance convenience are to be suitable incorporated in the detailed engineering.

1.56 All correspondence, submission of Bills, Data sheet, documents shall be marked to the designated the Manager-in-charge or his/her authorised representative Compliance to statutory & regulatory requirements during consecution and erection shall be in the scope of EPC contractor.

1.57 In the event of non-availability of data or information related to the project, the contractor has to collect actual data from site. Nalco will facilitate providing data depending upon the availability at Nalco's archives or site. If the required data/drawing is not available with Nalco, it is the responsibility of the contractor to prepare/obtain the same at their own cost. E.g. if the layout drawing of the shop is not available, the same is to be prepared by the contractor lifting the dimensions from site. Soil testing, if required for completing detailed engineering of the project, shall be in the scope of the contractor.

1.58 The contractor shall specify the manner for movement/ storage of construction material for so that normal operating plant is not affected.

1.59 Provision of customer support training where ever required has to be reflected while preparation of detailed engineering. Training requirements such as schedule, programme content and other relevant information has to be brought out as soon as the commissioning of the plant is over.

1.60 Unless and otherwise specified, equipment/ system design shall be based on latest energy saving practices at the time of bidding and compatible to National and International Standard.

1.61 The specification & description in this document are provided as a broad guideline for the bidders. However, the bidder has to quote as per his design, engineering & specification satisfying the said guidelines with an aim to achieve full functionality as per acceptance criteria.

1.62 The site mobilization and work at site should start as per the time line mentioned approved Project schedule.

1.63 NALCO General Condition of Contract (GCC) shall form a part of this contract. However, the clauses specified in SCC shall supersede those specified in the general conditions of contract.

1.64 Notwithstanding anything herein provided and notwithstanding the transference of all risks in respect of the materials to the CONTRACTOR, the ownership in respect of the material shall at all times be and remain with NALCO. An inventory shall be made by the CONTRACTOR of all surplus construction materials and empties including but not limited to scrap, wastages and unserviceable material supplied and/or remaining in the hands of the CONTRACTOR upon completion of the contract for whatsoever reason, and the CONTRACTOR shall forthwith, upon being required to do so, place the NALCO in undisputed possession of and transport the said material to NALCO's stores or otherwise as reasonably directed by the Manager-in-charge or his/her authorised representative

ANNEXURE IV : LIST OF TENDER DRAWINGS

ANNEXURE IV

LIST OF TENDER DRAWINGS

SL. NO.	DRAWING NO	DESCRIPTION
TENDER BASIC DRWAINGS		
1	14L08-DWG-M-PL-001, REV. I	Proposed layout of Alumina Unloading & Transportation System in Smelter Plant
2	14L08-DWG-M-PL-002, REV. G	View Profile for Unloading & Conveying System
3	14L08-DWG-M-PL-003, REV. D	View Profile for Unloading & Conveying System
4	14L08-DWG-M-PL-004, REV. D	View Profile for Unloading & Conveying System
5	14L08-DWG-PR-PFD-001 SH 1of 2, REV. A	Process Flow Sheet for Wagon Unloading System
6	14L08-DWG-PR-PFD-001 SH 2 of 2, REV. C	Process Flow Sheet for Unloading and Conveying to Silo System
7	14L08-DWG-PR-PID-001 SH 1of 2, REV. C	Process and Instrumentation Diagram Wagon Unloading System
8	14L08-DWG-PR-PID-001 SH 2 of 2, REV. D	Process and Instrumentation Diagram Unloading and Conveying to Silo System
9	14L08-DWG-E-0101,R-5	Key Single Line Diagram
REFERENCE DRAWINGS		
10	1919-55-48-00-A1-743,R-2	Alumina Handling and Storage: GA of pile cap and tunnel for Silo-1 and silo-2
11	1919-55-48-00-A1-760,R-1	GA & details of alumina silo roof SL-3 and SL-4
12	1.540300, R-5	Alumina and Crushed Bath Handling System Silo House (Silo-6) : GA of Foundation & RC detail of Retaining Wall Structural Drawing
13	1.540301, R-3	Alumina and Crushed Bath Handling System Silo House (Silo-6) : RC detail of Foundation & Strip of Beams Structural

		Drawing
14	1.552667, R-5	Alumina and Crushed Bath Handling System Silo House (Silo-6) : Sectional Elevation of Air Piping at Silo Areation System at Silo-6
15	1.552661, R-5	Alumina and Crushed Bath Handling System: Overall Plan of Compressed Air Piping For Silo-6
16	1.552651, R-5	Alumina and Crushed Bath Handling System: Overall Plan of Compressed Air Piping For Silo-8
17	1202-00-16-48-0953	Air Compressor House : Detail of Super Structure and Gantry Girder(Cap 10T)
18	00-21-0017C/G/01,R-2	GA and Schematic views of Cooling Tower -CT-III(E)
19	4375-08-16-49-0283,R-1	Anode Rodding Shop & Assembly Storage
20	220/ELE/GA/A1/7454 Sh 1 of 4	11 KV Distribution System for 220 KV Sub station
21	4375-00-16-50-0010,R-1	SLD- Sub Station 730.37
STANDARD ELECTRICAL DRAWINGS		
22	14L08-DWG-E-0106 SH 1 of 10 to SH 10 of 10	415 SLD
23	14L08-DWG-E-0700 SH 1 to SH 5	Cabling Note and Details
24	14L08-DWG-E-0400 SH 1 to SH 34	General Arrangement of Cable Tray, Trench & Support Details
25	14L08-DWG-E-0600 SH 1 of 30 to SH 30 of 30	Grounding Note and Details
26	14L08-DWG-E-0105 SH 1 of 7 to SH 7 of 7	HT SLD
27	14L08-DWG-E-0800 SH 1 to SH 40	Illumination Notes and Details
28	14L08-DWG-E-0101 SH 1 of 13 to SH 13 of 13	Lightning Protection and Details
29	14L08-DWG-E-1206	Battery Charger Scheme
STANDARD INSTRUMENTATION AND CONTROL DRAWINGS		
30	14L08-DWG-I-001	Automation System Architecture

31	14L08-DWG-CCTV-001	CCTV System Architecture
32	14L08-DWG-I-CR-002	Tentative Lay out of Control Room-2
33	14L08-DWG-I-DI-001	Digital Input Isolation Scheme
34	14L08-DWG-I-DP-001	HT Drive Logic
35	14L08-DWG-I-DP-002	LT Drive Logic
36	14L08-DWG-I-GTC-008	Tentative Lay out of GTC-8 Control Room
37	14L08-DWG-I-PS-001	24V DC Power Supply Drawing
38	14L08-DWG-I-UPS-001	UPS Architecture

ANNEXURE I
DESIGN BASIS REPORTS (DBR)

SL. NO.	ENCLOSURES	DOCUMENT NO
1	Design Basis Report for Alumina Unloading & Transportation System- Process & Mechanical	14L08-000-DBR-M-001, REV. 6
2	Design Basis Report for Alumina Unloading & Transportation System- Electrical	14L08-000-DBR-E-001, REV. 3
3	Design Basis Report for Alumina Unloading & Transportation System- Control & Instrumentation	14L08-000-DBR-I-001, REV. 4
4	Design Basis Report for Alumina Unloading & Transportation System- Civil & Structural	14L08-000-DBR-S-001, REV. 2

DESIGN BASIS REPORT

FOR

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

PROCESS & MECHANICAL



NATIONAL ALUMINIUM COMPANY LTD.

(A Govt. of India Enterprise)

Nalco Bhavan, P/1, Nayapalli
Bhubaneswar-751013, Odisha
Phone: 91-674- 2301988 to 2301999
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DOC. No. 14L08-000-DBR-M-0001

MARCH 2021

DEVELOPMENT CONSULTANTS PRIVATE LIMITED
CONSULTING ENGINEERS
BLOCK DG-4, SECTOR II, SALT LAKE CITY ,KOLKATA – 700091, West Bengal, India

DOCUMENT CONTROL SHEET

PROJECT	:	ALUMINA UNLOADING AND TRANSPORTATION SYSTEM.
CLIENT	:	NATIONAL ALUMINIUM COMPANY.LTD.
DOCUMENT TITLE	:	DESIGN BASIS REPORT (PROCESS & MECHANICAL)
DOCUMENT NO.	:	14L08-000-DBR-M-001
REV. NO.	:	5
DCPL JOB NO.	:	DCPL-14L08

ENDORSEMENTS

REV. NO.	DATE	DESCRIPTION	PREP. BY SIGN.(INITIAL)	REVW. BY SIGN.(INITIAL)	APPRVD BY SIGN.(INITIAL)
5	21.07.15	FOR APPROVAL	S. Mukherjee SM	DN	DKG
4	13.07.15	FOR APPROVAL	SM	DN	DKG
3	29.04.15	FOR APPROVAL	SM	DN	DKG
2	10.04.15	COMMENTS INCORPORATED	SM	DN	DKG/AKM
1	25.02.15	ISSUED FOR COMMENTS	SM	DN	DKG/AKM
0	08.01.15	ISSUED FOR COMMENTS	SK/SM	DN	DKG/AKM

DEVELOPMENT CONSULTANTS PRIVATE LIMITED
CONSULTING ENGINEERS
DEVELOPMENT CONSULTANTS HOUSE, BLOCK DG-4, SECTOR II, SALT LAKE CITY, KOL - 700091, INDIA

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1. INTRODUCTION

1.01 This document is to draw out design memorandum / technical features for Alumina Unloading and Transportation at Smelter Plant, ANGUL of National Aluminium Company Limited (NALCO), Odisha.

1.02 The scheme shall be in line with Process Flow Sheet, (Drg. No. 14L08-DWG-PR-PFD-001 REV. A (2 Sheets) and Proposed layout Sectional Drawings of Alumina Unloading & Transportation System in Smelter Plant (Drg. No. 14L08-DWG-M-PL-001,14L08-DWG-M-PL-002, 14L08-DWG-M-PL-003 & 14L08-DWG-M-PL-004).

The new Alumina Unloading and Transportation system will commence from wagon unloading and will terminate above the existing silos (silo no.6&5,2&1). From silo no.1&5 the incoming alumina will be transported to silo no.3&4, 7&8 respectively through existing conveying /air sliding path.

Alumina will be coming in the BTAP closed wagons in a rake. Wagon unloading system shall include 2 nos. rope winch systems for hauling of 12 nos. BTAP wagons in each system and positioning of wagons on the unloading platform, Pneumatic wagon unloading system followed by air slides placed in an underground pit by gravity and through underground pipe conveyor to transfer points located above the ground for further conveying by pipe conveyors to the alumina silos. De-dusting, Ventilation & Air Conditioning system at appropriate locations shall be provided.

1.03 The work for proposed system shall be carried out conforming to latest applicable Indian Standards or other recognized international standards such as ASTM / CEMA / ASME / ISO/ DIN / JIS in the absence of Indian standards.

1.04 Alumina Unloading and Transportation facility shall comply with applicable statutes, regulation and safety codes related to design, construction & operation of the wagon unloading and transportation system.

Sl. No.	Type of Wagon	Height (m)	Width of Tank (m)	Length over coupling / overall (m)	Gross Mass (tonne)	Payload (tonne / Volume) Approx.
1.	BTAP Wagon	4.29	3.200	9.78 /12.32	81.3	58 / 62m3

2. GENERAL INFORMATION:

PLANT HISTORY:

National Aluminum Co. Limited (NALCO) has set up a multi-location Bauxite alumina– Aluminum Complex along with captive Power Plant in the state of Odisha. The implementation of the project started in the year 1981 and all the segments of the project were commissioned by 1987 and are operating at rated capacity. As part of Phase-I expansion Pot line-3, pot room auxiliaries and new carbon plant were installed at Angul to enhance total production of Primary aluminum to

345000TPY. As part of Phase-II expansion (Pot line-4), NALCO is further enhancing its total production capacity of Primary aluminum to 4, 60,000TPY.

3. DESIGN BASIS:

3.1 SITE DATA:

Aluminium smelter plant of NALCO is located at a site approximately 5 km. from the nearest town of Angul in the state of Odisha. The site is connected by a link road to the existing highway NH-55, linking NH-5 (Calcutta-Madras) and NH-6 (Calcutta- Bombay).

3.2 SITE LOCATION:

State where located Nearest important Town /distance Nearest Railway Station	:	Odisha Angul/ 5 km. For passenger traffic-Angul Railway Station 7 km away with the opening of Talcher-Sambalpur rail line from plant site. Goods in rakes and wagons: Bhudhapank – NALCO siding (SCPM) 11 km from Smelter. Goods in small Consignment: Talcher, about 25 km. From Smelter.
Nearest port and distance	:	Paradeep Port – 190 km.
Nearest Airport and Distance	:	Bhubaneswar Airport – 140 km.
Nearest Highway Milestone	:	National Highway (NH-55) – 1km.distance

3.3 MATERIAL CHARACTERISTICS:

CHARACTERISTICS OF ALUMINA

Type	:	Sandy
Maximum density after Compression under 4 bar	:	1.1 t/m3
Angle of repose during reclaiming and during loading	:	35 degree & 23 degree respectively
Internal angle of friction	:	27 degree to 36 degree

Angle of friction on steel	:	25 degree
Granulometry	:	+ 125 micron max. 15%
		- 45 micron max. 12%
		Typical 10%
Hardness	:	9 on Mohs' Scale

SPECIFICATION OF ALUMINA

Item	Unit	Typical	Limit (max)
SiO_2	Wt %	0.01	0.025
Fe_2O_3	Wt %	0.01	0.015
TiO_2	Wt %	0.003	0.004
Na_2O	Wt %	0.39	0.5
P_2O_5	Wt %	0.001	0.002
V_2O_5	Wt %	0.0015	0.002
CaO	Wt %	0.025	0.06
Alpha	Wt %	<2.0	10.0
-45 micron	Wt %	8.0	20 (Max corresponds to CA 15 grade Alumina)
+125 micron	Wt %	10 - 12	15
LOI (300- 1000 ^0C	Wt %	0.6 - 0.7	1.0

BET	:	60-70 m^2/g (Typical)
		40 m^2/g (Min) & 80 m^2/g (max)
Bulk Density	:	0.95 to 1 t/m^3 Typical)

UTILITIES AVAILABLE AT BATTERY LIMIT

Plant air cum instrument air

Oil Content in gm/Nm3	:	Nil
Supply Pressure	:	4.5 kg/cm^2 (g) min (line should be designed for 9 kg/cm^2(g)
Temperature	:	45^{0}C max
Dew point	:	+3^{0}C to + 5^{0}C at 7 kg/cm^2(g)

4. SYSTEM REQUIREMENT

Requirement of Fresh Alumina for the smelter plant (after expansion)	:	900000 T per annum
Days/Annum.	:	365
No. of operation shift/week	:	18 (max)
Total hours/shift	:	8
Effective operating hours/day	:	24
Rake capacity	:	2880-3120 T
No. of wagons in a rake	:	48 to 52
No. of track	:	Track 1, Track 2 and Engine Escape Line
No. of Wagon on each track	:	26
Alumina unloading	:	8 nos. simultaneously from Wagons
Rate of unloading for individual wagon	:	≈ 2 T/min
Wagon unloading and conveying capacity to silo	:	1000 TPH

The alumina handling plant is designed to operate 365 days in a year without interruption. The proposed Alumina Unloading and transportation system shall be designed & installed in such a way so that any one stream can be operated and if required both streams can be operated simultaneously.

4.1.0 GENERAL

The following Design Criteria shall apply to all mechanical equipment.

4.01.01 The system shall be capable of operating continuously round the clock throughout the year. The installation must be designed so that it can always be serviced without having a complete shutdown.

4.01.02 Design of all facilities shall be in accordance with this specification and the respective specification enclosed with the Purchase requisition.

4.01.03 Alumina unloading and transportation system shall be laid out and constructed for convenience and safety of operation and maintenance. All equipment shall be oriented to permit servicing in such a way as to require a minimum of dismantling. The specification indicates a minimum standard of quality for the materials, fabrication and construction of the proposed plant.

4.01.04 All equipment and materials (mechanical, piping, electrical, instrumentation, controls, civil, architectural etc) shall be sourced from manufacturers acceptable to DCPL and NALCO. For the items not covered in the list, contractor shall submit the sub-vendor list along with the proven track record of the proposed sub-vendors for review/approval of NALCO and DCPL before placing orders for those items.

4.01.05 All electrical installations including the hoists in open area shall be provided with rain protection hood.

4.01.06 Maintenance platforms/access walkways shall be provided at one end beam for each electric monorail hoist.

4.01.07 All the equipment shall be field proven for such an operation taking into consideration normal preventive and running maintenance of the unit and their auxiliaries. The spare part list along with the drawings and part numbers shall be provided.

4.01.08 All equipment, controls and structure shall be designed for installation in carbon and alumina dust charged atmosphere of aluminium smelter area and seismic condition of site.

4.01.09 All equipment shall be of proven design. Prototypes or extensive modifications of the basic designs are unacceptable.

4.01.10 The installation shall be designed with adequate facilities for maintenance & operations.

4.01.11 The design, fabrication, painting, supplies and testing shall conform to relevant international codes and standards, Indian codes and standards, wherever applicable, shall take precedence over those of other nationalities. Only latest editions including addenda shall be referred to.

4.01.12 Design, fabrication & operation of the plant shall be based on the following:

A) Indian factory act

B) Indian explosive act

C) Petroleum & Carbide of calcium manual

D) Fire protection manual of fire sectional committee, Insurance association of India

E) Regulations laid down by explosive directorate and electrical inspectorate

F) Regulations of Director general of civil aviation for all stacks

G) NFPA code of practice

H) Regulation of electrical equipment of buildings insurance association of India

I) Regulation of both Central and state pollution control boards of overall pollution control for both surface and air

J) Indian electricity rules

4.01.13 An air cooled screw compressor (1w+1s) for pulse jet cleaning of de-dusting unit, cooling chamber, dampers and actuators at wagon unloading area shall be provided. Contractor shall tap the compressed air from the existing Plant compressed air line for pulse jet cleaning of three (3) nos.de-dusting units, located at three (3nos.) transfer houses area. Fluidization air for air slide shall be generated by blowers/centrifugal fans which will be supplied by contractor.

4.01.14 Compressed air and supply air facilities supplied by the contractor shall include all compressed air piping, valves, regulators, pressure gauges and fittings as required.

4.01.15 All blowers and compressors generating process air supply for AUT shall be housed in a common blower/compressor house, which shall provide weather protection as well as act as noise enclosure common to all equipment inside the room. The noise level shall be maintained as per requirement of environmental norms.

4.01.16 All equipment to be supplied shall be of robust design and manufacture and shall correspond to state of the art of manufacturing technology. Selected equipment shall have a high degree of availability, require minimum maintenance and operate with high efficiency. Electrical and thermal energy consumption shall be low. Equipment shall be designed for heavy-duty industrial application, capable of handling very abrasive materials in dusty environments. The equipment shall be suitable for continuous operation at uniform maximum load without adverse effect on the life or maintenance of the equipment under prevailing conditions. Furthermore it shall be suited to all local climatic and operating conditions at the site.

4.01.17 The equipment shall be designed with sufficient safety margins from the mechanical design and the process performance point of view. It shall be capable of re-starting after stopping due to power failure or other process-related interruption (i.e. interlock).

5. EXISTING SYSTEM DESCRIPTION

The requirement of fresh alumina for the smelter plant after expansion will be approximately 9, 00,000TPY.The additional requirement of fresh alumina for the phase-2 expansion is approximately 2, 42,350 TPY.

In the existing NALCO Smelter Plant, requirement of alumina is being catered by transporting alumina from Damanjodi to Angul in specially designed pneumatically operated wagons. These wagons have a payload capacity of approx 60 T each. Total alumina payload in a rake comprising 48 to 52 wagons i.e. approximately 2880 to 3120 T.

The residence time of rake is at present 8 hrs as maximum. The unloading time of one rake is approximately 5 hrs. During unloading, a group of wagons are placed in position and each wagon is connected to compressed air inlet. Flexible hoses are connected with one end to wagon evacuation

points and other end to the fixed pipes leading to air slides. The rate of unloading for individual wagon is 2 T/min. The extracted alumina is conveyed through air slide for feeding to intermediate bin (15 T capacity). From the intermediate bin (having fluidized bottom) alumina comes to belt conveyor TR1 that conveys alumina to existing silos 1, 2, 3, 4, 5, 6, 7 & 8 through number of belt conveyors/air slides at the rate of 1000TPH.

The main conveyor TR1 is integrated with weigh scale of the load cell type to meter the quantity of alumina to be conveyed to the silos. In the existing unloading system an outlet has been provided from the distribution box located over silo No. 1 to feed to air slide HA-AL-001. The air slide HA-AL-001 conveys alumina to the belt conveyor HC-BL-002.The belt conveyor transports alumina to pot line 3 areas for feeding to Silo No.5 (TI-AL-020) or to Silo No. 7 (TI-AL-021), through air slides and belt conveyor HC-BL-012.

6. PROPOSED SYSTEM DESCRIPTION

The plant will have a yearly aluminium production capacity of 4,60,000 T after phase-2 expansion, which approximately corresponds to a yearly requirement of 9,00,000 T of alumina. To achieve such alumina requirement a new system with wagon unloading facility by gravity and alumina conveying to the silo 5&6 and silo 1&2 (separately) have been envisaged.

From silo1 & silo 5 the alumina can be diverted to silo 3&4 and silo 7 &8 respectively through existing conveying path (conveyor / air slides).Similar to existing system, alumina will arrive at the plant in specially designed pneumatically operated wagons. Each rake is grouped in 48 to 52 wagons corresponding to a service capacity of approx. 2880 to 3120 ton. This new system has been envisaged to facilitate to convey alumina to each silo @1000 TPH through pipe conveyors (for silos 1, 2&5, 6) independently to all the silos during shut down of existing main conveyor TR1 & also conveyor (HC-BL-002) which is conveying alumina from silo1 to silo 5. Afterwards alumina transportation facility has been connected to existing belt conveyor TR2 & BL012 (both conveyors having 1400mm belt width) for filling of silos 3, 4 & 7, 8 respectively.

Unloading of alumina from wagon for this new system shall be done in between proposed expansion railway tracks1 &2 (12m apart), located at east side of Rolling Plant (RP). Suitable rope winch systems (2nos.) for hauling 12 BTAP wagons has been envisaged. The unloading of 8 wagons shall be done at a time (4 nos. wagon from each track).The drive units and automatic rope tensioning arrangements of the winch systems shall be located in a common shed / house. 2 nos. Rope winch system (reversible type) have been provided for wagon hauling, positioning for unloading and also operate haulage winch to move the wagons from the unloading zone and again set for the position for next 8 wagons. By adopting the suitable connecting / removing of hitch ropes / round link chain siling to the near side rope / far side rope, the optimisation of unloading cycle are to be obtained.

A dedicated operator cabin shall be provided over the unloading area at the starting point to precisely control the placement of rake in the unloading stations.

Unloading of alumina from each BTAP wagon is to be connected to compressed air inlet and also flexible hoses to be connected with one end to wagon discharge points and other end to fixed pipes for

gravity discharge (for quick unloading and lesser energy consumption) to the air slides placed in an underground pit (i.e. in between two railway tracks). Unloaded alumina shall be conveyed by air slides (3 nos.) to pipe conveyor. Additionally pneumatic shut off gate shall be provided for control of the capacity of the pit outlet to feed material to AS-300. PC-100 partly underground and partly over ground which in turn feed alumina either to pipe conveyor PC-200 or another pipe conveyor PC-300 through 2-way chutes at transfer point TP-1 located above ground. Underground tunnel shall have the sump with pumping (1w +1s) facility to drain out water from the sump. The pipe conveyor (PC-100) shall be provided with integrated Belt weigh scale of load cell type for metering amount of Alumina conveyed to the silos. The pipe conveyors PC-200 & PC-300 shall carry same alumina from TP-1 to silo-1&2 and silo-5 &6 respectively through air slides (4 nos.). Two nos. transfer points (TP-2 & TP-3) shall be provided, one near silo 1 &2 and other transfer point near to silo5 & 6 to convey alumina to silo1& 2 and silo5&6.

One rack and pinion type passenger cum goods lift of capacity 1Ton (16 passengers) with one side collapsible gate shall be provided near the transfer point (TP-3) of silo 5&6.

Five nos. de-dusting units with measurement system of DP, Inlet pressure, outlet pressure and pulsing pressure etc. one at unloading area, one at feeding area of pipe conveyor PC-100 from air slide (AS – 300) and three nos. at different transfer houses shall be installed. The dust emission level from the de-dusting units shall be limited to 50 mg/Nm3.

One new control room, MCC room, Blower room & VVVF room shall be suitably installed. No disturbance to the existing system while erection and commissioning will be allowed except during hook-up. During construction and erection, proper care shall be taken for existing equipment at the interface.

7. MAJOR EQUIPMENTS

Sl. No.	Eqpt. No	System / Item description	Qty	Brief specification	Drawing No.
1		Rope winch system for wagon hauling	2		
2		Pneumatic Unloading System from wagons to Air slides (underground) through flexible Hose connections:			
2a	KA100 to 108	Oil Free Screw Compressors (Air Cooled) 3.0 kg/cm2 (g)	8w+1s		
2b	BL100 / 200 &300	Fan type Blower for air slides	3		
2c	FN 100 & 200	Fan in Blower Room	1w+1s		
2d	AS 100 & 200	Air Slide	2	500 tph for each	

Sl. No.	Eqpt. No	System / Item description	Qty	Brief specification	Drawing No.
2e	SG-001, SG-002	Manual Operated Slide Gate	2		14L08-DWG-PR-PID-001 (2 sheet)
3	AS 300	Air Slide	1	1000 tph	
4	EH-1 & EH-2	Electric Hoist with motorized trolley greater than 10m lift and travel	3	Cap: 3 ton for Unloading Station & Compressor Room	
5	EL 01	Goods cum passenger lift (Rack and Pinion type) near transfer point (TP-2) of silo 5 &6	1	Capacity: 1000 kg	
6	DE-1A & DE-1B	De-dusting system complete unit in unloading station & on pipe conveyor PC-100	1+1		
6a	DC 100 A/B	Dust Collector	1+1		
6b	EF 100 A/B	Dust Extraction Fan with motor	1+1		
6c	RV 100 A/B	Rotary air lock valve	1+1		
6d		Oil Free Screw Compressors (Air Cooled) For supplying pulse air to Dedusting units	1w+1s		
7	PC 100	Pipe Conveyor	1	Cap: 1000 tph	
8	EH-3, EH-4& EH-5	Electric Hoist with motorized trolley for Pipe Conveyor drive unit	3	Cap: 4 tons each for TP-1, TP-2& TP-3	
9	DG 01	Diverting gate (pneumatic Operated)	1		
10	AS 400	Air Slide	1	Cap: 1000 tph	
11	AS 401	Air Slide	1	Cap: 1000 tph	
12	PC 200	Pipe Conveyor	1	Cap: 1000 tph	
13	DE-2	De-dusting system complete unit in Transfer Point (TP-1)	1		
13 a	DC 200	Dust Collector	1		
13 b	EF 200	Dust Extraction Fan with motor	1		
13 c	RV 200	Rotary air lock valve	1		
14	JB 001	Junction Box	1		

Sl. No.	Eqpt. No	System / Item description	Qty	Brief specification	Drawing No.
15	PG 001 & 002	Pneumatic operated cut off gate	2		14L08-DWG-PR-PID-001 (2 sheet)
16	DE-3	De-dusting system complete unit in Transfer Point (TP-2)	1		
16 a	DC 300	Dust Collector	1		
16 b	EF 300	Dust Extraction Fan with motor	1		
16 c	RV 300	Rotary air lock valve	1		
17	PC 300	Pipe Conveyor	1	Cap: 1000 tph	
18	AS 500	Air Slide	1	Cap: 1000 tph	
19	AS 501	Air Slide	1	Cap: 1000 tph	
20	DE-4	De-dusting system complete unit in Transfer Point (TP-3)	1		
20 a	DC 400	Dust Collector	1		
20 b	EF 400	Dust Extraction Fan with motor	1		
20 c	RV 400	Rotary air lock valve	1		
21	BL 400	Fan type Blower for air slide	1		
22	BL 401	Fan type Blower for air slide	1		
23	BL 500	Fan type Blower for air slide	1		
24	BL 501	Fan type Blower for air slide	1		
25	BW-001	Belt Weigh Scale on Pipe Conveyor (PC-100)	1		
26	P-1 &2	Sump Pump	1w+1s	Cap: 20m3/hr	
27		Elevator (Rack & Pinion Type)	1	1 Ton	

The above is a list of major equipment only. Any other equipment required to make the system complete in all respect for its successful and guaranteed operation which is acceptable to NALCO and DCPL is also deemed to be included under bidder's scope without any additional cost to Owner.

8. TECHNICAL FEATURES OF ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

The technical features of major equipment of alumina unloading and transportation system should address all functional, safety and environmental requirement. All equipment foundation bolts shall be high tensile (HT) bolts.

8.01 PIPE CONVEYORS

8.01.01 COMPONENTS OF THE PIPE CONVEYOR:

A. **Mechanical**

1. Conveyor Belt
2. Idler incl. Bracket
3. Pulleys
4. Plummer Block
5. Pulley Bearing
6. Discharge Hood
7. Discharge Chute & Liner
8. External Pre-Scrapper
9. External Main Scrapper
10. Int. V Plough Belt Cleaner
11. Drive Motors
12. Input Coupling
13. Gearbox
14. Output Coupling
15. Coupling Guards
16. Drive Base Frame
17. Pulley Frames
18. TU Arrangement
19. Disc Brake
20. Guide Frame
21. Take Up Cage
22. Stringer Frame & Post
23. Deck Plate
24. Skirt Board Assy.
25. Safety & Limit Switches.
26. Suitable no. of stairs, cross-over and platform from ground shall be provided wherever access is required for regular inspection, Lubrication or operation of machinery or equipment.
27. Clear walkway on one side of 1200 mm and other side of 600 mm minimum width shall be provided along the length of pipe conveyor gallery.
28. In an underground tunnel, a clear walkway space of 1000 mm shall be provided along the length of the conveyor on either side.
29. The pipe conveyor gallery structure shall be of box type with side sittings and also top covered to avoid rainwater entry.
30. 1500 mm clearance shall be maintained all around drive system for maintenance purpose.

31. Maintenance platform & walkway for pipe conveyors shall be of chequered plate construction

B. **Electrics & Controls**

Electrical drive motors for pipe conveyors shall be VVVF drive and for detail description of VVVF drive, please refer relevant electrical DBR.

C. **Structural Steelwork & Civil work**

Please refer relevant civil & structural DBR.

8.01.02 CONVEYOR PARAMETERS

A. Design

Code & Standard	-	As per manufacturer's standard
Capacity	-	1000 TPH
Utilisation Factor/ Filling Factor	-	0.7
Slope Factor	-	As applicable
Belt Speed	-	3.2 m/s
Belt Width	-	1800mm
Pipe Diameter	-	450mm
Bulk Density (After Fludisation)	-	0.85T/m^3

B. Belting (Grade M24 FR) Fire Resistance Type

Code & Standard	-	IS / DIN / BS / JIS
Duty	-	Continuous
Edge Construction	-	Moulded both edge capped.
Cover	-	Rubber

C. Pulley

Code & Standard	-	IS 8531	
Shell	-	IS 2062	
Disc	-	IS 2062	
Hub	-	IS 2062	
Construction	-	Welded	
Shaft	-	50C8 (IS 1570) / EN-9 (BS 970)	
Connection	-	Keyed to Hub	
Machining Tolerance	-	IS 919	
Balancing	-	Statically Balanced	
Lagging	-	Neoprene Rubber	
Type	-	Drive Pulley :	Grooved
	-	Non Drive Pulley :	Plain
Shore Hardness	-	55-60 Scale A	
Plummer Blocks	-	Cast Iron Housing	
Bearing	-	Double Row Self Aligning Spherical Roller	

D. Idler

Code & Standard	-	IS 8598/Manufacturer's standard
Construction	-	Grease Packed & Sealed for Life
Roll Tubes	-	ERW Black conforming to IS 9295
Shaft	-	50C8 (IS 1570) / EN-9 (BS 970)
Machinging Tolerance	-	IS 919

Bearing	-	Deep Groove Ball Bearing
Bearing Housing	-	Press Formed out of 3 mm DD Steel Sheet
Housing Connection	-	Welded to Roll Tubes
Inner Seals	-	FRP
Labyrinth Seals	-	FRP
Inner Dust Seals	-	FRP
Outer Dust Seals	-	Press Formed out of 1 mm DD Steel Sheet
Out of Roundness	-	+/- 0.5 mm
Mounting	-	Drop in Bracket Slot
Brackets	-	IS 2062 Fabricated
Carrying Idler	-	3 Equal Roll – In Line/PSK Rollers
Return Idler	-	2 Equal Roll – In Line/PSK Rollers
Impact Idler	-	3 Roll with Rubber Disc. – In Line
Pipe Forming Idler	-	12 (6+6) / 9 (6+3) Equal Roll – In Line

E. Skirt Board

Body	-	IS 2062 / 10 mm Plate
Liner	-	HARDOX 400 / 12 mm Plate
Sealing	-	Segmented Modular Rubber Blade
Cover	-	IS 2062 / 2 mm Sheet
Mounting	-	From Stringer Frame

F. Deck Plate

Material	-	IS 2062
Thickness	-	3.15 mm

G. Chute Work

Discharge Hood	-	IS 2062 / 4 mm Sheet
Discharge Chutes	-	IS 2062 / 10 mm Plate
Liner	-	HARDOX 400 / 10 mm Plate

H. Technological Structure

Stringer & Short Post	-	IS 2062 / Rolled Section
Size	-	ISMC 150
Construction	-	Bolted

I. Gear Box

Type	-	Helical / Bevel Helical
Housing	-	Fabricated
Lubrication	-	Splash.

Mechanical Rating - Should be greater than equal to at least 1.25 times on Motor Rating Or 1.5 times on Drive Pulley Shaft Power.

Thermal Rating - shall be at least equal to the motor rating.

Cooling Type - Natural Cooling.

Holdback - Integral with Gear Box

J. High Speed Input Coupling

Type	-	Resilient
Service Factor	-	1.5 times on Motor Rating for Resilient Type

K. Low Speed Output Coupling

Type	-	Geared
Service Factor	-	1.5 times on Motor Rating

L. Pull Cord Switch

Location	-	30 m C/C (Walkway side)
Enclosure	-	Cast Aluminium
Protection	-	IP 65
Contact	-	2 NO + 2 NC
Operating Positions	-	1-0-1
Reset	-	Manual

M. Belt Sway Switch (Both Side)

Location	-	50 m C/C
Enclosure	-	Cast Aluminium
Protection	-	IP 65
Contact	-	2 NO + 2 NC
Reset	-	Manual

N. Speed Monitor

Function	-	Zero Speed Switch
Type	-	Inductive Proximity Switch
Location	-	Conveyor Pulley
Quantity	-	One (1)
Operating Distance	-	15 mm
Probe Enclosure	-	Brass

Protection	-	IP 67
Accessories	-	Monitoring Unit
Type	-	Rotational Speed Controller
Contact Rating	-	5 A

O. Pull Cord Rope & Eye Hook

Cord Material	-	GI Rope
Diameter	-	3 mm
Construction	-	30 swg / 6x7
Protection	-	PVC Sheath
Eye Hook Diameter	-	35 mm
Construction	-	6 mm Rod

8.02 AIR SLIDE

8.02.01 TECHNICAL REQUIREMENT

Air slides unit shall be complete with:

a) Bottom casing, complete with flanged air inlet manifolds with dampers, stiffeners and support brackets.

b) Top cover, complete with weather proof fixing arrangement, flanged feed spouts, bolted inspection hatches and flanged air vent connection with damper.

c) Flanged discharge boxes and distribution boxes.

d) Air slide maintenance is limited to the replacement of fluidization cloth.

e) Total length of air slides shall be divided into suitable no of segments. Fabric, of required size, preferably in single pieces for each air slide. Application of Silastic is must for installation of air slide fabric. Fabric supporting wire mesh at feeding zones. The fluidization cloth of air slides shall be of imported quality from reputed vendor.

f) Provision of balancing air in the air slide shall be kept. The control philosophy of balancing and methodology shall be clearly mentioned.

g) Provision must be kept in the air slide chamber for fixing manometer and pressure gauge with plug.

h) Flushing points shall be provided in all air chambers of air slides and vent pipe joints.

i) All air control valves of the air slides to be provided with butterfly valves only and suitable platform shall be provided for maintenance of valves in all areas.

j) Air permeability of the fabric shall be approximately1.15 m3/m2/min at 600 mmWC. Depending on bulk material characteristics, the air quantity may deviate from this figure.

k) Fan-Type Blowers

Guide values for air pressure (including reserve) are:

- Conveyor width ≤ 500 mm 60 mbar
- Conveyor width > 500 mm 80 mbar

Guide values for specific air volume are:

- Fine material 2 m3/m2 per minute
- Coarse material 3.5 m3/m2 per minute

l) Maximum speed: 3000 rpm for 50 Hz electrical supply.

m) Air filters shall be provided at fan inlets at man height.

n) Fans installed outdoors shall be protected against taking in of rain through the suction inlet.

o) Casing mounted fans are as well accepted.

p) All bolts, nuts, washers and loose fittings, as would be necessary for erection.

8.03 SCREW TYPE AIR COMPRESSOR

Nine (9) nos. (8 working and 1 standby) oil free air cooled Screw type air compressors, each having suitable capacity free air delivery at 3.0 bar for unloading of wagon and two (1 working and 1 standby) Oil Free Screw Compressors (Air Cooled) for supplying pulse air to Dedusting units 7.5 kg/cm2(g) with suction filters fitted with electrical & instrumentation, interconnecting cables etc. These compressors shall be controlled both from local control panel view and from level 2 SCADA system. The piping design has to be done in such a way that the stand by compressor shall be capable of substituting any blower as per requirement.

Compressed air will be passed through air dryer and air receiver and quality of air shall be such that instrument air receiver shall receive compressed air having aerosol of 1ppm and particle size down to 1 micron.

8.04 FAN

The fans shall be capable of withstanding the stresses which may be experienced during normal operation and during over speed testing. All fans shall be suitable for outdoor installation.

All the fan units shall be reasonably noise and vibration free in operation and hence of reasonably low speed. The noise level shall be limited to 80 db at 1.5M radius.

Operating pressure of fan shall not exceed 93% of Peak pressure of fan performance curve.

Fan static efficiency – min. 80%

Drive – Directly coupled and motor

Fan performance testing shall be as per BS : 848, Class ‘A’ latest revision.

Anti-vibration pads to be provided for fan installed above ground level

Inspection doors with fly nuts and gasket of suitable size shall be provided on the scroll for easy access to fan internals for inspection, Cleaning and for in-situ rotor balancing.

Fan casing shall be provided with clean out doors and drain plugs, as required

Inlet Boxes are to be provided as required and casing shall be stiffened to resist vibrations and distortions.

Motorised inlet damper has to be provided for fans with motor rating above 11 kW.

The fan and the drive motor shall be rated for continuous operation.

The starting torque characteristic of the motor shall be suitable for the duty desired.

All centrifugal fans may have adequate arrangement for vibration isolation of minimum 70% efficiency as the case may be.

The centrifugal fans shall have flat backward inclined / backward curved blades. They shall be single inlet and shall be of single width type. For design purpose outdoor temp. shall be taken as 51 deg.C.

The fans shall be of robust construction. The thickness of the casing and impeller shall be as given below:

Casing – 8 mm.

Inlet box – 6 mm.

Blades – 8 mm (min.).

Fan should be designed for adequate duty keeping a margin in approximately 15% on pressure ratings. Operating speed of the centrifugal fan shall not preferably be more than 1500 rpm and velocity of outlet shall not exceed 15 m/sec.

8.04.01 MATERIAL OF CONSTRUCTION

The following materials shall be used for the construction of various parts:

a)	Fan scrawl	:	MS (IS 2062).
b)	Supports, frames & structures	:	MS (IS 2062).
c)	Cone inlet for wall exhausters / supply fans	:	CI or MS.
d)	Dampers – louver type and butterfly type	:	MS (IS 2062).
e)	Flexible connections for fan inlet & outlet	:	Rubber impregnated canvas with MS Flanges & Cleats. Split draw band type made of spring steel for DE System.

f)	'V' Pulleys	:	CI Multi-grooves (IS 210, Gr. 20).
g)	'V' Belt	:	Reinforced rubber of appropriate section.
h)	Slide Rails	:	CI or MS.
i)	Connection Pieces	:	Galvanized iron according to supplier's design.
j)	Bolts and Nuts	:	All foundation bolts and nuts shall be HT and Others shall be MS unless otherwise specified.
k)	Rain protection cowls, hoods and casing for roof exhausters	:	Casing & exhaust hoods will be hot dipped galvanized after fabrication from MS IS 2062.
l)	Vibration isolating pad, washers & bushes, if any	:	Hard synthetic rubber of hardness 40 degree shore.
m)	Chute thickness	:	10mm

8.05 BEARING AND BEARING HOUSING

- Anti friction bearings, suitable for specified duty conditions shall be used for the fans, conveyors, bucket elevators, etc. The bearings shall have a minimum life of 100,000 hours.
- The bearing make shall be of SKF / FAG / TIMKEN. The supplier shall provide authenticity certificate for genuineness of bearings. Spurious bearings shall be rejected.
- Bearings shall be provided with suitable lubrication system with adequate cooling arrangement to maintain the bearing & lubricant temperature within permissible limits. Grease lubrication system shall be preferred. For oil lubrication system, maximum permissible oil temperature during operating condition shall be limited to 90 deg.C / 40 deg.C above ambient temperature. Drain plug shall be provided in bearing housing.

8.06 DE-DUSTING UNITS / BAG FILTERS (JET PULSE TYPE)

8.06.01 GENERAL

- Not more than 8 dust sources shall be connected to a single dust filter.
- The maximum air to cloth ratio shall be 1.15:1 / air permeability shall be 1.15 m3/m2/min for general de-dusting.
- Pulse jet type bag filter shall be provided with suitably reinforced bag/man-catcher screens.

8.06.02 BAGS

- Filter cloth for dry gas application up to 135 °C: Needle felt made of high quality Polyester fibres (for air and alumina dust).
- For standardization of bags (e.g., diameter of 140/160 mm) most filters shall be matched in such a way that only one size (i.e. diameter, length) and filter bag type is used for similar applications.
- Maximum number of bags per row: 16 bags
- Bag cages shall be provided with longitudinal wires:
  - To 12 for filter cloth diameter < 160 mm.
  - Bag cages shall be of single piece design and shall be corrosion-resistant (galvanized, stainless steel or epoxy coated), depending on application.

8.06.03 BAG MONITORING AND PROTECTION EQUIPMENT

- Bag cleaning shall be controlled by timer and differential pressure measurement across the bag filter by DP gauge or transmitter.

  Manual condensate drain, pressure gauge and regulator at the inlet of compressed air receiver/manifold shall be provided.

8.06.04 DEDUSTING AIR VOLUME

- Air Slide : 125% of Air Blower capacity.
- Pneumatic Transport : 1.5 times of the expanded compressed air volume
- Small Bin (< 50 m3) : 1000 m3/h

8.06.05 VENTING DUCTS

- Inclined vent ducts for up and downwards dust-laden air flow shall have an inclination of at least 60 degrees measured from horizontal.
- A conveying velocity of 18-25 m/Sec shall be maintained at all points in the ductwork between dust collection hood and dust collection plant to ensure flow of air without settling of dust. Hinged cleaning hatches shall be provided on the ducting near the bends & interconnection of ducts. Measuring ports shall be provided on the ducting near each suction point and on ducting before & after the centrifugal fan to measure the flow rate and pressure. Platform with ladder shall be provided for approach to cleaning hatches & measuring ports.
- Horizontal ducts may be avoided.
- Minimum venting duct diameter shall be 133 mm (outside).
- Air velocity at venting hood entries shall not exceed 1.5 m/s
- Minimum duct and hood wall thickness shall be 3 mm

- All expansion / flexible joints shall have bolted flange-to-flange type connections on both sides of expansion joint for removal of complete unit. Minimum flange thickness shall be 6 mm.

Orifice plates with wear protection shall be used for balancing the de-dusting air volumes from the various de-dusting points of a single filter if wear is predicted.

8.06.06 HOPPER CONSTRUCTION

Hopper valley angles shall not be less than 55 degrees (measured from horizontal) for dust from general applications. For filters with the risk of operation below the water dew point, the casing insulation shall be minimum 50 mm of rock wool.

8.07 AIRLOCKS

- RAL casing should be casting of IS 4896 Grade II.
- Spring loaded tips to be provided on rotor vanes for continuous sealing.
- Tip blade shall be of replaceable and adjustable type.
- RAL size : min. 300 x 300 mm
- RAL speed not more than 20 rpm.
- Motor shall be suitable for 100% filling of RAL at compact density. Minimum 1.1 kW / 1500 rpm motor to be considered.

8.08 ROPE WINCH SYSTEM

Rope winch system for wagon hauling shall be as per vendor's standards.

8.09 EQUIPMENT PARAMETERS AND OTHER SALIENT FEATURES:

- Stack height for Dust collector system shall be as per latest pollution control norms.
- Motor name plate rating at 50ºC shall have at least 15% margin over the input power requirement of the driven equipment at duty point except for package type screw compressor where service factor motor are used as per manufacturers standard.
- The system shall be capable of operating continuously round the clock throughout the year. The installation must be designed so that it can always be serviced without having a complete shutdown.
- Alumina unloading and transportation system shall be laid out and constructed for convenience and safety of operation and maintenance. All equipment shall be oriented to permit servicing in such a way as to require a minimum of dismantling.
- All equipment and materials (mechanical, piping, electrical, instrumentation, controls, civil, architectural etc) shall be sourced from manufacturers acceptable to DCPL and NALCO.

- All electrical installations including the hoists in open area shall be provided with rain protection hood.
- Maintenance platforms/access walkways shall be provided at one end beam for each electric monorail hoist.
- All the equipment shall be field proven for such an operation taking into consideration normal preventive and running maintenance of the unit and their auxiliaries.
- All equipment, controls and structure shall be designed for installation in carbon and alumina dust charged atmosphere of aluminium smelter area and seismic condition of site.
- All equipment shall be proven design. Prototypes or extensive modifications of the basic designs are unacceptable.
- The installation shall be designed with adequate facilities for maintenance & operations.
- The design, fabrication, painting, supplies and testing shall conform to relevant international codes and standards, Indian codes and standards, wherever applicable, shall take precedence over those of other nationalities. Only latest editions including addenda shall be referred to.
- Design, fabrication & operation of the plant shall be based on the following:
  a) Indian factory act
  b) Indian explosive act
  c) Petroleum & Carbide of calcium manual
  d) Fire protection manual of fire sectional committee, Insurance Association Of India
  e) Regulations laid down by explosive directorate and electrical inspectorate
  f) Regulations of Director general of civil aviation for all stacks
  g) NFPA code of practice
  h) Regulation of electrical equipment of buildings Insurance Association Of India
  i) Regulation of both Central and state pollution control boards of overall pollution
  j) control for both surface and air
  k) Indian electricity rules
- Compressed air and supply air facilities supplied shall include all compressed air piping, valves and fittings as required.
- All blowers and compressors generating process air supply for AUT shall be housed in a common blower/compressor house, which shall provide weather protection as well as act as noise enclosure common to all equipment inside the room. The noise level shall be maintained as per requirement of environmental norms.
- All equipment to be supplied shall be of robust design and manufacture and shall correspond to state of the art of manufacturing technology. Selected equipment shall have a high degree of availability, require minimum maintenance and operate with high

efficiency. Electrical and thermal energy consumption shall be low. Equipment shall be designed for heavy-duty industrial application, capable of handling very abrasive materials in dusty environments. The equipment shall be suitable for continuous operation at uniform maximum load without adverse effect on the life or maintenance of the equipment under prevailing conditions. Furthermore it shall be suited to all local climatic and operating conditions at the site.

- The equipment shall be designed with sufficient safety margins from the mechanical design and the process performance point of view. It shall be capable of re-starting after stopping due to power failure or other process-related interruption (i.e. interlock).
- The open space between the walkways on both sides of the air slides, conveyors to be covered with plates for safety purpose.
- The pipe conveyor gallery shall be suitably designed to prevent ingress of rain water.
- Pipe conveyor belt shall be selected properly for smooth operation (namely pipe formation, flexibility etc.). Pipe conveyor belt grade shall be fire resistance type.
- One Maintenance cum Sub-Store to be constructed near Blower room.
- All the alumina unloading area shall be under shed to protect Sun & Rain.
- Platforms (full length of the shed for both tracks) shall be constructed for two side access to roof of BTAP wagons inside the shed for alumina unloading area.
- Flushing points to be provided in all air chambers of air slides and vent pipe joints.
- All air control valves of the air slides to be provided with butterfly valves only.
- Suitable platforms to be provided for maintenance of valves in all areas.
- All de-dusting chamber shall be protected from rainwater and in case of necessary, sheds/canopy to be provided.
- In the control room, all the screens must be TFT to avoid heavy magnetic field.
- The outdoor electrical /Instrumentation installations like local cabinet of motors and other instruments shall be provided with rain protection shed.
- Total system lighting arrangement shall be preferably 70 Watts HPSV (High Pressure Sodium Vapour) with glass fitting.
- Pull chord/Belt sway switches and other switches as mentioned in P&ID shall be provided considering system tripping.
- In the control room there shall be Audible buzzer and Indication light during Alarm/Trip of the any equipment /system.
- Elbow installed on alumina pipes must be designed to resist abrasion. The inside pipe shall be lined with an abrasion proof medium. Elbow radius must not be less than 1 meter.
- The fluidization cloth for air slide shall be of fabric quality from reputed vendor.
- Pressurized ventilation system shall be provided in the blower room.

9. PERFORMANCE REQUIREMENT OF MAJOR EQUIPMENTS

Pipe conveyor

Equipment Number	:	PC-100/200/300
Capacity	:	1000 TPH
Accuracy	:	± 5%

Air slides

Equipment Number	:	AS-100/200
Average Capacity	:	480 TPH
Design Capacity	:	500 TPH

Air slides

Equipment Number	:	AS-300/400/401/500/501
Design Capacity	:	1000 TPH

Dust Emission

Equipment Number	:	DC-100/200/300/400
Type	:	Bag Filter type
Location	:	As per site condition
Function	:	Filter the air loaded with alumina dust before venting it to the atmosphere.
Dust Load	:	Approx. 25 gms/Nm^3
Dust Emission to atmosphere	:	50 mg / Nm^3 (desirable)

10. UTILITY FOR ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

One make up water line (existing 200-WT-35-2305-A34) will be tapped from existing line at the Co-ordinate N= (-) 1153.28M, E = (-) 2581.83M
8" Fire Hydrant (U /G Line) shall be available from existing line at the co-ordinate

N= (-) 939.874M, E = (-) 2343.605M

8" / 12" compressed air line shall be tapped from the existing line at the co-ordinate

N= (-) 1258.68M, E = (-) 2581.83M

The compressed air line for bag filters near silo-6 and silo-2 shall be tapped from the nearest existing compressed air line.

Drinking water supply line for proposed shall be tapped from existing system near RP area.

11. ATTACHMENT

SL. NO.	ENCLOSURES	DRAWING NO
1)	Proposed layout of Alumina Unloading & Transportation System in Smelter Plant	14L08-DWG-M-PL-001, REV. I
2)	View Profile for Unloading & Conveying System	14L08-DWG-M-PL-002, REV. G
3)	View Profile for Unloading & Conveying System	14L08-DWG-M-PL-003, REV. D
4)	View Profile for Unloading & Conveying System	14L08-DWG-M-PL-004, REV. D
5)	Process Flow Sheet for Wagon Unloading System	14L08-DWG-PR-PFD-001 REV. A (Sheet 1 of 2)
6)	Process Flow Sheet for Unloading And Conveying to Silos System	14L08-DWG-PR-PFD-001 REV. C (Sheet 2 of 2)
7)	Process And Instrumentation Diagram For Wagon Unloading System	14L08-DWG_PR-PID-001 REV. C (Sheet 1 of 2)
8)	Process & Instrumentation Diagram - Unloading & Conveying to Silos System	14L08-DWG_PR-PID-001 REV. D (Sheet 2 of 2)

DESIGN BASIS REPORT

FOR

ALUMINA UNLOADING AND TRANSPORTATIONSYSTEM

ELECTRICAL



NATIONAL ALUMINIUM COMPANY LTD.

(A Govt. of India Enterprise)

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DOC. NO.14L08-000-DBR-E-001

FEBRUARY, 2015

DEVELOPMENT CONSULTANTS PRIVATE LIMITED
CONSULTING ENGINEERS
24B Park Street , KOLKATA - 700 016, West Bengal, India

1. DOCUMENT CONTROL SHEET

PROJECT	:	ALUMINA UNLOADING AND TRANSPORTATION SYSTEM.
CLIENT	:	NATIONAL ALUMINIUM COMPANY.LTD.
DOCUMENT TITLE	:	DESIGN BASIS REPORT FOR ALUMINA UNLOADING AND TRANSPORATION SYSTEM.
DOCUMENT NO.	:	14L08-000-DBR-E-001
REV. NO.	:	03
DCPL JOB NO.	:	DCPL-14L08

ENDORSEMENTS

REV. NO.	DATE	DESCRIPTION	PREP. BY SIGN.(INITIAL)	REVW. BY SIGN.(INITIAL)	APPRVD BY SIGN.(INITIAL)
3	18.10.21	As per comment	SD	SB	AC
2	30.09.21	THIRD ISSUE	SD	SB	AC
1	17.02.15	SECOND ISSUE	BM	~~BB~~	DKG
0	04.12.14	FIRST ISSUE	BM	BB	DKG

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ATTACHMENTS

ANNEXURE-A TECHNICAL PARTICULARS OF ELECTRICAL EQUIPMENT

DRAWING KEY SINGLE LINE DIAGRAM: 14L08-DWG-E-0101, Rev.4

1.0 INTRODUCTION

National Aluminium Company Limited (NALCO) intends to set up additional alumina handling& transportation system for existing smelter plant. The purpose of this project is to enhance its existing capacity of Alumina unloading & Transportation system by introducing a new wagon unloading system along with transportation system to existing Silo.

2.0 CODES AND STANDARDS

All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) and IEC or equivalent standards published by the Bureau of Indian Standards (BIS). In case of a conflict between IEC and other standards, the requirement of IEC shall govern.

Equipment and material conforming to any other standards, which ensure equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.

The electrical installation shall meet the requirements of Indian Electricity Rules as amended upto date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

3.0 PROPOSED POWER SYSTEM

The power supply for the proposed augmentation system shall be received at 11kV level through two no. HT cable at 11kV switchgear of new substation. This 11kV switchgear shall be used to receive power from existing substations 710.37 and 11kV switchgear at switchgear room-3 near 220kV switchyard and to feed HT motors of the proposed system & LT transformers. 11kV shall be further stepped down to 415V by two no (2X100% capacity) 1.6MVA*, 11/0.433kV oil filled transformer to feed LT auxiliary loads of the new system. The transformer capacity shall be selected in such a way that in case of outage of one transformer, the other transformer will take care of total loads. In order to meet the requirement of emergency power for emergency lighting power shall be received from existing substation 710.37 through Al. XLPE cable.

*Minimum and Indicative. Exact Rating shall be decided during detailed engineering.

For Electrical Power Distribution system, please refer Key Single Line Diagram, Dwg. No. 14L08-DWG-E-0101, Rev.5 attached with this design basis report. The electrical system parameters as envisaged are given below.

Voltage Level	Description	Utilization
11 kV	11 kV± 10%, 3 ph, 3 wire, 50 Hz,±3%Non-effectively earthed, 40kA* for 1 sec.	Power Source from existing system. Power feeding to Motors above 200kW and LV transformer.

Voltage Level	Description	Utilization
415V	415V± 10%, 3 ph, 4 wire, 50 Hz±3%, effectively earthed; Fault level : 50 kA* for 1 Sec	Power distribution to LT motors above 200W and up to 200kW, Other LT loads.
DC	110V DC,(+) 10% to (-) 15%, 2 wire, ungrounded, 25kA* for 1Sec.	Switchgear control, indication, protective relay circuits etc.
240V/110V AC	240V/110V AC, 2 Wire supply to UPS	Motors 200W and below. Other loads and module control supply etc.

1

* Indicative only. Shall be decided during detail engineering.

Brief description of the new electrical equipment and system are described in following clauses.

4.0 MAJOR ELECTRICAL EQUIPMENT

4.1 HV Switchgear

The11kV switchgear shall be used to receive power from existing 11kV HT switchgear and feed power feed power to HT drives and LT transformers.
The switchgear shall be indoor, metal-clad, floor mounted, self-standing, dust proof construction, draw out type with Vacuum circuit breaker. Design and construction shall be such as to allow extension at either end. All HT drive shall be vacuum breaker operated. Circuit breaker shall not produce any harmful over-voltage during switching off induction motors, unloaded lines and unloaded transformers. If required, surge protective device shall be provided to limit over-voltage to 2.2 times the peak value of rated phase to neutral voltage.

All Switchgear shall be provided with double bus bar and isolators and shall have bottom cable entry. The main buses (front and rear bus) and connections shall be of high conductivity copper or aluminum alloy. Insulating sleeves for bus bars and cast-resin shrouds for joints shall be provided. The switchgear enclosure shall conform to the degree of protection IP-4X.Voltage Transformer (VT) shall be cast-resin, draw out type and shall have an accuracy class of 1.0. Voltage transformer shall be mounted in a separate vertical panel.

Each switchgear shall be provided with 20% spare feeders with minimum one no of each type and rating.

4.2 LV switchgear

415 V Power cum Motor Control Centers (PMCC) shall be used to feed LT auxiliary loads of the proposed system. This switchgear shall receive power from 11kV switchgear through two no. 11/0.433kV transformer.
PMCC shall be sized for maximum 100% connected load plus 20% margin.

PMCC/MCCs/DBs shall be indoor, air insulated, and metal-clad type. The design construction shall be such as to permit extension at either end. All PMCC shall be provided with three phase busbars and neutral busbar. All bus bar compartments shall be fully enclosed. Main and vertical busbar of PMCC/MCC shall be made of Aluminium. Earth bus bar shall be of copper. All bus bars of PMCC shall be capable of withstanding the mechanical forces and thermal stresses due to 50 kA short circuit current for 1 sec.Degree of protection for LV switchgear shall be IP-52.

For feeder ratings of 800 A and above ACB shall be provided. For feeders less than 800A, MCCB shall be provided depending on the application. All the breakers are EDO type. All the breaker feeders shall have micro processor based external relay with communication protocol to link with SCADA, EMS system. All the ACB incomer breakers from transformer and B/C ACB shall be of 50kA breaking capacity.

All motors rated 110kW &upto 200kW shall be air circuit breaker controlled with external numeric motor protection relay. All the motor up to 30 kW shall be provided withMPCB.

Motors rated above 30kW and below 110 kW shall be Contactor operated by numeric motor protection relay with RS485 communication. For motors between 30kW to 110kW, MCCB with E/F protection shall be provided.

Motors rated below 110 kW shall have DOL starter.

3 phase energy meters with communication facility shall be provided for motor size more than 30KW.

Working height shall be limited between 450mm and 1800mm from floor level.

4.3 LT Non-Segregated Phase Busduct

The 415V non-segregated phase bus duct will serve as interconnection between the 415V Indoor Switchgear and outdoor/Indoor transformer terminals.

The 415V bus duct shall be non-segregated phase enclosure, natural air cooled type. The bus conductor shall be of high conductivity electrolytic grade copper or aluminum alloy, supported on fine glazed porcelain / cast resin / FRP insulators fixed to enclosure. Bus duct enclosure shall be made of Aluminum alloy. The thickness of enclosure material shall not be less than 3mm.

Phases shall be enclosed in a weather-proof, dust-tight enclosure without any barrier between phases. Enclosure for indoor run shall be IP52 protected. Outdoor enclosure shall have IP 55 degree of protection.

4.4 Auxiliary Transformer

The auxiliary transformers shall be used to provide 415V power supply to plant auxiliaries. In order to meet the above requirement two no. 1600kVA*, 11/0.433kV transformer has been envisaged. The

transformer shall be Oil Natural Air Natural cooled. Vector group shall be Dyn11. The transformer shall be provided with Off Circuit Tap changer with tapping range +/-5 @ 2.5%.
The transformer HV terminal shall be connected to HV switchgear through Al XLPE cable and LV terminal shall be connected to 415V switchgear through non segregated phase busduct.

The transformer capacity shall be selected in such a way that in case of outage of one transformer, the other transformer will take care of total LT loads. The transformer shall be outdoor type but to be located indoor.
*Minimum and indicative. Exact Rating shall be decided during detailed engineering.

4.5 AC & DC Motor

Motors shall be general purpose, constant speed, squirrel cage, three/single phase, induction type. Enclosures for the motor and the cable box shall conform to the degree of protection IP-55

Motors rated above 200W and upto 200kW shall be fed from 415V system and motors rated above 200kW shall be fed from 11kV system.

3 LT motors upto 200kW output rating at 50 ºC and of continuous duty shall be energy efficient type – efficiency class Eff**3** conforming to IS: 12615-**2018 / IEC-60034-30.**

All motors shall be either totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or closed air circuit air cooled (CACA) type.

The motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals. The mill motors shall be suitable for operating at 75% of rated voltage for one (1) minute.

The terminal box shall be capable of withstanding maximum system fault current for a duration of 0.25 sec.
All insulated winding shall be of copper.

HT motors shall have Class F insulation with winding temperature rise limited to 120ºC. Windings shall be impregnated to make them non-hygroscopic and oil resistant. The lightning impulse and coil inter-turn insulation surge withstand level shall be as per IEC-60034 – Part 15.

LT motors shall have Class F insulation with temperature rise limited to 120ºC.

Motor of rating 30 kW and above shall be provided with space heaters, suitably located for easy removal or replacement.

3 All HT motors shall be provided with minimum four (4) numbers simplex or two (2) numbers duplex platinum resistance type winding temperature detectors per phase. For Bearing Temperature detection, 2 **nos of** platinum resistance type detectors shall be provided each at NDE &DE.

4.6 Battery and Battery Charger

DC system shall provide reliable sources of DC power supply for control, indication, protection and annunciation of the plant. In order to provide reliable DC supply Lead Acid Plante type battery of required capacity shall be used. The DC system shall be 110V.

The batteries shall be so sized as to meet emergency load duty cycle requirements for one (1) hour. While estimating battery capacities, a design margin of 15% shall be kept. An ageing compensation factor of 1.25 shall be applied. The battery shall be provided with battery charger and DCDB.

Battery charging equipment shall consist of dual float cum boost charger. The battery charging equipment will be digital microprocessor based controlled and will be designed to supply the continuous DC load in addition to float/trickle/boost charging of the battery.

4.7 VVVF Drives

The system shall be energy efficient, designed as standard product and shall provide very high reliability, high power factor, low harmonic distortion and low vibration/ wear/ noise. VFD shall comply with major standards IEC 60146, IEC 60289, IS 5553, IEEE 519, IEC 61800 etc.

Each VFD will be of sufficient capacity and will produce a quality output waveform for stepless motor control from 10 to 100 percent of base speed. Each VFD will be suitable for either constant torque (CT) or variable torque (VT) loads as required by the driven equipment. To facilitate checkout and maintenance, each VFD will be capable of sustained operation at the minimum speed (10 percent of base speed). In addition, each VFD system will be capable of operation while disconnected from the associated motor.

The drive shall trip in case the speed exceeds 105% of the maximum operational speed or reduces to 95% of the minimum operational speed for more than 10 second.

For CT loads (conveyors), each VFD will be capable of a momentary overload of 150 percent of rated motor current for 1 minute out of any 10 minute period. When the load type dictates, each VFD will be capable of producing full rated torque at any speed in the operating range. VFD system shall be equipped with following minimum components.

a) Isolation/converter transformer.
b) Converter (at least 12 pulse).
c) Inverter.
d) Harmonic filters, if reqd.
e) All associated controls and protective devices.
f) Enclosure for rectifier/inverter and associated controls.

4.8 Power and Control Cables

The HV power cable will generally be XLPE insulated & LT power cable shall also be XLPE insulated, extruded PVC inner sheath, armoured and overall extruded FRLS grade PVC sheathed with stranded aluminium conductor of H4 grade. HV power cable shall be Un-earthed.

The control cables will be PVC insulated, extruded PVC inner sheathed, unarmoured/ armoured and overall extruded FRLS grade PVC sheathed with stranded copper conductor.

The cable sizes will be standardized to minimize too many sizes. The minimum cross section of power cables will be 6 mm 2 for aluminium & 2.5 mm 2 for copper conductor, of control cable 2.5 mm 2 copper and instrument cable 1.5 mm 2 copper.

The actual size of all HT and LT cables will be calculated on the following basis.

a) Continuous Current Rating.
b) Capability to withstand fault current.
c) Voltage drop at normal load as well as during starting of motor.

5.0 ELECTRICAL SYSTEMS

5.1 Illumination system

Suitable illumination system will be provided to have efficient lighting. All the lighting fixture shall be energy efficient fixture.Generally the following illumination level will be provided:

a)	Transfer Point, Conveyor Gallery	:	70 Lux
b)	Switch gear Room	:	300 Lux
c)	Corridors, Walkways, Staircase	:	70 Lux
d)	Control Room with false cealing	:	300 Lux
e)	Transformer Room	:	200 Lux
f)	Toilets/ passage	:	50 Lux
g)	Battery Room	:	200 Lux
h)	Unloading Area	:	50 Lux
i)	Street Lighting	:	20 Lux

j)	office area	:	300 Lux
k)	Cable spreader room	:	70 Lux
l)	Compressor room	:	150 Lux
m)	Control room/swgr. Room (emergency lighting)	:	50 Lux

k) Emergency Lighting : Beside the above , at least One no. (1) emergency fixture shall be provided at entry, exit and each landing of stair cases, platforms of Electrical Substation Buildings, Control Rooms, TPs, maintenance area , unloading area, etc.

The lighting system shall be designed with following concepts:-

Normal A.C. Lighting

This will be provided by A.C. energy efficient lighting fixtures distributed throughout the plant. These lights will be ON as long as the plant A.C. supply is available.

Normal lighting fixtures will be fed from respective area lighting panels, which in turn will be connected to main lighting distribution board. The main lighting distribution boards will be fed through respective 1:1 ratio lighting transformer, which forms a part of the MLDB. Normal A.C. supply thus made available by the MLDB is 415V, 3ph, 4Wire , 50Hz effectively grounded.

Emergency A.C. Lighting

On failure of normal A.C. supply, emergency A.C. lighting will be provided in selected areas for general visibility, safe movements and operation of important auxiliaries.

Emergency lighting distribution board shall be fed through 1:1 ratio lighting transformer, which form a part of ELDB. The power for A.C. emergency lighting shall be arranged from emergency power distribution board. The power supply for emergency lighting shall be 415V, 3ph, 4Wire, 50HZ, effectively grounded. Emergency power for lighting shall be arranged by contactor from existing substation 710.37. Supply, laying, termination of the above cable shall be under the scope of this package.

5.2 Grounding System

The system shall (a) provide safety to personnel from contact of dangerous potential caused by ground fault, (b) ensure sufficient grounding current for effective relaying and (c) stabilize circuit potential with respect to ground.

Ground grid conductor of mild steel rod shall be used. The minimum conductor section is determined on the basis of ground fault current. This section is then increased by an allowance to account for the soil corrosion loss of 0.3 mm per year over the design life of 30 years. However, the minimum size shall be 1x40 mm dia mild steel conductor.

The ground grid conductors will be buried in earth at a minimum depth of 1000 mm. The length of ground conductors below earth will be sufficient to ensure a ground resistance less than 1 ohm.All ground grid conductor connections will be welded type. Earth test pit with chamber to measure individual and grid resistance separately shall be provided.

Galvanized steel flats shall be used for all connections above earth.

Inside building, ground conductors will be run for each floor supported on building steel and/or cable trays. These ground conductors in turn will be connected to the station ground grid through riser (at least two) coming up along building columns/cable shafts.

Two separate and distinct ground connections will be provided for each electrical equipment in compliance with I.E. Rules.

Equipment ground connections will be sized to carry the available ground fault current. Considerations shall also be given to mechanical ruggedness of the connections and to limit the number of sizes. Substation earth grid is to be connected with the existing plant grid at least at 2 points.
Electronic equipments and systems, metal enclosures of all electronic panels shall be connected to a grounding system with which is isolated and separate from the electrical equipment grounding system.

Following minimum sizes of earth continuity conductors will generally be used for grounding of equipment:-

a)	40 mm. dia. MS Rod as ground electrode and ground grid
b)	75 x 10 mm GS or 50 x 6 mm GS strip as main risers depending on system fault current for switch yard equipment & structure, rail, fence riser
c)	75 x 10 or 50 x 6 mm GS strip for all switchgears, transformers and motor control centers
d)	50 x 6 mm GS flat for motor above 90 KW

e)	35 x 6 mm GS strip for rotor starters and motors rated between 30 KW and 90 KW
f)	25 x 3 mm GS strip for control desk, small distribution board and motor rated between 5 KW and 30 KW
g)	8 SWG GI wire for local push button stations, junction boxes and motors below 5 KW

5.3 Cabling System

Cabling work shall be carried out in such a way as to provide a reliable and assured electric power supply system to all auxiliaries.

Cables will generally be laid on cable trays, cable trench, cable rack, overhead supported from building steel/structures or cable bridge/cable trestle. Cable trench shall be avoided as far as possible in outdoor areas. Cables shall not be buried directly in ground unless explicitly permitted in some areas.

Cable trays shall be of pre-fabricated GI ladder/perforated type sheet steel complete with matching fittings like brackets, elbows, bends, reducers, Tees, crosses, tray cover etc. and hardwares like bolts, nuts, washers, GI straps, hook etc.as required. Cable trays shall be ladder type for power and control cables, and perforated type for instrumentation cables. Separate trays shall be used for control & power cable. Punched identification tags made of 2 mm aluminium plates shall be fixed on each cable at both the ends and few other locations on the tray.

Cable trays, fittings and accessories shall be factory-fabricated out of rolled mild steel sheets and hot dip galvanized as per relevant IS.

Cable trays shall be supplied in standard length of 2.5 meters and in standard width of 150mm, 300mm, 450mm and 600mm.

Mild steel sheets used for fabrication of cable trays and all fittings except the side coupler plates shall be of 2mm thickness. 3mm sheet shall be used for side coupler plates.

5.4 Lightning Protection System

The main purposes of the lightning protection system shall be (a) to provide protection to structures from lightning strokes and (b) to provide a low resistance-conducting path to lightning discharge.

Lightning protection shall be provided for switchgear room, other auxiliary building, and other structures. Lightning protection will also be provided for building/ structures where the overall rise factor exceeds 10-6 as per IS: 2309.

Vertical air terminals shall be of 20mm dia galvanized steel rod on the structure/building.Horizontal air termination of 75x10 mm GS flat conductor on the roof of the installation shall be so laid out that no part of the roof will be more than 9 meters from the nearest conductor.

Down conductors of 75x10 mm GS Flat for all installations except for conveyor gallery will run along the outer surfaces of the building and shall have a test joint about 1500 mm above ground. It shall be 25x3 mm GS flat for conveyor gallery.

An earth electrode of size 40 mm. diameter 3 metre long MS will be provided at the connection point of the down conductor with the station ground.All connections will be of welded type.

6.0 EQUIPMENT PROTECTION

The primary objective is to mitigate the damage of the plant and equipment during fault or system disturbances.

Automatic trip functions will be initiated for isolation of fault, which could cause immediate and severe damage. Protection relays shall be microprocessor based numerical relay with communication facility. Communication protocol shall be compliant with IEC 61850. Numerical relays shall be used for protection and monitoring only. No logic or control functionalities shall be incorporated in it.

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Every effort will be made to avoid unnecessary trip. Whenever possible, therewill be annunciation to alert the operator to take corrective action in time.

The major protections envisaged for the various equipment are listed under individual headings. All associated relays for completeness of scheme, auxiliary relay, lockout relay, check synchronizing relays, auto synchronizer etc. will be provided as required.

6.1 HV Switchgear

Minimum protections to be provided for different type of circuits are listed below -

A. Incomer :

a. IDMTL over current (51) for phase fault

b. IDMTL over current (51N) for earth fault

c. IDMTL over current (51SN) for stand by earth fault (for incomer from transformer only).

d. Restricted E/F (64) (for incomer from transformer only)

e. Differential Relay (87T) (for incomer from transformer rated 5 MVA & above)

f. Under voltage with time delay (27)

g. VT fuse failure

h. Circuit breaker failure

i. Auxiliary relays for Transformer Protection like Buchholz Relay Alarm & Trip, Oil Temperature Alarm & Trip, Winding Temperature Alarm & Trip, OLTC Buchholz Alarm & Trip, Oil Pressure level and Pressure relief device operated Alarm.

B.Tie feeder : a. IDMTL over current (51) for phase fault

b. IDMTL over current (51N) for earth fault

c. Under voltage with time delay (27).

d. VT fuse failure

e. Circuit breaker failure

f. Synchronizing check relay, if applicable, complete with guard relay

C. Motor feeder : a. Thermal overload (49)

b. Phase fault (50)

c. Unbalance (-Ve seq.) (46)

d. Locked rotor (50 LR)

e. Definite time O/C (50G) for earth fault (through CBCT)

f. Differential (87) protection for motor above 1000 KW rating.

g. Vibration Monitor (39) (optional)

h. Starts per Hour (66).

g. Circuit breaker failure

h. Winding temperature

i. Bearing temperature

D. Auxiliary Transformer : a. IDMTL over current (50/51) with high set instantaneous units for phase faults

b. Definite time O/C (50G) for earth fault (through CBCT)

c. Differential protection (for transformers rated 5MVA and above)

d. Auxiliary relays for Transformer Protection like Buchholz Relay Alarm & Trip, Oil Temperature Alarm & Trip, Winding Temperature Alarm & Trip, OLTC Buchholz Alarm & Trip, Oil Pressure level and Pressure relief device operated Alarm.

e. Circuit breaker failure.

6.2 LV Switchgear

The minimum protections to be provided for circuit breaker controlled feeders are listed below:

A. Incoming Feeders

a) 3-Inverse time O/C relays (51) for Phase faults

b) 1-Inverse time O/C relay (51N) for Earth faults

c) IDMTL Over Current (51 SN) for stand by earth fault (for incomer from transformer only)

d) Restricted E/F (64)
(for incomer from transformer only).

e) VT Fuse failure.

f) Circuit Breaker failure.

g) Sensitive earth fault detectors shall be provided in DC system to annunciate earth faults

B. i) Motor feeders rated above 110 kW and up to 200 kW shall be breaker controlled with Microprocessor based Numerical motor protection relays having the following protection features.

a) Thermal model with negative sequence current.

b) Voltage compensated acceleration.

c) Under voltage, over voltage protection.(SR Type)

d) Overload protection.

e) Short circuit & SC back-up.

f) Current unbalance.

g) Locked rotor protection

h) Ground fault.

i) Temperate monitoring (stator, bearing etc.).

j) Phase reversal.

k) VT fuse failure at bus VT and secondary fuse detection scheme.

ii) Motor Feeders rated up to and including 110 kW shall be MCCB and Contactor operated with the following protection features.

a) Bimetallic thermal overload relay(hand reset Contactor operated type) with in built single phasing preventor.

b) Short circuit protection by MCCB.

c) Locked rotor protection

d) Earth fault protection

e) Under voltage protection (SR type)

The relay shall have facility for user interface capability, character display, keypad, LED indicator and communication port along with licensed version software.

C) Outgoing feeder : a. IDMTL over current relay (51) for phase fault – 3 Phase

b. IDMTL over current relay (51N) for earth fault.

D) Bus-coupler : Check Synchronization relay (25).

7.0 SYSTEM CONTROL

There shall be one main control room for complete Process Plant located at new substation. Control Philosophy of the Plant Equipment shall be such that each equipment shall have three modes of operation selectively through respective Local-Remote selector switch preferably at control room. Plant on operation shall have only emergency stop facility.

Auto mode
In this mode the equipment shall be operated from the Central Control Room with DCS/PLC fulfilling all sequence and process interlocks.

Manual mode
In this mode the equipment shall be operated manually from the Central Control Room by individual start/stop device after fulfilling all sequence and process interlocks.

Local mode

In this mode individual drive shall be started and stopped from the local push button station in de-interlock mode. However safety interlock, if any, for the drive shall be fulfilled.

Incomer & Bus coupler of 11kV system shall be controlled from existing 220kV SCADA as well as proposed SCADA at newsubstation.

8.0 LAYOUT CRITERIA

Layout of switchgear room shall be liberally designed with adequate clearances. Switchgear/ control room shall have clear head room of 3.5 M (minimum) and cable cellar room clear head room 3.00M (Minimum)

Switchgear room shall be located in the first floor of the substation building and ground floor of the same building shall be used for cable cellar. Separate battery room shall be provided in substation building.

Following factors shall be considered while finalizing the room size:-

i. Minimum clearance between two switchgear panels, facing each other shall be maintained as 3000 mm. These distances shall be maintained for all other panels located inside the room.

ii. Clearance from any obstruction like column, wall, and vertical raceway on back side of switchgears shall be maintained as 1000mm (minimum) and shall also comply with manufacture's standard.

iii) Minimum Space between the sides of two switchgears, between any two panels or between switchgear and the wall shall be 1000 mm. Where access is not envisaged, clearance shall be 200 mm.

iv) Clearance between front face of SWGR and any obstruction like column, wall, vertical raceway, etc. shall be maintained as 1500 mm (minimum) and shall also comply with manufacture's standard. All clearances shall be as per relevant standards.

v) Clearance between switchgear panels and any other panels, facing each other shall be maintained as 3000 mm.

vi) Minimum Clearance from top of bus duct to nearest obstruction shall be at least 1000 mm.

vii) Access to Rooms, Doors, etc. to be provided in various floors shall consider movement of the panels during erection and later during maintenance.

viii) Switchgear shall be arranged to minimize interference with floor beams. Where interference is unavoidable dummy panel shall be provided.

ix) Switchgear room/MCC and cable spreader room shall be pressurized above the atmospheric pressure to prevent ingress of dust.

x) Adequate space and provision for handling of equipment shall be provided.

xi) Control room and battery room shall be Air conditioned.

xii) Layout shall have due provision for maintenance area, shift room and all equipment (e.g. Crane, Hoist etc.) for handling of heavy equipments shall be provided.

xiii) Adequate clearance shall be provided at both end of PMCC/MCC panel for future extension of at least one vertical module.

ANNEXURE-A

TECHNICAL PARTICULARS OF MAJOR ELECTRICAL EQUIPMENT

1.0 11kV SWITCHGEAR

Type	:	Metal-clad, draw out
Service	:	Indoor
Rated Voltage KV rms	:	11 kV± 10%
Phase	:	Three
Rated Frequency	:	50 Hz + 3% to -3%
System grounding	:	Resistance Earthed
Bus bar Material and Rating	:	Double Busbar, 800A
Rated short time withstand current	:	40 kA for 1 Sec
Type of Breaker	:	VCB

2.0 415V SWITCHGEAR

Type	:	Metal-clad, horizontal draw out horizontal isolation ACB and MCCB Module Fixed type
Service	:	Indoor
Rated Voltage (U_e)	:	415 ± 10% V
Phase	:	Three Phase, Four Wire
Rated Frequency	:	50 Hz ±3 %
System grounding	:	Effectively earthed through resistance.
Bus bar Material and Rating	:	3000A
Rated short time withstand current	:	50 kA for 1 Sec.

3.0 415V NON-PHASESEGREGATED BUSDUCT

Type	:	Non-segregated phase, self-cooled.
Service	:	Indoor
Rated Continuous Current	:	2500Amps
Material		
a. Bus conductor	:	Aluminum alloy Grade 63401 (56.5% IACS) IACS: International Annealed Copper Standard
b. Bus enclosure		
> 2000A	:	Aluminum alloy Grade 31000 (56% IACS).
Rated short time withstand current	:	50 kA for 1 Sec.

4.0 AUXILIARY TRANSFORMER

Type	:	Oil filled, Two winding transformer
Rated power	:	1600 kVA**
Rated voltage ratio (line to line)	:	11/0.433 kV
No. of phases	:	3
Rated frequency	:	50 Hz
Type of Cooling & Respective Power	:	ONAN (100%)
Insulation level (SI: Switching Impulse Voltage, LI: Lightning Impulse Voltage, AC: Short duration induced& separate source AC withstand Voltage)		
.HV- (SI/Li/AC)	:	75 kVp / 28 kV rms
L.V- (LI/AC)		:- kVp / 3 kV rms

L.V Neutral – (LI/AC)	: - kVp / 3 kV rms
Vector group	:Dyn11
Short-circuit impedance at 75oC at principal tap	:6.25%**
Type of taps provided	:Off load full capacity

** Minimum and Indicative. Impedance value shall be with IS tolerance.

5.0 BATTERY

Type	:Lead Acid PLANTE
Application	:D.C. Closing/Tripping, indicating of SWGR/PMCC, Critical Lighting.
Battery nominal voltage	:110 V
Mounting	: Wooden Rack

6.0 BATTERY CHARGER

Charger	:Dual float cum boost charger
Type	: Solid-state, full wave, fully controlled with Micro-processor based AVR, three-phasebridge, suitable for continuous duty application.

7.0 VVVF DRIVES

Application	: Variable / constant torque as required by the driven equipment.
Nominal input voltage, volts	: **690 V**
Nominal frequency, hertz	: 50
Speed range	: 10 to 100 percent
Minimum continuous speed	: 10 percent
Overload capability	: >150% for 1 min in 10 min interval

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8.0 CABLES

HV Power Cable	: Al., XLPE insulated, extruded PVC

inner heath (for multicore cable), strip/round wired armoured, Extruded FRLS PVC outer sheath.

LV Power Cable	:	:Al/Cu conductor, XLPE insulated, extruded PVC inner sheath (for multicore cable), strip/round wired armoured, Extruded FRLS PVC outer sheath.
Control cables		:Stranded and non-compacted Cu conductor, PVC insulated, , round wired armoured, Extruded FRLS PVC outer sheath.

9.0 CABLE TRAY

i) Type : Galvanized, pre fabricated cable tray of300, 450 & 600 mm

DESIGN BASIS REPORT

FOR

ALUMINA UNLOADING AND TRANSPORTATION-SYSTEM

CONTROL & INSTRUMENTATION



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(A Govt. of India Enterprise)

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DEVELOPMENT CONSULTANTS PRIVATE LIMITED
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DOCUMENT CONTROL SHEET

PROJECT	:	**ALUMINA UNLOADING AND TRANSPORTATION SYSTEM**
CLIENT	:	**NATIONAL ALUMINIUM COMPANY LTD.**
DOCUMENT TITLE	:	**DESIGN BASIS REPORT FOR ALUMINA UNLOADING AND TRANSPORTATION SYSTEM**
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ENDORSEMENTS

REV. NO.	DATE	DESCRIPTION	PREP. BY SIGN. (INITIAL)	REVW. BY SIGN. (INITIAL)	APPRVD. BY SIGN. (INITIAL)
4	18.10.2021	As per comments	PB	DC	AC
3	23.07.2015	As per comments	PB	DC	DKG
2	25.06.2015	As per comments	PB	DC	DKG
1	20.12.15	As per comments	SN	DC	DKG
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1.0 GENERAL:

National Aluminium Company Limited (NALCO) intends to set up additional alumina handling & transportation system for existing smelter plant. The purpose of this project is to parallel system of Alumina unloading & Transportation system (capacity 900000 Ton per year) by introducing a new wagon unloading system along with transportation system to existing Silo.

2.0 FIELD INSTRUMENTATION:

Instrumentation sensing, transmission, measuring & computing systems will be electronic and final control elements such as control valves etc shall be pneumatic in general.

Signal transmission from field to control room and vice-versa will be in the current mode i.e. 4-20 mA DC through signal isolator having gain adjustment feature.

All field Instruments are envisaged to be Smart type giving output with superimposed digital signal conforming to HART protocol.

All safety switches of the conveyor belt shall have individual local indication as well as remote indication.

All temperature elements RTD/Thermocouple will be duplex type. Temperature transmitters will be used for all temperature elements to generate 4-20 mA signals. Up to 200^0C RTD shall be used, more than that Thermocouple may be used.

All site pressure transmitters shall have provision of local indication as well as signal to the control room for indication. However, all transmitters shall have in built local indication and communicate through HART Protocol.

Suitable Level measurements / Sensors shall be provided. All level transmitters shall have display unit at 1 meter above grade level. For open environment the enclosure housing the controller shall be of IP 67 protection.

Pull chord switch shall be intelligent type.

All field instrument installation shall have suitable approach for maintenance.

Canopy shall be provided for all open environment installation.

All field instrument enclosure shall have IP 67 protection for open environment installation. Others may have IP 65 protection.

All Solenoid Valve for pulsing/purging of the bag filter system shall be actuated by centralized PLC (not a local PLC) directly through interposing relay or contactor. Terminal block shall have Fuse TB along with Fuse blown indicator.

The dedusting system shall be provided with differential pressure transmitter having local indication as well as in the PLC.

Separate earth pit shall be provided at new control room for instrumentation like VIZ, PLC etc.

3.0 CABLE:

All field instruments will be terminated in the local junction box. Individual & overall shielded, twisted pair (1.0 sq. mm) cables shall be used for analog signals. Over all shielded (1.5 sq mm) core cable shall be used for Digital signals. Multicore or Multipair cables will be used from local junction box to the marshalling cabinets or Input/output terminal blocks of PLC system. All cable shall be ATC Cu cable.

Cabling shall be done in such a way to considering transportation facility of the plant.

4.0 CONTROL & AUTOMATION:

In order to have better supervision, operation and control of the Alumina unloading & Transportation plant, microprocessor based redundant Programmable Logic Controller (PLC) suitable for industrial control system has been envisaged. The control system shall have the facilities for remote monitoring and sequential control, including local operation of individual equipment, audio and visual fault annunciation, normal status display, signaling, data & alarm logging, report generation, data storage for historical analysis, data display and printing etc. The PLC will be situated in the New Control Room.

Hot Redundant PLC System (i.e. Redundant CPU, Communication Processor, Power supply of each rack) has been envisaged in New Control Room (Near Unloading Area). I/O card will be non-redundant. Make sure all information will be available in the PLC System.

Besides the above new PLC, additional I/O of the following area shall be accommodated in the respective area existing PLC:

- Control Room - 2 PLC
- GTC - 8 Control Room PLC

Control Room -2 PLC:

Existing Control Room -2 have non redundant Siemens S-7 300 PLC. Additional I/O of the silo 1 & 2 area shall be accommodated in existing Control Room – 2 PLC. There is free space in the existing I/O panel to accommodate the additional I/O card. Vendor has to supply additional I/O card along with all accessories like back plane PCB, Terminal Block, interposing relay, Cable, Power supply module etc. to accommodate additional I/O. The supplied I/O cards shall have sufficient numbers of channel so that it can accommodate all the requirement of process and shall have about 30% of spares channels available for future use. Vendor to ensure that all I/O cards & accessories shall be from same make, family of hardware as that of existing one. Graphics up gradation of existing HMI along with hook up of existing Siemens S-7 300 PLC & New PLC at New Control Room over redundant Fiber Optic communication under the vendor scope. Necessary hardwire & software like Network Switch, Fiber Optic, Converter (if any) etc. shall be supplied by the contractor.

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GTC-8 Control Room:

Existing GTC-8 Control Room have redundant Rockwell Control Logix PLC with Flex I/O. Additional I/O of the silo 5 & 6 area shall be accommodated in existing GTC-8 Control Room PLC. There is free space in the GTC-8 Control Room to accommodate the additional I/O Panel. Vendor has to supply additional I/O Panel with I/O card, Communication card along with all accessories like back plane PCB, Terminal Block, interposing relay, Cable, Power supply module etc. to accommodate additional I/O. The supplied I/O cards shall have sufficient numbers of channel so that it can accommodate all the requirement of process and shall have about 30% of spares channels available for future use. Vendor to ensure that all I/O cards & accessories shall be from same make, family of hardware as that of existing one. Graphics up gradation of existing HMI along with hook up of existing Rockwell Control Logix PLC & New PLC at New Control Room over redundant Fiber Optic communication under the vendor scope. Necessary hardwire & software like Network Switch, Fiber Optic, Converter (if any) etc. shall be supplied by the contractor.

4

The purpose communication with existing PLC & New PLC is to get rid of the issues of any overlapping of command regarding silo filling, necessary interlocks to be incorporated in the existing PLC as well as new PLC.

Local panels, if at all offered for the drives like Air Blower, Compressor etc, will be placed near to drives.

Switchgear related input will be connected to New PLC for information of electrical system & report generation. It is envisaged that IED will be connected to Network switch with Peer to Peer Communication and MFM will be connected to PLC through RS 485 communication with daisy chain. Hardwired electrical I/O will be connected to PLC directly through control cable.

Following facilities have been envisaged for the PLC system as minimum:

1) Real time automatic centralized control (starting and stopping) from control room for all equipment in accordance with a pre-determined sequence (both for starting and stopping) for normal operation of the plant so as to ensure safe and efficient operation of entire plant.

2) Stopping of any equipment from the control station located near the drive of respective equipment under all conditions including emergency.

3) The wagon unloading control and silo selection shall be carried out from the new control room. The signals indicating faults on the silos shall be visualized in the above of control room. Selection of silo to be filled will be made by an operator MANUALLY according to Alumina level in different silos. These levels will be indicated by devices designed to show at any given time the level of alumina in storage. When wagons have been emptied, unit should be stopped in reverse order i.e. equipment nearest wagons first. Any incident, equipment

stoppage or blocking will be reported to unloading station by audio-visual signal.

4) Stopping of conveyors in case of emergency by safety Switches etc. provided along the conveyors. Tripping of any conveyor will trip upstream conveyors & downstream conveyors sequentially after a time lag. Safety switch has been envisaged both side of all conveyors maintaining standard distance. Safety Switch status will be displayed in the HMI.

   Each safety switch will be addressed to MCC. Hardwired multiplication will be done in the MCC. One contact will be connected to PLC and other one will be connected to MCC for hardware interlock.

5) Safety interlocks of the equipment should be provided hard-wired into the drive level i.e. in MCC. All the drive safety related switches shall be multiplied in the MCC to make two contacts other than that used in the scheme. One set of contact shall be sent to the PLC and the other set of contact shall be used to MCC / Sw. Gr. to realize the drive safety interlock. This will ensure minimum Drive Safety aspects of all the Drives. However the logic for the safe operation of each equipment will be developed during detail engineering

6) Suitable material level sensor shall be provided in each Bin/Hopper.

7) PLC System will be communicated with VVF drives & other 3rd party system through soft communication depending on the system protocol, if any.

8) Starting and stopping of any desired equipment can be done independently from local control stations located near the respective motors / drives for maintenance / repair / testing by selecting remote / local mode of operation from the LPBS.

9) Sounding audio alarm / warning system prior to starting of the plant for information to plant personnel / maintenance staff to keep a safe distance from equipment under operation.

10) Special care should be taken so as to ensure availability of signal to & from PLC & field keeping the furthest distance between PLC & field instruments in design consideration.

11) EEPROM / Non volatile Reprogrammable Flash ROM having sufficient capacity to store the logic program along with the tag/symbol name.

12) 24 VDC power supplies (if any) used for PLC cards / I/O interrogation shall be configured in hot redundant mode through diode bridge. DI shall be envisaged for monitoring the health of these power supplies and corresponding alarm to be generated in the HMI screen in case of failure.

13) Local hard I/Os are proposed in PLC-2 (Silo 1&2) and PLC-6 (Silo 8) control room located at GTC 8 Control room. All necessary items(hardware and software if any) required shall be in the

scope of the vendor/system supplier.

14) All analog I/Os (mA signal) shall be through signal isolators having gain adjustment feature.

15) All PLC outputs to be routed through fuse terminal having LED type fuse blown indication and interposing relay board having dual ended potential free relay contacts having suitable contact rating.

16) All digital I/O interrogation shall be through Non UPS power supply only.

17) All the software licenses (PLC, Microsoft, Antivirus etc.) must be purchased in the name of " Smelter Plant, National Aluminium Company Limited, Nalconagar, Angul". The Documentary evidence in this regard must be submitted to Nalco.

18) All licenses should be paper based only.

19) All the HMI stations/CCTV servers shall be loaded with Antivirus software having 3 Year license.

20) Software:
   a) All Scada screens shall be developed in consultation with NALCO.
   b) Application program MUST be developed in LADDER LOGIC only.

21) Local hard I/Os for the existing PLC is proposed in PLC-2 (Silo 1&2) and PLC-6 (Silo 8) control rooms. If Existing space available in the existing panels is not sufficient, then extra panel to house the local I/Os shall be in the scope of vendor along with all necessary items (hardware and software if any) to communicate with the existing PLC shall be in the scope of the vendor/system supplier.

22) Inter PLC communication-
The communication with the existing PLCs located in the control room – 2 and GTC-8 control room shall be in the scope of the vendor. All necessary hardware, software, configuration, services etc. shall be in the scope of the vendor.

23) The control of all equipment will be done from the New Control Room.

5.0 DRIVE CONTROL PHILOSOPHY:

a) Local/Remote Selection

For every drive there will be a Local/Remote Selector Switch near the drive, preferable in the same plague of Local Push Button Station. The Selector Switch is kept in Local position during testing, commissioning only. Normally the Selector Switch will be kept in Remote position.

b) Remote Operation

Drives can be started from Remote Mode i.e. HMI stations provided there is no safety interlocks active & Local/Remote Selector Switch kept in Remote position. Also in this type of operation, the sequential starting of the drive can be performed by group selection mode as well as individual selection mode provided there is no safety interlock active & process interlock are alive.

Drives can be stopped from Remote Mode i.e. HMI stations irrespective of any situation. The drives will stop automatically in case safety interlock is active.

c) Local Operation Mode

Drives can be started from Local Mode i.e. through LPBS provided Local / Remote Selector Switch are selected in Local mode.

Drives can be stopped from Local Mode i.e. LPBS irrespective of any situation. The drives will stop automatically in case safety interlock is active.

d) *Emergency Operation*

One no emergency push button is envisaged for every drive. This push button will be physically situated on the operator console in Control Room. The emergency push button will be directly hardwired to MCC / SW GR for stopping of the drive irrespective of any situation.

e) Conveyor Operation Philosophy

In case of tripping of any intermediate conveyor in a chain of conveying system, the feed end conveyor has to stop first. With a pre-set time gap adjacent downstream conveyor shall stop sequentially.

In case of starting a chain of conveyor, the discharge end belt has to be started first. The adjacent belts will be started with a preset time gap sequentially towards feed end.

- Operation of Siren

  A safety warning through siren/hooters near the drive for the field personnel & safety of major drive a pre-set time followed by a definite time when drive will start.

6.0 UPS:

Redundant UPS (2 x 100%) with common Ni-Cad battery having state-of-the art technology (IGBT with PWM) is envisaged for Control Room. The power supply of UPS shall be from emergency feeder and by pass line shall be from raw feeder. This UPS power will also cater to CCTV system as required. Loading of the UPS shall not be more than 80% of total load.

7.0 CCTV:

IP based CCTV cameras will be located for each plant section for the monitoring of relevant areas from Control Room. Some of the cameras shall have facility of pan, tilt and zoom for selection of target area and closer view of the area under observation. The numbers of cameras are as follows:

a) 10 nos. of PTZ Cameras
b) 10 nos. of Fixed Cameras

Location of the camera will be finalized during detail engineering. Cameras will be interfaced to the control and monitoring system through video server. Two no of desktop mounted 24" LED based screen will be there in the Control Room along with a 74" wall hanging screen for monitoring & control of CCTV Cameras.

8.0 DRAWINGS & DOCUMENTS:

The following drawing and documents to be supplied

a) Control Philosophy.
b) I/O/F List
c) Electrical schematic wiring drg. (from field devices to PLC I/O card.)
d) Instrument loop drawing.
e) Instrument power supply drg.
f) P&ID drg.

g) All field instrument settings.

9.0 Special Tools and Tackles

Any special tools/instruments required for communicating/parameter setting/viewing/diagnostics viz. HART communicator, IR Cable (if any), special cable etc.. shall be supplied along with the instrument.

##

DESIGN BASIS REPORT

FOR

ALUMINA UNLOADING AND TRANSPORTATION-SYSTEM

CIVIL & STRUCTURAL



NATIONAL ALUMINIUM COMPANY LTD.

(A Govt. of India Enterprise)

Nalco Bhavan, P/1, Nayapalli
Bhubaneswar- 751013, Odisha
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3

DOC. No. 14L08-000-DBR-S-0001

JULY 2015

DEVELOPMENT CONSULTANTS PRIVATE LIMITED
CONSULTING ENGINEERS
DEVELOPMENT CONSULTANTS HOUSE,
BLOCK DG-4, SECTOR II, SALT LAKE CITY,
KOLKATA – 700091
West Bengal, India

DOCUMENT CONTROL SHEET

PROJECT	:	ALUMINA UNLOADING AND TRANSPORTATION SYSTEM.
CLIENT	:	NATIONAL ALUMINIUM COMPANY.LTD.
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3	10.07.15	NALCO'S COMMENTS INCORPORATED	SK	RN	SB
2	10.04.15	NALCO'S COMMENTS INCORPORATED	SH	SB	SS
1	20.02.15	NALCO'S COMMENTS INCORPORATED	SH	SB	SS
0	02.01.15	ISSUED FOR COMMENTS	SH	SB	SS

DEVELOPMENT CONSULTANTS PRIVATE LIMITED

CONSULTING ENGINEERS

DEVELOPMENT CONSULTANTS HOUSE, BLOCK DG-4, SECTOR II, SALT LAKE CITY, KOL - 700091, INDIA

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1.00.00 PROJECT INFORMATION

1.01.00 **Project** : Alumina Unloading and Transportation System.

1.02.00 **Executing Agency** : National Aluminum Company Limited.
Nalco Bhavan, P/1, Nayapalli, Bhubaneswar- 751013
Odisha, India

1.03.00 **Project Site** : Angul, Odisha, India

3

1.04.00 **Location** : Approximately 5 KM from the nearest town of Angul in the state of Orissa. The district is situated in the central part of Orissa. The district finds its circumferential limits within 20031" and 21.21^{0}North Latitude and 86.11^{0}East Latitude. It is surrounded on the North by Keonjhar and Sundargarh, East by Cuttack and Dhenkanal, South by Boudh and West by Sambalpur and Deogarh district.

1.05.00 **General Topography**: Topographically the district can be divided in to three natural tracks. First is a chain of hills running along the northeastern boundary of the district covering Pallahara. Another chain of hills runs along with south-west boundary covering Athamallik and Angul. The third natural division is a valley of river Brahmani running along with boundary of Talcher through Kaniha touching Pallahara.

1.06.00 **Site Conditions and Climatic Condition**

i)	Record max. temperature	:	50.9 °C
ii)	Average daily max. temperature	:	30 °C
iii)	Average daily minimum. Temperature	:	18 °C
iv)	Record minimum. Temperature	:	5 °C
v)	Annual Average rainfall	:	1421 mm
vi)	Maximum rainfall recorded in one hour	:	100mm
vii)	Maximum relative humidity	:	68.3 %
viii)	Prevalent direction of wind from	:	southwest and northwest
ix)	Prevalent wind speed	:	50 m/s
x)	Seismic Zone	:	Zone III

2.00.00 SCOPE OF WORKS

2.01.00 GENERAL SCOPE

Following are the systems/plants, which constitute the total scope and define the battery limits for the subject namely **"ALUMINA UNLOADING AND TRANSPORTATION SYSTEM"**:

2

- Pneumatic Conveying system for unloading of Alumina from BTAP wagons and its transfer to an under ground pit.
- Air slides with blowers for alumina unloading and transportation
- Pipe conveyors
- Dedusting System for dust suppression and evacuation of additional air.
- Compressed Air supply system located within the unloading area with compressors and blowers, all accessories including pipes & piping support.
- Rope winch systems for hauling wagons.
- Power Distribution System
- Control & Instrumentation System including Control Room

The scope of work of the contractor under this package shall be as described hereunder basically pertaining to all the equipment and facilities with respect to Process/Mechanical, Environmental, Electrical, Instrumentation, Architectural, Civil & Structural, finishes, sanitary and plumbing for the above mentioned systems:

Design, manufacture, planning, fabrication, assembly, shop testing and shop painting including procurement and supply of all materials, labour, supervision and necessary quality assurance testing.

- Receiving/unloading, storage at site, handling at site including insurance till take over.
- Site fabrication, construction and final assembly.
- Layout and Civil & Structural construction
- Erection and Final painting.
- Maintenance till handing over.

- All such relevant work and services as are necessary for successful commissioning and handing over to the total satisfaction of the Purchaser, of the subject complete with all systems, sub-systems equipment, accessories, auxiliaries and ancillaries materials and facilities, buildings, foundations and all other related civil and structural work as required on EPC basis within the battery limits as broadly described in the following clause no. 2.02.00.

2

2.02.00 CIVIL & STRUCTURAL SCOPE

The detailed Scope of work under the purview of this project shall be as per the list given below:

A] Removal of shrubs & trees.

B] Topographical Survey.

C] Route survey of both under ground & over ground structures.

D] Geotechnical Investigation.

E] Area Grading

3

F] RCC Building , Steel Structures, Brick Masonry Work with Fly Ash Brick, Cement Plaster, Painting(Internal & External) , Door, Windows & Roof Sheeting etc :

1) MCC, VVVFD & CONTROL Building– (Two storied)
2) PLC Building- (Single storied)
3) COMPRESSOR & BLOWER Room- (Single storied)
4) Watch Tower with operators cabin to control the placement of rake in the unloading system.
5) Drive Winch & Auto Rope House.

G] Transfer Points / Junction Houses

H] Passenger cum good lift at transfer point

I] Pipe Conveyor galleries (About 1400m long) along with supporting Structure and under ground tunnel (About 100m long) and Pent House.

J] Unloading Station (Under ground RCC structure with sump): air slides etc.

K] Blower and other machine Foundations.

L] Pits and misc. underground structure.

M] Misc. supporting structure as required.

N] RCC Approach Road (7.5 m width) with concrete drains on both sides.

O] Pipe & Cable Supporting Structure

P] Paving as per plot plan.

Q] Sewerage system

R] Storm Water collection & disposal System.

S] Drinking Water Supply Distribution System.

T] All ladder, stairs and their foundations.

U] All equipment supporting foundations inside and outside buildings.

V] Dismantling of Miscellaneous structures & Foundations and their rerouting where required.

3

3.00.00 SITE AND SOIL CONDITIONS

2

The present site is full of vegetation & small trees. The site is slightly undulated in nature.

The subsoil in general is a loose to medium dense silty sand mixed with gravels followed by weathered sand stone layer. The weathered sand stone layer is underlain by hard rock (sandstone) stratum which exists at variable depth.

Soil Survey and testing at site and its Report shall be carried out by the Tenderer after award of contract. Moreover, routine tests (where required) for the important structures on actual field locations shall also be carried out by the Tenderer before submission of design documents to cross check the safe bearing capacity. The Contractor shall also investigate and determine the water table, including any temporary rise of the water table during the rainy season.

3

4.00.00 CIVIL AND STRUCTURAL CODES & STANDARDS

4.01.00 Codes and Standards

4.01.01 Loads

IS 875	:	Code of Practice for design loads (other than earthquake) for buildings and structure.
IS 1893	:	Criteria for earthquake resistant design of structure Foundations
IS : 1080	:	Code of Practice for design and construction of shallow foundations in soils (other than raft, ring and shell).
IS : 1904	:	Code of Practice for design and construction of foundations in soils: General requirement loads (other than earthquake) for buildings and structure.

IS : 2950	:	Code of practice for design and construction of raft foundations; Part-1 : Design.
IS : 2974 (Part 1)	:	Code of Practice for design and construction of machine foundations for Reciprocating Type Machine.
IS : 2974 (Part 2)	:	Code of Practice for design and construction of machine foundation for Impact Type Machine (Hammer Foundations).
IS : 2974 (Part 3)	:	Code of Practice for design and construction of machine foundations for Rotary Type Machine (Medium & High Frequency).
IS : 2974 (Part 4)	:	Code of Practice for design and construction of machine foundations for Rotary Type Machine of Low Frequency.
IS : 2974 (Part 5)	:	Code of Practice for design and construction of machine foundations for Impact Machines other than Hammer.
IS : 8009 (Part 1)	:	Code of Practice for calculation of settlement of foundations : Shallow foundations subject to symmetrical static vertical Loads.
IS : 8009 (Part 2)	:	Code of Practice for Deep foundations subjected to symmetrical static vertical loading.
IS : 11089	:	Code of Practice for design and construction of ring Foundations.
IS 13301	:	Guidelines for vibration isolation for machine foundations

4.01.03 Reinforced Cement Concrete

IS : 456-2000	:	Code of Practice for Plain and Reinforced Concrete
IS : 3370	:	Code of Practice for Concrete Structures for the storage of liquids
IS : 3414	:	Code of Practice for design and installation of joints in buildings
IS : 4326	:	Code of Practice for earthquake resistant design and construction of buildings
IS : 5525	:	Recommendation for detailing of Reinforcement in reinforced concrete works
IS : 13920	:	Code of Practice for Ductile Detailing of RCC structures subjected to Seismic Forces

4.01.04 Structural Steel

IS : 800	:	Code of Practice for General construction in steel
IS : 808	:	Dimensions for hot rolled steel beam, column channel and angle sections
IS : 813	:	Scheme of symbols for welding
IS : 816	:	Code of Practice for use of metal arc welding for general construction in mild steel
IS : 9595	:	Recommendation for metal arc welding of carbon and carbon manganese steel

IS : 3502 : Specification for steel chequered plates

4.01.05 Handbook and Special Publications

SP:6 (Part 1)	:	Handbook for Structural Engineering- Structural Steel Section
SP:6 (Part 2)	:	Handbook for Structural Engineering- Steel Beams and Plate Girders
SP:6 (Part 3)	:	Handbook for Structural Engineering- Steel Columns & Struts
SP:6 (Part 4)	:	Handbook for Structural Engineering- Use of High Strength Friction Grip Bolts
SP:6 (Part 5)	:	Handbook for Structural Engineering- Cold formed light gauge steel structure
SP:6 (Part 6)	:	Handbook for Structural Engineering- Application of Plastic theory in steel structure
SP:6 (Part 7)	:	Handbook for Structural Engineering- Simple welded girders
SP-7	:	National Building Code of India
SP-16	:	Design Aids for reinforced concrete to IS : 456
SP-20	:	Handbook on masonry design and construction
SP-22	:	Explanatory handbook on codes for earthquake engineering
SP-24	:	Explanatory handbook on Indian Standard Code of Practice for plain and reinforced concrete
SP-25	:	Handbook on causes and prevention of cracks in buildings
SP-32	:	Handbook on functional requirements of industrial buildings (lighting and Ventilation)
SP-34	:	Handbook of concrete reinforcement and detailing

5.00.00 GENERAL REQUIREMENT

5.01.00 Buildings

Different types of buildings shall have roofing, side walls finishes, Pavements and drains etc. The buildings shall have enough natural lighting and ventilation and should be aesthetically pleasant. Proper sealing arrangement with flashings, mastic or sealants to make the building waterproof and to prevent leakage of water at down comers, junctions, openings etc. shall be provided as directed by the Engineer. LSTK vendor shall Guarantee a period of minimum five years for water proofing treatment.

3

Roofed buildings shall have water proofed roofs with drainage outlets and discharge pipes. Concrete roof shall be cast with 1% slope.

The following general philosophy should be maintained while designing the buildings and structures:

1

a) Maximum use of day lighting by using translucent/polycarbonate sheets and natural air ventilation systems for buildings.
b) Insulation of office/building roofs.
c) Efficient air distribution for adequate cooling and heating in well designed structural works.

5.02.00 Access for Operation and Maintenance

1

Each building and structure shall be designed so as to provide enough space with emergency exit for easy operation and maintenance and to give the workers good and safe environment. All working, maintenance and access areas shall be covered and protected from weather unless otherwise accepted by the Engineer.

5.03.00 Structures

5.03.01 Pipe Conveyor Gallery and its Supporting Structures

Conveyor gallery will be supported on trestles that are to be placed at approximately 20 m centre to centre. Height of all trestles is more or less constant and it is approximately 50 m height.

Plate bearings with elongated holes may be accepted only for short span and small lengths of conveyor bridges. In other cases, roller or rocker and roller bearings shall be provided, unless otherwise approved by the Engineer.

5.03.02 Transfer Points / Junction Houses:

Transfer Points shall be of steel over ground structures. These structures are required for transferring discharged alumina from unloading area to silos through pipe conveyors. Its sizes will be considered by the Tenderer so as to accommodate enough space for easy operation of the pipe conveyor. All Working, maintenance and access areas shall be covered and protected from weather unless otherwise accepted by the Engineer.

5.03.03 Foundation

All foundations shall rest on sound virgin soil. Foundations on filled-up soils shall not be permitted. Concrete shall not be laid directly on ground but shall be laid over lean concrete.

Machine foundations shall be structurally isolated from adjacent foundations and structures by bituminous boards or other means, to prevent transmission of vibrations unless otherwise approved by the Engineer. The minimum weight of foundation shall not be less than three times the machine weight unless otherwise approved by the Engineer. Anti-vibration mountings shall be provided and dynamic analysis of Compressor foundations shall be made if required.

5.03.04 Hoppers

In general hopper shall be of steel construction with 12 mm thick liner plate [Tiscral/ Sailma / Sail hard or equivalent liners]. ROM ore bins for storage of alumina ore shall be of steel construction with 16mm thick Tiscral/SAIL Hard liner plate. General data sheet specification shall also be satisfied. 3

Bins and hoppers shall be designed considering these to be full. Over-pressure and dynamic effect shall be considered based on flow, height of fall, size of ore and other factors. Alternate and adjacent bins shall be considered as empty or full, as applicable, to determine the worst loading condition.

For this IS: 9178-1979 [Part-I, II & III] covering Criteria for Design of Steel Bins for Storage of Bulk Materials shall be followed.

5.03.05 Water Retaining Structures

Water retaining structures shall be designed as per IS:3370. The structures shall be so designed and constructed as to make these completely water proof. Water proofing admixtures like Plastocrete – N or equivalent shall be used as per manufacturer's recommendation. The degree of fixity of wall with the foundation slab shall be determined considering elasticity of structure and soil. Minimum thickness of walls/slabs including slabs not subjected to any significant stress shall not be less than 200mm. Water stoppers shall be provided at all construction and expansion joints unless otherwise accepted by the Engineer. Water stoppers shall be of PVC/rubber, minimum 250mm wide and 5mm thick. Tests shall be made for water tightness of the structures before backfilling. LSTK vendor shall Guarantee a period of minimum five years for water retaining structures. 3

5.03.06 Underground Pits, Basements and Tunnels

Underground structures below water table shall be designed as water retaining structures unless full waterproof treatment by suitable water proofing treatment is provided. Water stoppers shall be provided at all construction and at expansion joints below water table. Adequate slope (minimum 1 in 200) on floors and sumps shall be provided for proper 3

drainage. Drainage from sumps shall be generally by gravity. Sump pumps shall be provided where required.

5.03.07 Drainage

Down comers and lined drains with perforated covers around the buildings shall be provided. Concrete plinth protection, 1.0m wide, shall be provided around the buildings. The finished ground floor levels shall be minimum 300mm above the adjacent finished grade. Arrangement for floor washing shall be provided where required.

5.03.08 Sanitary Sewage System

Sanitary Sewage drainage system is required for all RCC buildings. This shall comprise of local septic tank and soak pit close to the building. It must be connected to existing near by sewerage network of plant. 3

5.03.09 Storm Water System

The storm water runoff generated around unpaved areas inside the plant is considered to be uncontaminated water. This water runoff shall flow overland facilitated by grading of the plant area to the peripheral sloped Reinforced Concrete U-ditches. The runoff from U ditches will be discharged /connected to the existing drainage system. It must be connected to existing under ground storm water drainage system of plant. 3

5.03.10 Anti-termite Treatment

Full protection shall be provided against action of termites. Anti-termite pre-construction chemical treatment shall be provided where required.

6.00.00 MATERIALS

6.01.00 General

Unless specified otherwise, only best quality commercially available materials shall be used. 3

6.02.00 Bricks and Mortar

Bricks shall be of class designation 7.5 with average crushing strength not less than 7.5 N/sq.mm. Fly ash bricks shall be used provided it's designated class shall conform to Class-10 of IS: 13757-1993 (Burnt clay fly ash building bricks-Specification). The bricks shall be machine moulded with requisite dimensional tolerance as per the above Code.

6.03.00 Concrete

Concrete shall be of following grades or nominal mix , unless otherwise specified :-

Lean concrete	:	1:4:8
All Structural Concrete	:	M25
Structural Concrete for Machine Foundation	:	M30
Structural Concrete for Concrete Roads	:	M35

The Contractor may use higher grades of concrete and design accordingly.

Minimum cover to main reinforcement

The following minimum clear cover shall be provided for RCC works:

- Slab (Roof & Floors), canopy, cantilever, waist slabs	25 mm or diameter of the bar whichever is greater
- Beam (Roof, Floor & Tie), Lintel	Do
- Column	40 mm
- Column Pedestal	50 mm
- Retaining Wall, Basement Wall, Pit Wall	
a) Face in contact with Earth/Water	50 mm
b) Free face	25 mm or the diameter of the bar whichever is greater
- Foundation Slab, Base Slab and Plinth Beam	50 mm

Minimum thickness of the structural concrete

The following minimum thickness shall be as followed:

- Footings	250 mm
- Slab thickness in raft foundation with beam and slab construction	300 mm
- Floor / Roof Slab, Walk Way, Canopy Slab resting on beams	125 mm
- Cable / Pipe Trench / Launder Walls and Base Slab	150 mm
- Cantilevered Canopy Slab	150 mm
- Parapet	100 mm

3

-	Underground Pit Reservoir	
-	Walls	150 mm
-	Base Slab with Beams	200 mm
-	Base Slab without Beams	300 mm

Minimum height of Pedestals

The minimum projection of Pedestal supporting any steel structure / stanchion base shall be 300 / 150 mm above the high point of pavement / finished grade / finished floor level whichever is higher, for outdoor and indoor located pedestals respectively. The maximum projection of pedestal for stair case / ladder shall be 200 mm.

Minimum cover to foundation bolts

Minimum distance from the center line of foundation / anchor bolt to edge of pedestal shall be the minimum of the following:

i) Clear distance from the edge of the base plate / base frame to the outer edge of pedestal shall be minimum 75 mm.
ii) Clear distance from the face of the pocket to the outer edge of the pedestal shall be 100 mm.
iii) Clear distance from the edge of shear or anchor plate to the edge of the pedestal shall be 100 mm.

6.04.00 Reinforcement:

High strength deformed bars conforming to IS 1786 (f_y =500) shall be used. If reinforcement of grade f_y = 500 N/m^2 is used, it should be of ductile nature.

6.05.00 Structural Steel

The material for structural steel work shall conform to IS:2062-Gr-A except for Dynamic Loaded structures which shall conform to Gr-B only. High strength bolts of class 8.8 shall be used for bolted field connection.

Purlins, girts may be connected by bolts of class 4.6. Chequered plates shall be 6 mm o/p thick. Concentrated load more than 1.5 kN shall not be provided on chequered plates.

6.06.00 Grouting

Unless otherwise approved, only free flowing non-shrink cementitious grout shall be used. Epoxy grout shall be used for machine foundation.

Chemical injection or grouting method will be used to make the walls & base slab waterproof.

6.07.00 Doors and Rolling Shutters

Sizes and location of rolling shutters shall be indicated in Basic Engg. Drawing based on technological requirements. All external doors and where required from fire protection shall be steel doors. Internal doors shall be solid core flush doors with kicking plates except in toilets where FRP paneled doors shall be provided. Sizes of doors shall be adequate for erection and maintenance of equipment but neither less than the width of walkways and corridors nor less than 1.0m wide and 2.1m high. For toilet doors sizes may be reduced to 0.9m wide for the main entry and 0.75m wide for entry to units. All windows and louvers shall be of Aluminium standard section with toughen glass. For MCC & PLC all doors shall be provided with Aluminium door frames and panels.

3

7.00.00 LOADS AND STRESSES

7.01.00 Dead Loads

The loads shall comprise all loads of permanent nature.

7.02.00 Imposed Loads

Minimum imposed loads shall be considered as follows:

	Type of floor / roof	**Imposed Load**
i)	All Roofs including roof of conveyor galleries (except Roof Supporting Control Room and Cooling Tower Deck)	As per IS:875 (Part-II); dust load on inaccessible roof @ 25 Kg/ sq.m (extra) shall be considered.
ii)	MCC, Control Room Roof etc,	250 Kg/Sq.m.
iii)	Cooling Tower Deck	250 Kg/Sq.m. for the free portion and equipment load in the occupied portion.
iv)	Floor of conveyor galleries	Apart from equipment loads 300 Kg/Sq.m on entire length of walk ways & 500 Kg/Sq.m on individual panels of walkways.
v)	Steel floors in platforms	300 Kg/Sq.m plus equipment load.
vi)	Stairs, landings, corridors & floor of	500 Kg/Sq.m.

	Type of floor / roof	Imposed Load
	cable spreader rooms	
vii)	Electrical MCC & Control Room, Ventilation Room and other concrete floors	750 Kg/Sq.m.
viii)	Trench covers except those subjected to crossing of vehicles.	500 Kg/Sq.m.
ix)	Trench & Tunnel below roads.	IRC Class-A loading or actual Vehicle weight whichever is higher. Impact factor to be taken as 25%.
x)	Surcharge pressure on ground (e.g beside trench)	1500 Kg/Sq.m minimum.

The above live loads shall be increased to take care of erection loads and actual equipment loads as necessary.

xi) Characteristics of Alumina

Type	: Sandy
Maximum Density	: 1.1
Angle of repose during reclaiming	: 35 degree
Angle of repose during loading	: 23 degree
Internal angle of friction	: 27 degree to 35 degree
Angle of friction on steel	: 25 degree

7.03.00 Wind Load

Wind Load shall be considered as per IS: 875 (Part-3) – Latest. The basic wind speed shall be taken as 50 m/s. The terrain shall be considered as of Category -3. Design life shall be considered as 50 years. Topography factor shall be taken as 1.0.

7.04.00 Seismic Load

For Seismic load, the area shall be considered to be in Zone-III as per IS: 1893-2002 and the importance factor shall be taken as 1.0. Response reduction factor shall be considered as stipulated in IS: 1893-2002.

7.05.00 Temperature Effect

Temperature stresses due to variation of plus minus T^0C shall be considered for exposed structures. This temperature variation T shall be calculated from Site Climatic Temperature Data. However, if permitted by the Consultant, temperature effect need not be considered for buildings less than 75m in length.

7.06.00 Combination of Loads

Loads shall be combined for the worst condition for design. Various design loads considered shall be combined in accordance with clause 8.0 of IS: 875 [Part-5] to give the most severe loading condition for design of structures. However, wind and seismic loads need not be considered simultaneously.

7.07.00 Stability

Stability of the structures shall be ensured as per the provisions of IS: 456 and IS: 800, considering also the conditions stated under design criteria in this document.

7.08.00 Deflections

The maximum deflections shall be within the limits specified by the relevant standards

8.00.00 TYPICAL DESIGN PRINCIPLE OF SOME STRUCTURES

Some typical design methodology of structures are given in the annexures.

ANNEXURE – I : DESIGN OF BUILDING STRUCTURES

1.0.0 DESIGN CONSIDERATIONS

1.1.0 GENERAL

1.1.01 Structures shall be designed such that they are economical and safe and meet the functional and service requirement of the technological process for which they are designed. The architectural planning of the building shall be based on the guidelines and requirements given in the tender drawing and specification.

1.1.02 The structures shall be designed conforming to relevant safety regulations, factories acts, electricity rules and stipulations of statutory bodies as applicable to the project.

1.1.03 Natural ventilation shall be provided ensuring that it prevents rainwater entry into the building.

1.1.04 Mild steel gutters and down pipes with gutter outlets and grating shall be provided to carry rainwater from roofs of buildings to the drainage system for such building at ground level. In case access is provided to roof, gutters shall be designed walkable and painted with Epoxy paint.

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1.1.05 Adequate facilities in the form of monorails, hoists, platforms etc. shall be provided to facilitate repair and maintenance of overhead cranes equipment etc. Access to this platform shall be provided by stairs from the nearest accessible floor or platform. Transverse runway platform shall be provided at the gable end for crane maintenance.

1.1.06 Access to all floors, gangways and landings shall be by staircases. Access to roof and landing of secondary importance or where such access is used only rarely, shall be by vertical ladders with safety caging.

1.1.07 Access to roof shall be generally located at gable ends and if required also at intermediate locations, so that for every 150 meters length of the building at least one access to roof is available.

1.1.08 Platforms for access to crane cabin shall be provided and shall preferably be located at the gable end i.e. crane maintenance bay.

1.1.09 Edges of floors, gangways, stairs and landings shall be provided with safety hand railings.

1.1.10 Roof with access shall be provided with safety hand railings along the periphery of the roof.

1.1.11 All gable ends of buildings, platforms shall be provided connecting the walkways at crane gantry level.

1.1.12 Floors, gangways and landings shall be covered as follows:

[a] Gangways and landings shall have chequered plate with a minimum thickness of 6mm o/p suitably stiffened to meet design load requirements.

[b] Repair and operating platforms other than the above shall have chequered plate flooring with minimum thickness of 8 mm o/p suitably stiffened to meet design load requirements.

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[c] Where there is a possibility of gas and dust collection, hot dip galvanized open gratings shall be used.

1.1.13 Protective metal heat shields shall be provided for steel structures exposed to continuous heat radiation or splashing on structures is likely to occur.

1.1.14 All buildings and their foundations shall be designed so that it shall be possible to extend them in the longitudinal direction at a later date without further strengthening of gable structures.

1.1.15 Sheeting on sides and gables shall generally terminate 3.5m above floor level, sides below this level shall be generally screened by brick walls allowing sufficient air inlet to achieve natural ventilation, unless otherwise required from technological and ventilation requirements.

1.1.16 Connection by permanent bolts to structural elements subjected to vibration loads shall be provided with lock nuts.

2.0.0 ELEMENTS OF STRUCTURES

2.1.00 COLUMNS & BEAMS

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2.1.01 At the location of passage/ opening through columns, web shall be suitably strengthened by vierendal panel or modified lattice system.

2.1.02 Shear force at the column base shall be resisted either by shear keys shop welded to the underside of the column base plates or by welding base plate to inserts provided in foundation.

2.1.03 The level of underside of column base shall be so chosen such that the complete anchor table lies below the finished floor level, thus keeping the shop floor free from projection of anchor tables.

2.2.0 CRANE GIRDERS

2.2.01 Crane girders shall generally be of simply supported design, unless continuous crane girder is specifically required.

2.2.02 The flange plate shall be welded to web plate with full penetration butt weld with fully automatic submerged arc welding. Bottom flange plate shall be welded to web plate by continuous fillet welds with automatic/ semi-automatic welding.

2.2.03 All intermediate stiffeners shall be fitted against top flange and welded to it by fillet welds / partial penetration butt welds. These stiffeners shall terminate short of bottom flange with at least 25mm gap. The stiffeners shall be fillet welded to web plate and corners shall be cut suitably to clear thermally affected area of web to top flange connection.

2.2.04 End bearing stiffener plates of crane girder shall be capable of transmitting the maximum reactions to the columns. The bearing surface of the bearing plate shall be planned / machined to ensure full tract.

2.2.05 Tension flange of crane girders shall be stabilized by horizontal latticed bracings, where required in order to limit the slenderness ratio of the flange.

2.2.06 Generally for girder having span more than 12 meter, vertical auxiliary girder and horizontal girder at crane girder bottom flange level shall be provided.

2.3.0 SURGE GIRDER WALKWAY

2.3.01 Continuous maintenance walkways with safety hand railings shall be provided along each column row adjacent to each crane gantry girder. These walkways shall be of non-slip plate construction connected to crane girder top flange by continuous fillet weld.

2.3.02 Connections between surge girder and the main columns shall be designed to resist load due to lateral breaking of crane trolley.

2.3.03 On the periphery of the building, full length hand rails shall be provided along the edge of the maintenance walkway at crane girder level.

2.3.04 Hand rail and its clearance from crane end carriage shall conform to provisions of relevant safety regulation.

2.4.0 CRANE STOP

2.4.01 Crane stops shall be provided at the ends of each crane girder system or as required to limit the movement of crane as per technological requirements.

2.4.02 Crane stop shall be bolted to crane gantry girder.

2.5.0 ROOF STRUCTURES

2.5.01 The main supporting element shall be roof trusses provided at uniform spacing to suit shop layout. Roof shall be provided with adequately sized roof monitor for natural ventilation, wherever required.

2.5.02 Roof shall have suitable slope to meet technological as well as rain water drainage requirements.

2.5.03 System of bracing shall be provided in the roof top chord and bottom chord levels along with longitudinal ties to ensure stability and rigidity of the roof structures. Vertical bracings between trusses shall also be provided wherever required.

2.5.04 Wind tie [50 x6 mm flat] shall be provided at eaves and ridge end of roof sheeting.

2.6.0 ROOF LIGHTING WALKWAYS

2.6.01 Full length roof lighting walkways, generally 800mm wide, shall be provided in each bay as required to match the number of rows of roof light provided in the building.

2.6.02 These walkways shall span between roof truss members and will be decked with chequered plate floor. Walkways shall be provided with hand railings on both the sides.

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2.7.0 ROOF DRAINAGE SYSTEM

2.7.01 Roof drainage system shall be designed for maximum precipitation for 5 minutes based on local meteorological data. A factor of safety of 1.3 shall be kept in the design.

2.7.02 All valley and eaves gutters shall be of pressed plate construction with a minimum sole width of 600mm so as to function as walkway.

2.7.03 Eaves gutter shall be provided for eaves height ranging between 10m to 25m above apron/ground level.

2.7.04 The gutters shall be laid to slope towards down pipes with welded outlets and having grills fitted flush with gutter sole. Slope of gutters and collector pipes shall not be flatter than the following limits:

[a] Longitudinal slope of gutter 1: 500

[b] Longitudinal slope of collector pipe 1: 300

2.7.05 Poking holes with cover shall be provided in the down pipes at suitable intervals as well as accessible levels, to clean the down pipes.

2.7.06 Collector pipes shall be provided with covered manholes at 6m interval.

2.7.07 Eaves gutter shall be provided with safety hand railing.

2.7.08 When rain water falls from higher to lower roof, double layer of sheets shall be provided for the portion of roof sheeting on which rain water falls, provided the drop of roof is in the range of 3m to 6m. In case the drop is more than 6m, independent gutter shall be provided.

2.7.09 Down pipes shall be spaced preferably at 24m centres. Down pipes shall be connected to the gutter with suitably designed hoppers with gratings at sole level of gutter, made of 8 mm dia. rounds at 50 mm centres.

2.7.10 Joints of gutter and collector pipes shall be by welding in order to achieve leak-proof.

2.8.0 WALL STRUCTURES

2.8.01 Wall runners with necessary sag rod arrangements shall be provided to support wall and gable sheeting, including internal partition wall, wherever required.

2.8.02 The wall posts shall generally terminate at 3.5m above roof level.

2.8.03 Gables of buildings shall have wall post spaced at intervals to suit bay width.

2.8.04 Walls shall be provided with louvers and glazing at appropriate levels, to provide natural ventilation and lighting.

2.9.0 FLOOR FRAMEWORK

2.9.01 Floor beams supporting vibrating equipments shall be designed to avoid resonant frequencies.

2.9.02 Beams along with framework, shall be provided with horizontal and vertical bracings [wherever permissible] to achieve overall rigidity.

2.10.0 VERTICAL BRACINGS

2.10.01 Vertical bracings shall be provided on all column rows for each expansion block.

2.10.02 Vertical bracings shall extend from ground level to roof level and shall be designed to transmit longitudinal forces i.e. wind forces, crane tractive forces, seismic forces etc. to the foundation.

2.10.03 Below crane girder level, the bracings shall be of twin system in the plane of each column leg, suitably tied or laced together.

2.11.0 ACCESS STAIRCASE, WALKWAYS, PLATFORMS AND LADDERS

a) Wherever possible access shall be provided by means of stairs.

b) All walkways and stairs leading to working platforms shall have minimum 1000 mm width of walkways/flight of stair.

c) All other walkways and stairs leading to areas for maintenance purpose, or due to restriction of space, shall have a minimum width of 800 mm of walkway/flight of stair, unless required otherwise.

d) Staircase shall be generally designed with slope of approximate 37.5° with the horizontal (in no case slope shall exceed 40° with the horizontal). Intermediate landings shall be provided wherever required such that vertical rise of each flight does not exceed 3000 mm. Risers in one flight shall be equally spaced.

e) Walkway floors and stair treads shall be designed with chequered plate (or non-slip type plates). Ribbed floor/treads may be provided wherever the possibility of accumulation of dust exists, taking care that such provisions do not create a nuisance to the operating personnel on the shop floor.

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f) Rise of treads in staircase shall not exceed 200 mm.

g) A minimum headroom of 2200 mm shall be provided over operating platforms, visitors galleries, or other areas with possibility of public gathering. In all other platforms, walkways and stairs, minimum headroom of 2000 mm shall be provided. Only in special cases, local headroom of 1800 mm may be allowed (i.e at intersection with structural members etc.).

h) Cat ladders shall be provided for access, wherever provision of staircase is impracticable due to limitations of space, or the access is required very infrequently.

i) Wherever the height of cat ladder exceeds 2.5 m, safety cage shall be provided. Intermediate landing shall be provided to cat ladders such that vertical height of single rise does not exceed 8.0 m.

a. Cat ladders shall be designed with following provisions:

i) Width of rung = 700 mm

Minimum width of rung at locations of space constraints = 500 mm

Minimum rise of rung = 250 mm

Maximum rise of rung = 300 mm

iii) Minimum clearance from rung of ladder to back of cage

(in case of caged ladders) = 700 mm

iv) Minimum clearance from the center of cage all round = 350 mm

v) Slope of cat ladders:

g) For normal cat ladders, slope shall be within the range of 75°-90° with the horizontal.

h) For ship-type ladders (i.e cat ladders with short side handrail) the slope shall be within the range of 65°-75° with the horizontal.

i) All walkways, platforms and stairs shall be provided with safety handrails. All handrails shall be constructed with steel tubes/angles for posts, top and middle rail and plates/sheets for toe plates. In case of stairs, the toe guards need not be provided.

j) The vertical height of hand railings on walkways and stairs shall be minimum 1000 mm above floor level.

k) Hand railing along edge of roof and gutters shall have a minimum height of 600 mm over top edge of gutters/sheets. In such hand railings toe guards need not be provided. (only top hand rail and mid rail shall be provided).

2.12.0 DESIGN

2.12.01 DESIGN OF STRUCTURES

2.12.01.01 Design of steel structures shall be done in accordance with IS: 800 latest.

2.12.01.02 Structures subjected to fluctuating / reversal of stresses [e.g. Crane girders] shall be designed in accordance with IS: 1024 -1979.

2.12.01.03 Resonance in structures- structures supporting vibratory/reciprocating equipments shall be designed so as to obviate occurrence of resonance. The ratio of applied frequency to natural frequency shall be beyond the limits of 0.7 to 1.5 [preferably less than 0.7]

2.13.0 DESCRIPTION OF DESIGN LOADS

2.13.01 Loads considered in design shall allow fully for all aspects of:

[a] Dead weight of structures, walls, floors, equipments, wiring, machinery, pipe work, cabling and any item of permanent nature.

[b] Superimposed loads for roofs and floors plus any temporary machinery not allowed within the general superimposed loads.

[c] Crane loads.

[d] Temperature loads from process requirements because of the position of the structure relative to the heat source or from support of mains, pipes etc. subjected to heat.

[e] Maximum range of temperature variation for climatic condition is to be calculated from Max/Min. Temperature data.

[f] Dust load.

[g] Dynamic loads from screens and other such reciprocating machinery.

[h] Maintenance Hoists.

[i] Wind loads.

[j] Seismic loads.

[k] From future expansion.

[l] Any special erection requirements.

2.13.02 For Loading codes, Load combinations etc. refer Cl. No.5.00.00 in LOADS AND STRESSES.

2.14.0 LIMITING DEFLECTION

2.14.01 The deflection shall be limited in various elements of structures in accordance with IS: 800-1984 [Clause-3.13]

2.14.02 In addition, the following limitations in deflection shall be observed in the design:

Vertical deflection

[a]	Monorail Track beam	Span/ 400
[b]	Main roof trusses, roof girders, main floor beams in operating platform	Span/ 400

Horizontal direction

[a]	Crane girders due to surge force [from one crane only]	Span/ 2000
[b]	Main column at crane rail level due to action of crane [for surge force consider one crane for single bayand one crane on adjacent aisles for multi-bay]	H / 2500
[c]	Open gantry for condition [b] above where H is the height of column from bottom of base plate to crane rail level.	H / 4000
[d]	All deflections shall be calculated without dynamic factor.	

2.15.0 CAMBER

Wherever excessive deformation is likely to cause operational problem or is aesthetically not agreeable, camber shall be provided to neutralize the effect of deformation due to dead load plus 50% of imposed loads.

2.16.0 EXPANSION JOINT

2.16.01 Longitudinal and transverse expansion joints shall be provided in buildings and structures in accordance with IS:800.

2.16.02 Expansion joints shall be formed by providing double rows of columns, with interconnecting gantry girders, secondary roof and wall framing being detailed to allow the maximum calculated movement for the specified temperature variation.

ANNEXURE-II : DESIGN OF PIPE CONVEYOR GALLERIES AND TRANSFER POINT/JUNCTION HOUSES

1.0.0 DESIGN CONSIDERATION

1.0.01 The pipe conveyor galleries shall be designed so as to meet functional requirements and shall provide space for operation, maintenance and removal of machinery and give the workers good and safe environment.

1.0.02 Gallery floors shall be of chequered plates supported on steel beams.

1.0.03 Steps shall be provided [rise not exceeding 130 mm] along the walkway if the gallery slope exceeds 12 degree. In case the slope of gallery is between 6 to 12 degree, suitable ribs shall be provided on floor [without any sharp edges] at 250 to 300 mm intervals.

1.0.04 Provisions shall be made for emergency exit from galleries to ground level and also for cross over above conveyor at 150 m intervals [maximum].

1.0.05 Roof of conveyor galleries shall be covered with Pre coated coloured Aluminium toughened sheets.

1.0.06 Roof of pipe conveyor galleries shall be flat type with a mild slope in two directions.

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1.0.07 The level of underside of the base plate of gallery supporting trestles shall be 300 mm above the average ground level of the surrounding area.

1.0.08 Protective hand railing shall be provided along gallery walkways, open platform, stairways, landings, edges of walkways when the gallery is not enclosed, and around erection openings, if any, to ensure safety of operation personnel.

1.0.09 Conveyor galleries longer than 150 m shall be provided with expansion joints with twin trestles/ supports. Each expansion block shall have fixed support/ rigid trestle with adequate arrangement [provision of top chord and bottom chord bracing to gallery girder etc.] for transferring the transverse and longitudinal forces to the foundation.

1.0.10 Gallery girder near Transfer Point shall be preferably supported on trestle located as close to the Transfer Point as possible with part of gallery girder between junction house and trestle cantilevered from the trestle. Supporting gallery girder on junction house shall be generally avoided.

1.0.11 When conveyor gallery crosses above or below H.T. Cables, a clear distance of 1.0 m between the structural elements /cladding and H.T. Cables shall be maintained.

1.0.12 When the conveyor bridge passes over plant roads, clearance between the road surface and the lowest point of the bridge shall not be less than 4.5 m or the height needed for the passage of the largest individual components of the plant equipment, whichever is the larger.

1.0.13 The Transfer Point shall be designed to suit the technological requirements. Number of floors, height of building etc. shall be decided accordingly.

1.0.14 In general Transfer Point shall be designed as framed structures on short span side and vertically braced on longer side to achieve stability.

1.0.15 Floors of Transfer Points shall be of steel cheq. plate floor (min. 8 mm o/p) supported on steel beams, unless required otherwise from technological consideration.

1.0.16 Roof and side covering of Transfer Points shall be with coloured Aluminium toughened sheets. Roof slope shall be 1:3 [1vertical, 3 horizontal]

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1.0.17 Suitable access staircase and safety hand railing shall be provided to all floors of junction house.

1.0.18 When hydro-washing of floor of Transfer Points / junction house is envisaged, the floor beam supporting RCC slab shall be laid to a suitable slope to achieve the same, wherever the same is not practicable to achieve, screed concrete shall be laid to a min. slope of 1.5%.

1.0.19 Wall sheeting shall generally start from the lowest working floor and extend up to roof level with louvers at each floor level to ensure adequate natural ventilation.

1.0.20 Monorails of maintenance hoists shall be provided for maintenance and repair of various equipments located on the floors.

1.1.0 COMPONENTS OF STRUCTURES

1.1.01 Gallery trusses

[a] Gallery truss shall be of latticed type construction and shall support roof as well as floor deck supporting conveyor system.

[b] The trusses shall be adequately braced at top and bottom chord level to transfer the horizontal wind forces to end portals.

1.1.02 Stringer beam

These beams shall be suitably placed to support the conveyor stringer post and shall deliver load to gallery trusses. Walkways on either sides of the conveyor shall also be supported on these stringer beams.

1.1.03 Supporting trestles

Intermediate trestles shall be two-legged and shall deliver loads from gallery trusses to the foundations. In addition four legged trestles shall be provided which will act as fixed support to transmit all longitudinal forces between expansion block, in addition to other forces.

1.1.04 Junction houses

[a] Floors- Floor beam layout shall be arranged to suit equipment layout as well as equipment anchoring system.
[b] Columns- In addition to loads from floor and roof, columns shall be designed to transmit horizontal load due to belt tension /snapping of belts to the foundation.

1.1.05 Belt Tension devices

Suitable structures shall be provided to accommodate belt-tensioning device which may be located either under the conveyor gallery or in the junction house itself.

1.1.06 Design of structure

[a] Design of steel structures shall be done in accordance with IS: 800 -1984.
[b] In absence of specific dynamic factor to be considered for the load from the pipe conveyor, a dynamic factor of not less than1.3 shall be considered for the design of floor beams and gallery girders.
[c] Gallery trusses and stringers as well as floor beams of junction house shall be checked for obviating occurrence of resonance and shall be designed accordingly.

1.1.07 Description of loads and loading codes

[a] Unless specified otherwise, all loading codes and loads shall be as per Cl. No.5.00.00 under LOADS AND STRESSES.
[b] Live loads from conveyor on the gallery floor shall be as per conveyor suppliers load data.
[c] While designing fixed support/ rigid in an expansion block of conveyor gallery the following loads [in addition to wind load] shall be considered :

i) Forces due to difference in frictional resistance of top and return idle rollers of conveyor.
ii) Forces due to inertia of rollers at the time of starting of conveyor belt.
iii) Break down load caused by snapping of belt [in case of multiple conveyors, snapping of one belt at a time] shall be considered.

[d] As per technological requirements, provision of supporting the following and load arising thereof shall be considered in the design of conveyor gallery:

i) Ventilation duct.
ii) Electrical cables / cable rack.
iii) Fire fighting equipments.

[e] Junction house floor shall be designed for the following loads:

i) Live load on floor.
ii) Tension from conveyor belt.
iii) Loads due to equipment's located on the floor.
iv) Load due to jamming of chutes.
v) Erection loads anywhere on the floor

1.1.08 Limiting Deflection

[a] The deflection shall be limited in various elements of structures in accordance with IS: 800.

[b] In addition, the following limitation in deflection shall be observed in the design :

i) Gallery trusses ……..... Span/ 400
ii) Top of end portal of gallery truss…… H / 1000 where
H = Height of portal above beam.
iii) Transverse deflection of top of supporting trestle, H / 1000 where
H = Height of trestle above FDN.

iv) Stringer supporting conveyor structural member directly supporting with tripper… … … … … … Span/900
v) Member supporting the tripper… … … .. Span/325

ANNEXURE- III : SPECIFICATION FOR DESIGN OF MACHINE FOUNDATION

1.0.0 GENERAL

Design guidelines for Loads, Load combinations, Materials & Analysis which shall be used for various Equipment Foundations including air compressor.

1.0.01 EQUIPMENT FOUNDATION

Equipment foundation like air compressor, pump foundation shall be block type foundation. Generally dynamic analysis shall not be required if the rotation mass is comparatively less. But pockets of anchor bolts and cut outs shall be provided as per approved mechanical GA drawing.

1.0.02 SCREEN AND FEEDING CONVEYOR SUPPORT FOUNDATION

Screen and Feeding conveyor with drive system are generally supported on steel structures having steel floors with chequered plates at various levels. Steel staircase shall be provided to access all the floors. This vibrating screen are floor mounted type and shall be supported on steel floor beam through bolts by using anti-vibration pads. This screen supporting structures shall preferably be independent of building structures with adequate bracing system up to ground level and its foundation shall be rigid enough to withstand the vibrating shock loads.

1.0.03 REFERENCE BOOKS FOR GUIDELINES:

[a] Handbook of Machine Foundation –by P. Srinivasalu & C.V. Vaidyanathan.

[b] Design of Structure and Foundation for Vibrating Machines-by Suresh Arya, Michael , O'Neill & George Pincus.

1.2.0 DESIGN PHILOSOPHY

1.2.01 MACHINE FOUNDATION

The machine foundation shall be designed to satisfy the following requirements:

[a] The natural frequency criteria of the foundation- machine unit.

[b] Vibration limits under steady state operation.

[c] Strength requirements under normal and abnormal condition.

1.2.02 ANALYSIS

Foundation at fundamental modes of vibration are at least +- 20% away from the operating The Eigen solution for the foundation shall be calculated to ensure the natural frequencies of the frequency of the crusher. The sizing of the foundation shall be arrived such that the mass of foundation shall be at least 2.5 times the mass of the whole machine.

The dynamic vibration amplitudes shall be calculated by applying the unbalanced loads of the crusher as the time varying loads at their loading points with the frequency of the forcing function equal to the natural frequency of the foundation or the operating frequency / first critical speed of the crusher. The vibration amplitudes shall be checked whether they are within the permissible limits as per manufacturer's requirement or the design codes.

The static analysis of the foundation shall be done for different load cases. The dead load. Live load and machine load on the foundation shall be calculated and shall be given as input. Then the different combined loads expected on the structure shall be calculated as per IS:2974 and the structure shall be designed for the worst of the above load combination.

1.2.03 LOADINGS

[a] DEAD LOAD : Dead load shall include the following loads:
- (i) Mass of the foundation and crusher house structure if supported on it.
- (ii) Mass of the crusher, driving motor and ancillaries.

[b] LIVE LOAD : Live load shall be considered as 5 kN/ sq.m applied on the area of Deck slab.

[c] MACHINE LOAD
- (i) Unbalanced force in normal operating condition:
  It shall be furnished by the crusher supplier. The same shall be multiplied by four [4] and shall be applied at the supporting points.
- (ii) Maximum Unbalanced force due to considerable wear & tear:
  It shall be calculated by considering the eccentricity 'e' as 1 mm.
- (iii) Maximum Unbalanced force in failure [or] abnormal condition:
  It shall be due to breakage of one hammer. It shall be taken as 5 times the operating unbalanced load.

1.2.04 VIBRATION AMPLITUDE

In the absence of any limits of vibration amplitude by manufacturer, permissible amplitude shall be considered as below [Ref: IS: 2974-Part-4]

[a] Permissible vibration amplitude is 300 microns for machine with operating frequency up to 300 c/s.

[b] Permissible Vibration amplitude is 100 microns for machine with operating frequency above 300 c/s.

1.2.05 EQUIPMENT FOUNDATION

The block foundation consisting of equipment, Gearbox and motor shall be designed as single block subjected to static and dynamic loads at respective application points as given in the equipment GA drawing.

Eccentricity in foundation block in X and Y direction due to the self weight of foundation and machine with respect to self weight of foundation system shall not be greater than 5% of the length and breadth of the foundation block in X and Y direction respectively.

Natural frequency and the amplitude of foundation shall be calculated using Barkan's method as described in Hand book of Machine foundation by P. Srinivashalu and C.V. Vaidyanathan.

Damping effect of foundation shall not be considered for dynamic analysis.

The sizing of the foundation shall be arrived such that the mass of the foundation shall be at least 2.5 times the mass of the whole machine. The weight of the base slab shall not be less than the combined weight of the structure and the machine.

Natural frequency of the foundation in the following modes shall be calculated:

[a] Vertical mode.

[b] Sliding and rocking mode in XZ plane.

[c] Sliding and pitching mode in YZ plane.

[d] Torsion mode.

Amplitude in three directions viz. X, Y & Z directions shall be calculated.

Dynamic forces and moments shall be calculated with dynamic factor [or] fatigue co-efficient as 2.0. Dynamic loads due to the amplitude shall also be calculated to arrive the total load on the foundation.

1.2.06 LOADS & LOAD COMBINATIONS

The following load cases shall be considered:

DL Dead Load of Foundation and Machine.

SSL Steady State Loads with fatigue factor-2.

1.2.07 LIMITING VALUES

Natural frequency of the block foundation shall be kept 20% away from the machine frequency.

Limiting horizontal amplitude at top of foundation shall be 0.2mm [200 microns]

Since dynamic factor 2.0 is applied for calculating the design forces for foundation design, seismic will not be critical.

ANNEXURE-IV : PIPE LINE SUPPORTING STRUCTURE

1.0.0 DESIGN CONSIDERATION

1.0.01 Bridges shall be provided to support pipelines of smaller diameters for which maximum permissible span is less than the distance between supporting trestles.

1.0.02 Trestles, which are designed to transmit longitudinal loads (along the length of pipeline) to the foundation, shall be four-legged construction. Other trestles, which transmit only the vertical load to the foundation, shall be two-legged construction.

1.0.03 Access stair and platforms shall be provided for maintenance of equipment installed in the pipeline (e.g. Valves etc.). Maintenance walkways with hand railing shall also be provided along the pipeline, wherever required. Provision of access stairs, walkways platforms, hand railing etc. shall conform to clause 1.2.12 of this specification.

1.1.0 DESIGN OF STRUCTURES

1.1.01 Design of steel structures shall be done in accordance with IS: 800.

1.2.0 DESCRIPTION OF LOADS AND LOADING CODES.

1.2.01 Unless otherwise specified hereinafter, all live loads shall be considered in accordance with IS: 875-1987 (Part-2).

1.2.02 Wind load shall be considered in accordance with IS: 875-1987 (Part-3).

1.2.03 Seismic loads shall be considered in accordance with IS: 1893.

1.2.04 In addition, pipeline, bridge and supporting trestle shall be designed for the following loads:

a) Weight of liquid or condensate, as is appropriate for pipeline.
b) Weight of valves, compensators, fittings etc. in addition of self-weight of pipe.
c) Load due to thermal expansion of pipeline.

1.02.05 Maintenance platforms shall be designed for a service load of 5 KN/$m^{2.}$

1.3.0 COMBINATION OF LOAD

1.3.01 The various loads specified shall be combined in accordance with clause 8.0 of IS: 875-1987(Part-5) to give the most severe loading condition for design of structures.

1.4.0 STRESS ENHANCEMENTS

1.4.01 Permissible limits of stress may be increased, wherever permissible, in accordance with IS: 800.

1.5.0 LIMITING DEFLECTION

a) Deflection of gallery bridge structure shall be limited to span / 400.

b) Transverse deformation of trestle shall be limited to H / 1000 where H = Height of trestle above foundation level.

c) The deflection of other elements of structures shall be limited in accordance with of IS: 800.

ANNEXURE – V : STANDARDIZATION AND UNIFORMITY

1.0.0 GENERAL

Every endeavour shall be made to achieve standardization and uniformity amongst the steel structures of different units of the plant.

1.0.01 The following items shall be kept in view in design of structures:

a) Uniform layout module shall be adopted to the extent possible consistent with economy. It is suggested to adopt a basic module of 3 m for building width and 6 m for column spacing along building length.

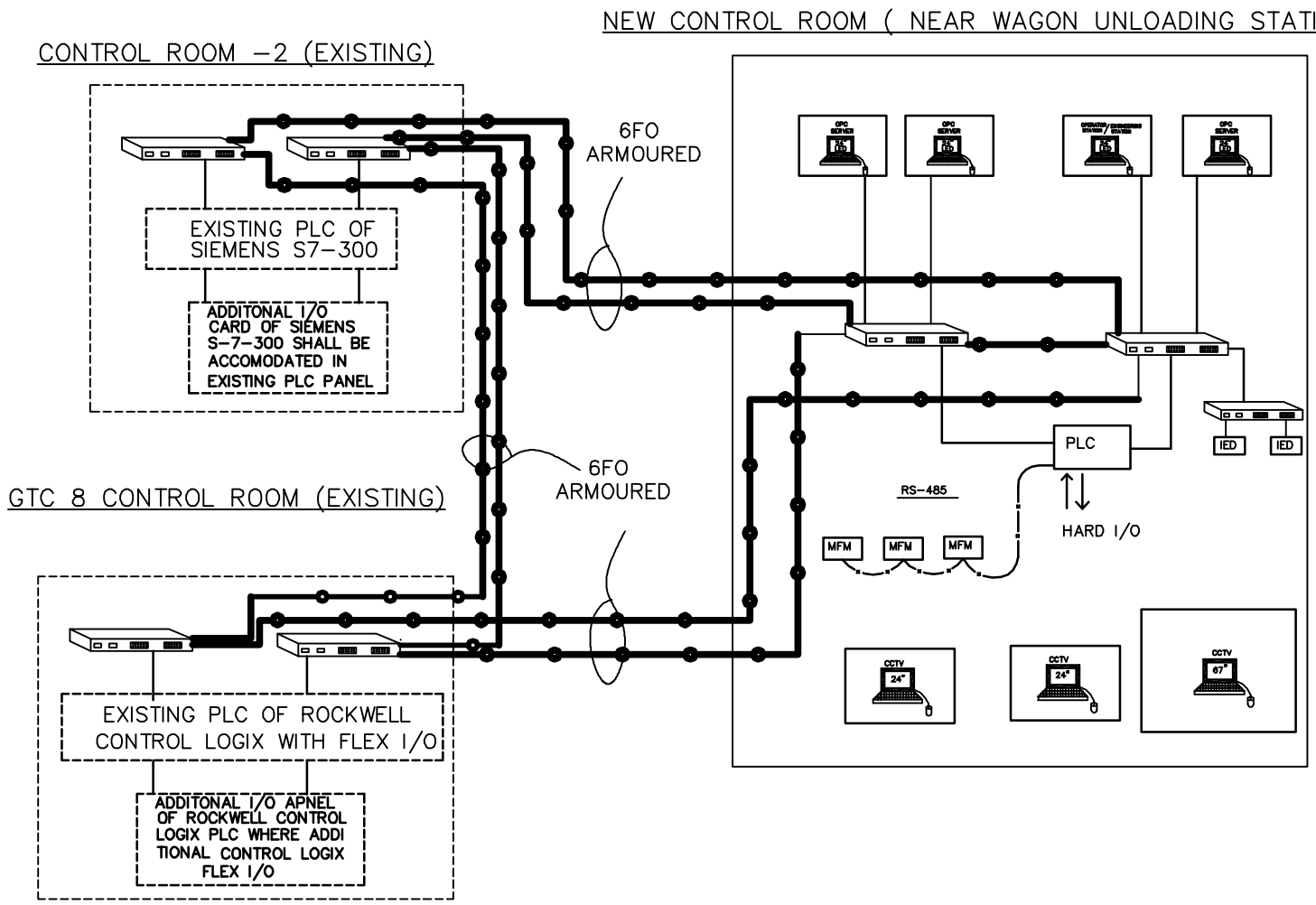
b) Uniform slopes of roofs matching with existing buildings unless specifically required otherwise for any particular unit.

c) Provision of expansion joints by using twin columns & expansion joint treatment. 3

d) Uniform adoption of clearance between structures and moving parts of equipment's.

e) Provision of adequate natural ventilation by using louvers (canopy like structures) at appropriate location.

STANDARD INSTRUMENTATION AND CONTROL DRAWINGS



NOTE

LEGEND

ES– ENGINEERING STATION

OS– OPERATING STATION

FIBER OPTIC

CAT5 CABLE

RS485 CABLE

R I/O– REMOTE INPUT OUTPUT

PLC– PROGRAMMABLE LOGIC CONTROLER

FOR TENDER ONLY

REVIEWED											
			DC	DC	SN	SNC			1	24.11.14
			DC	DC	SN	SNC			0	26.09.14
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

AUTOMATION SYSTEM ARCHITECTURE

ALUMINA UNLOADING & TRANSPORTATION SYSTEM AT ANGUL , ORISSA

NALCO

DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

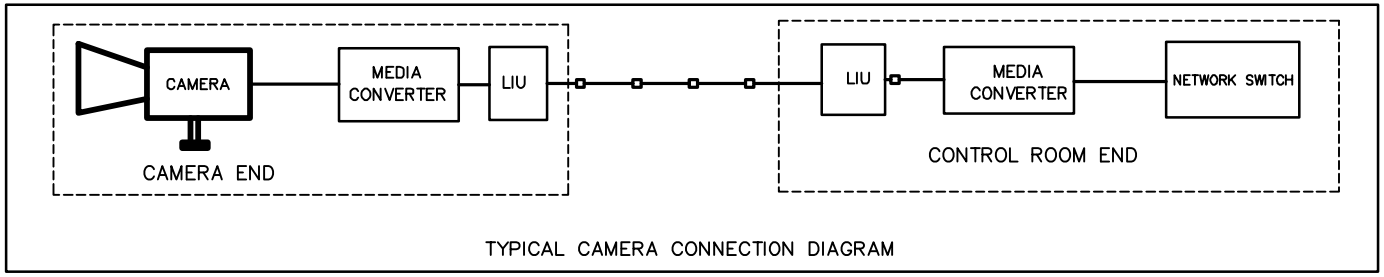
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DWG. NO. 14L08-DWG-I-001 | REV. 1

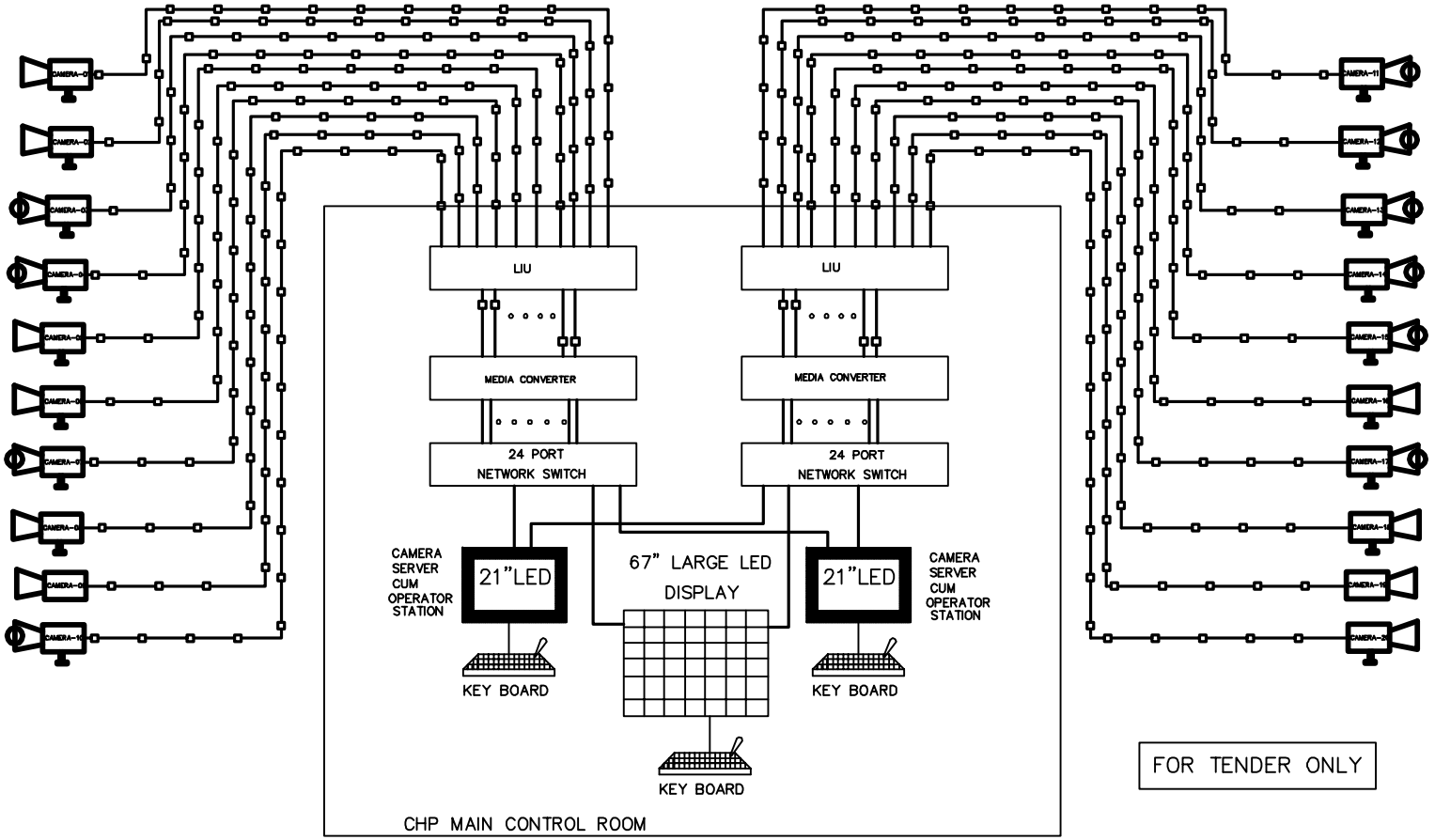
DT: -26.09.14

14L08-DWG-I-001

A3 (9-96) [420x297]



TYPICAL CAMERA CONNECTION DIAGRAM



NOTE :

1. MINIMUM 10 NO. OF FIXED & 10 NO. OF PTZ CAMERA HAS BEEN ENVISAGED FOR ENTIRE PLANT.
2. QUANTITY OF CAMERA MAY INCREASE FOR SMOOTH OPERATION OF PLANT & THE SAME WILL BE IN VENDOR SCOPE.
3. DISTRIBUTION OF CAMERA WILL BE FINALISED DURING DETAIL ENGINEERING.

LEGEND

FIBER OPTIC

CAT 6 Cable

LIU LIGHT INTERFACE UNIT

PTZ CAMERA

FIXED CAMERA

FOR TENDER ONLY

REVIEWED										
			DC	DC	SN	SNC			0	26.09.14
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

CCTV SYSTEM ARCHITECTURE

ALUMINA UNLOADING & TRANSPORTATION SYSTEM AT ANGUL , ORISSA

NALCO

DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

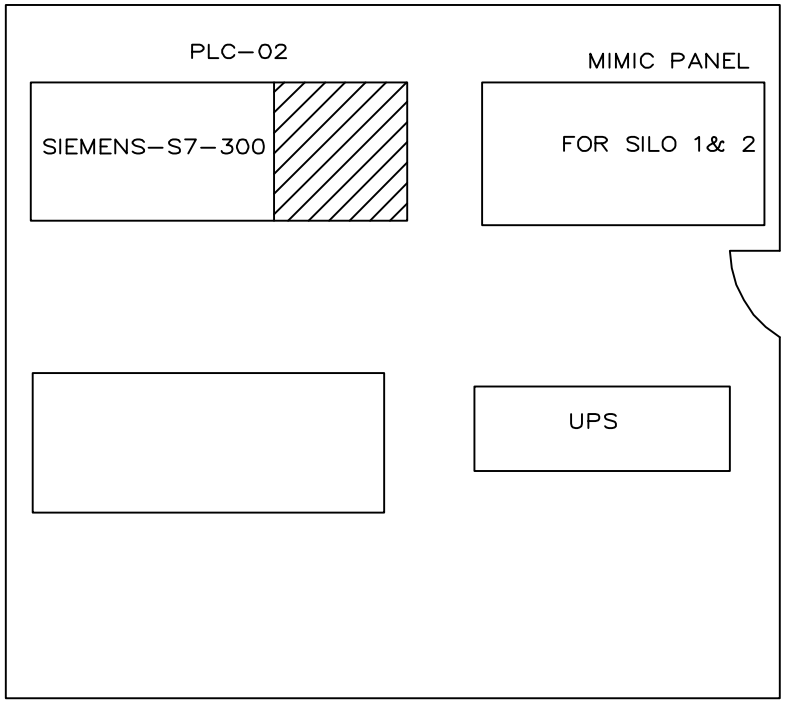
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DWG. NO. 14L08-DWG-1-CCTV-001 | REV. 1

DT:-26.09.14

14L08-DWG-1-CCTV-001

A3 (9-96) [420x297]



NOTE

LEGEND

EXISTING PANEL WHERE NEW I/O CARDS ETC, OF SIEMENS S–7–300 TO BE INSTALLED NETWORK SWITCH/ FIBRE OPTIC CONNECTOR TO BE INSTALLED HERE I/O RELAY BOARD TO BE INSTALLED IN THIS PANEL IN CASE THE SAME IS NOT POSSIBLE BETTER TO PROVIDE A NEW PANEL FOR HOUSING I/O RELAY BOARDS.

REVIEWED										
			DC	DC	SN	SNC			0	24.11.14
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

TENTATIVE LAYOUT OF CONTROL ROOM–2

ALUMINA UNLOADING & TRANSPORTATIN SYSTEM AT ANGUL , ORISSA

NALCO

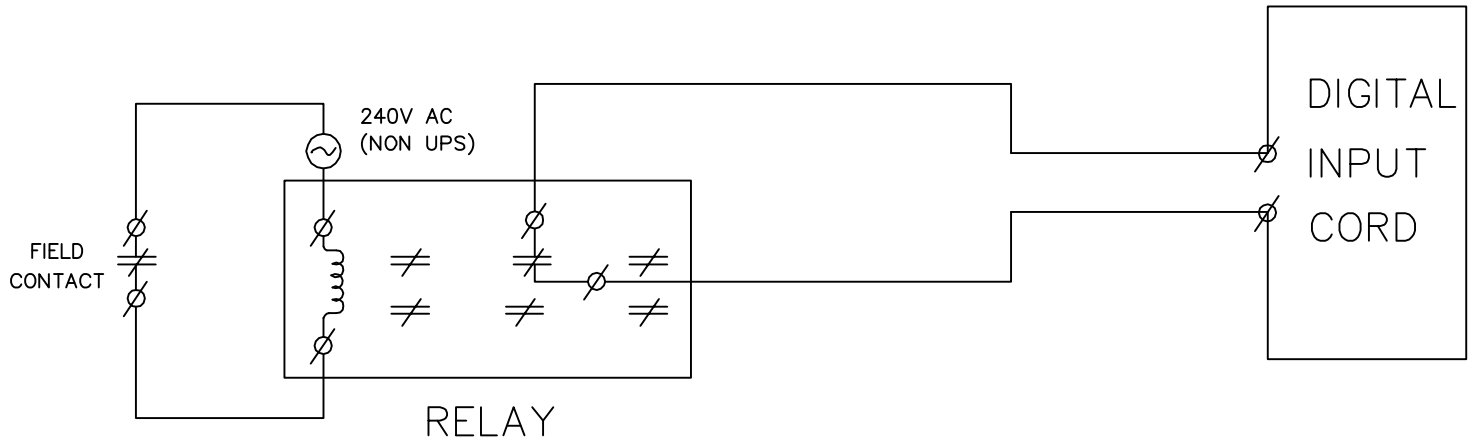
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : NIL

DWG. NO. 14L08–DWG–I–CR–002 | REV. 0

14L08–DWG–I–CR–002 DT:–24.11.14

A3 (9–96) [420x297]



DIGITAL INPUT ISOLATION

NOTE

LEGEND

FOR TENDER ONLY

REVIEWED											
			DC	DC	SN	SNC			0	26.09.14
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

DIGITAL INPUT ISOLATION SCHEME

ALUMINA UNLOADING
& TRANSPORTATION SYSTEM AT ANGUL ,
ORISSA

NALCO

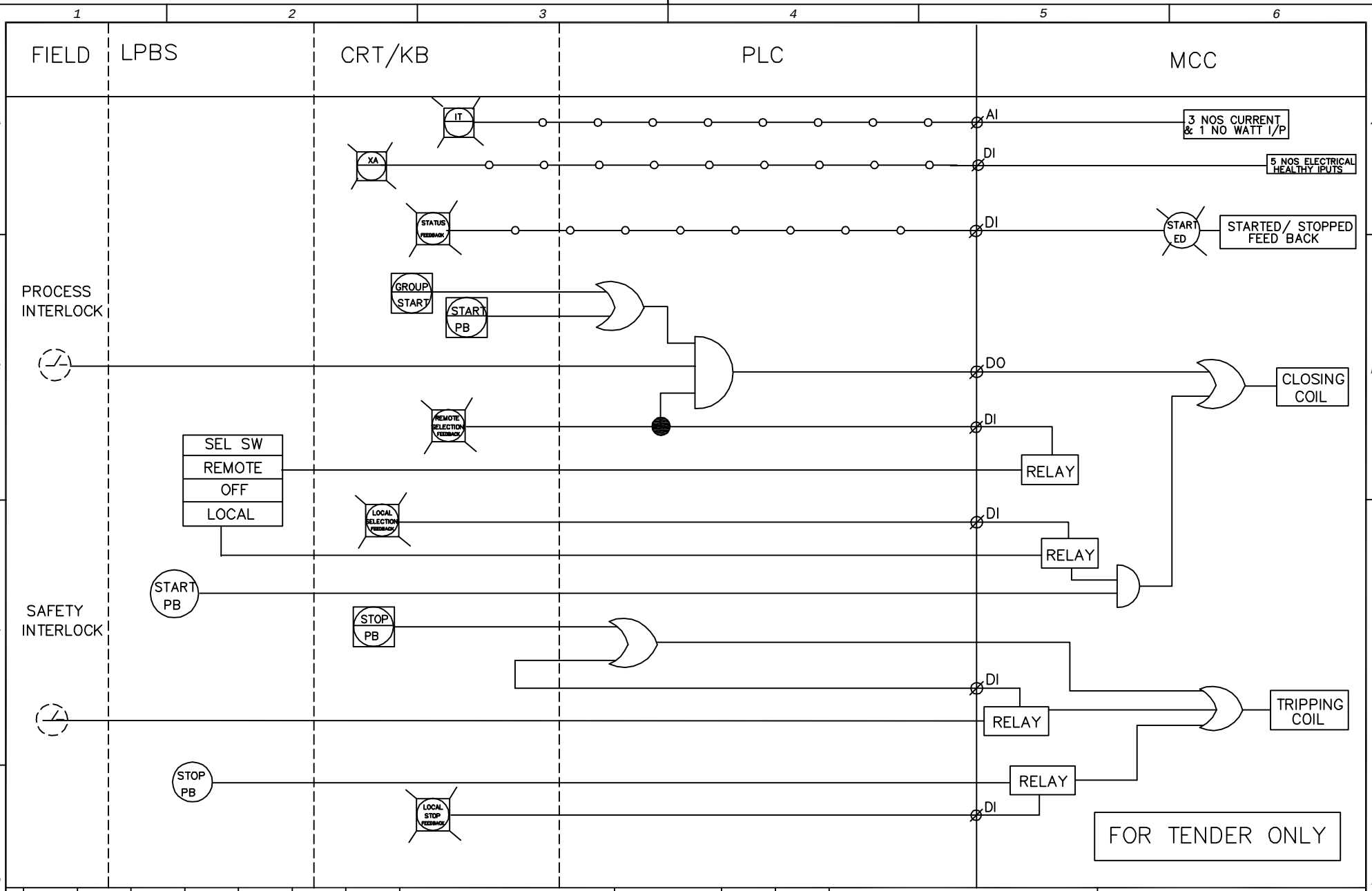
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CONSULTING ENGINEERS

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DWG. NO. 14L08-DWG-I-DI-001 | REV. 0

14L08-DWG-I-DI-001 DT:-24.11.14

A3 (9-96) [420x297]



REVIEWED											
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			DC	DC	SN	SNC			0	26.09.14
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

HT DRIVE LOGIC

ALUMINA UNLOADING & TRANSPORTATION SYSTEM AT ANGUL , ORISSA

NALCO

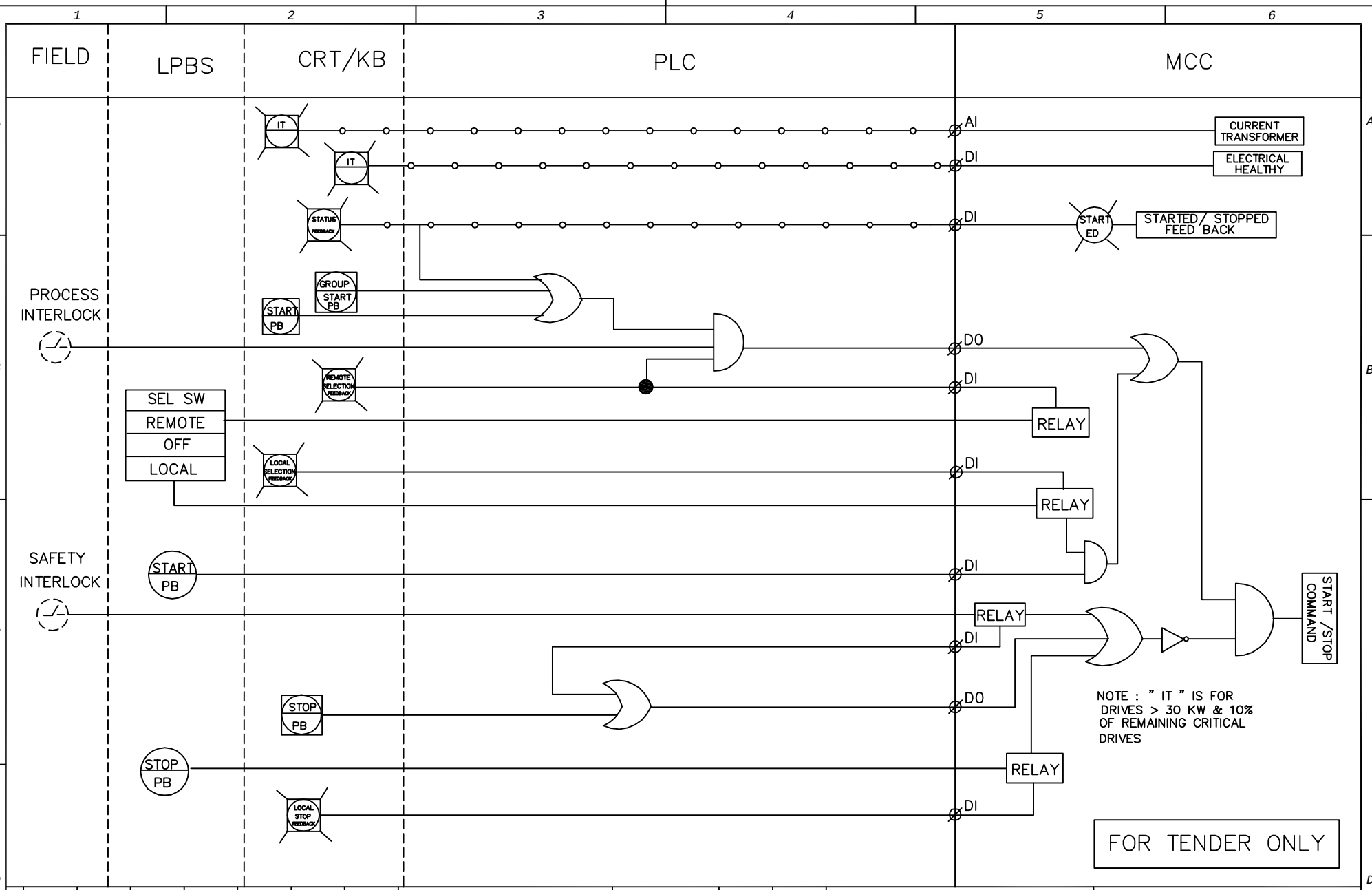
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CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : NIL

DWG. NO. 14L08-DWG-I-DP-001 | REV. 1

14L08-DWG-I-DP-001 DT:-26.09.14

A3 (9-96) [420x297]



REVIEWED											
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			DC	DC	SN	SNC			0	26.09.14
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

LT DRIVE LOGIC

ALUMINA UNLOADING & TRANSPORTATION SYSTEM AT ANGUL , ORISSA

NALCO

DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : NIL

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14L08-DWG-I-DP-002 DT:-26.09.14

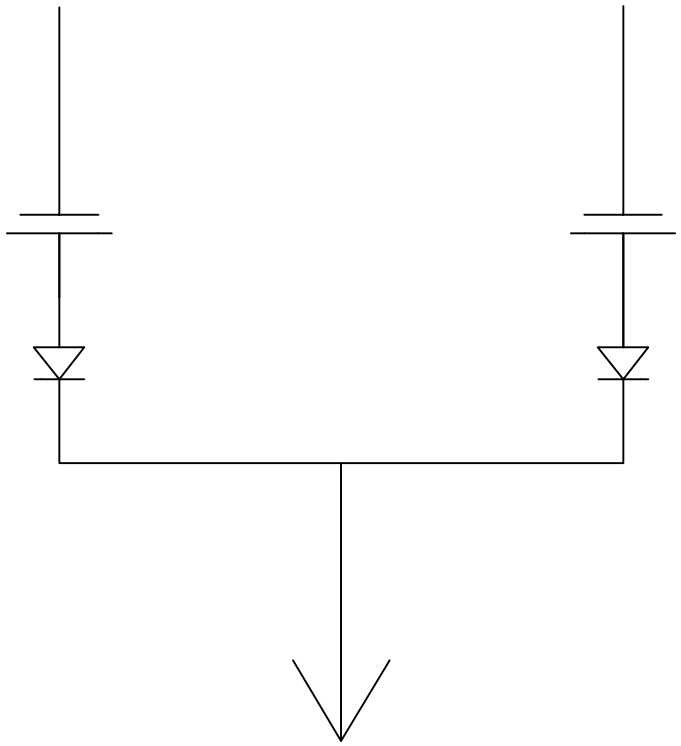
A3 (9-96) [420x297]

24V P.S UNIT DERIVED

FROM UPS

24V P.S UNIT DERIVED

FROM UPS



TO PLC PANEL FOR POWERING

I/O CARDS NETWORK SWITCH ETC.

FOR TENDER ONLY

NOTE

LEGEND

REVIEWED											
			DC	DC	SN	SNC			0	24.11.14
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

24V DC POWER SUPPLY DRAWING

ALUMINA UNLOADING & TRANSPORTATION SYSTEM AT ANGUL , ORISSA

NALCO

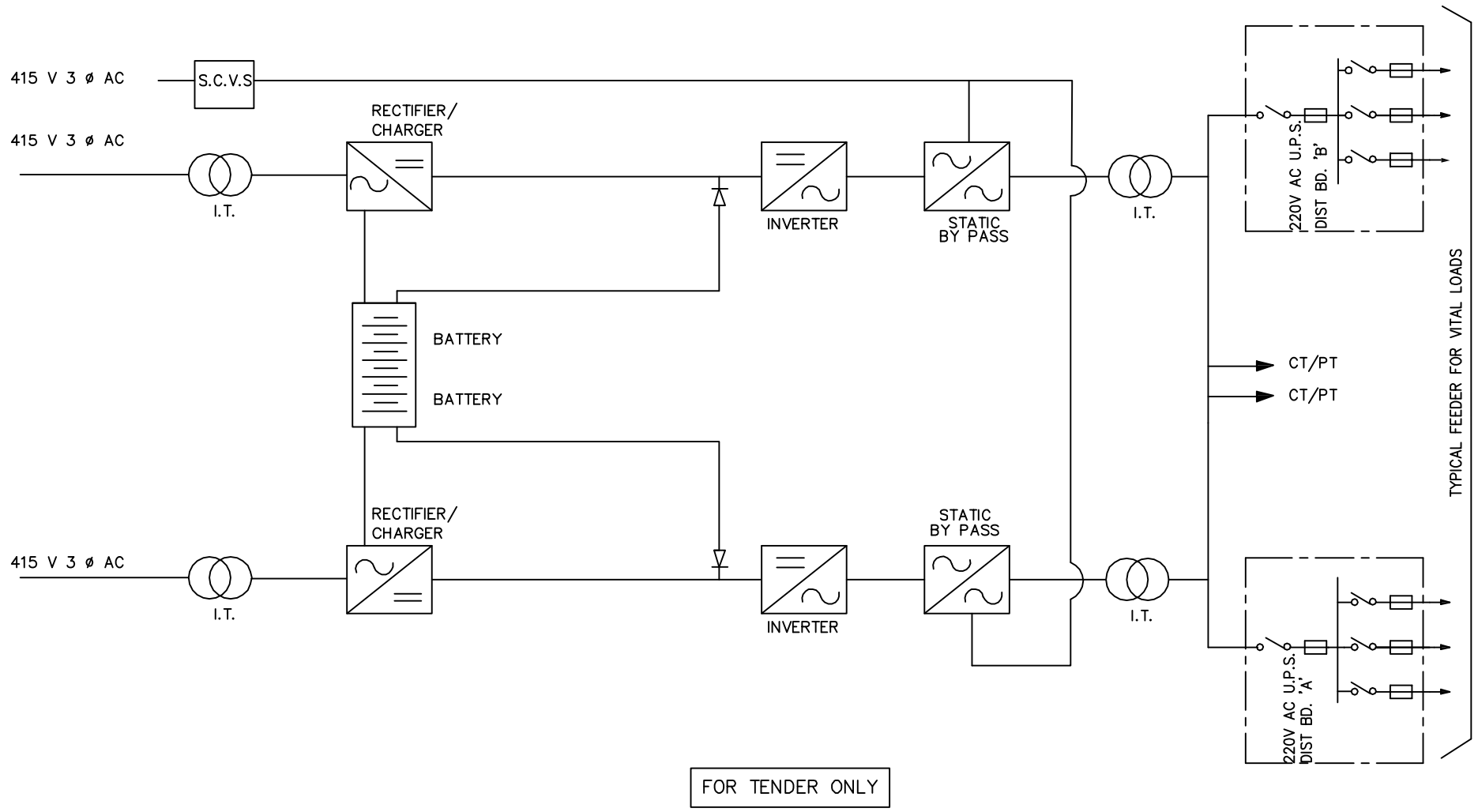
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : NIL

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14L08-DWG-I-PS-001 DT:-24.11.14

A3 (9-96) [420x297]



FOR TENDER ONLY

REVIEWED											
			DC	DC	SN	SNC			1	26.11.14
			DC	DC	SN	SNC			0	26.09.14
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

UPS ARCHITECTURE

ALUMINA UNLOADING & TRANSPORTATION SYSTEM AT ANGUL , ORISSA

NALCO

DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : NIL

DWG. NO. 14L08-DWG-I-UPS-001 | REV. 1

14L08-DWG-I-UPS-001 DT:-26.09.14

A3 (9-96) [420x297]

MCC/VFD

ROCK WELL I/U

ROCK WELL I/O

I/O PROCESS PLANT

UPS

NEW ROCKWELL PANEL

(FALSE FLOOR/GROUND FLOOR)

NOTE

PROPOSED LOCATION OF NEW ROCKWELL PANEL FOR ADDITIONAL I/O

LEGEND

FOR TENDER ONLY

REVIEWED	APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE
	DC	DC	SN	SNC	DOOR & NEW ROCKWELL PANEL RELOCATED		1	08.10.21
	DC	DC	SN	SNC			0	24.11.14

TENTATIVE LAYOUT GTC-8 CNTROL ROOM

ALUMINA UNLOADING & CONVEYING SYSTEM AT ANGUL , ORISSA

NALCO

DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : NIL

DWG. NO. 14L08-DWG-I-GTC-008 | REV. 1

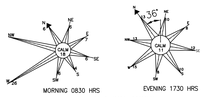
14L08-DWG-I-GTC-008 DT:-24.11.14

A3 (9-96) [420x297]

DWG. NO. 14L08-DWG-M-PL-001 | REV. I

PLANT NORTH

MAGNETIC MERIDIAN | TRUE MERIDIAN | 0°-36'



STATION ANGUL

PERIOD 1931–1960
WIND ROSE (SM/SNM)–FOR MEAN WIND DIRECTION
(% AGE NO. OF DAYS OF WIND FROM)

N-1600.00 | N-1400.00 | N-1200.00 | N-1000.00 | N-800.00 | N-600.00 | N-400.00 | N-200.00

E-1600.00 | E-1800.00 | E-2000.00 | E-2200.00 | E-2400.00 | E-2600.00 | E-2800.00

8" /12" COMPRESSED AIR LINE AFTER ISOLATION VALVE N-1258.68 E-2581.83 — DET.-C

MAKEUP WATER LINE FROM 200-WT-35-2305-A34 N-1153.28 E-2344.42 — DET.-B

8" FIRE HYDRENT (U/G LINE) N-939.874 E-2343.605 — DET.-A

L-XING CH: 1211.72m Km. 11/279.97 F/BDPK

PROPOSED SCHEME:-

MAJOR BUILDING LIST	QTY.
1. WAGON UNLOADING STATION.	01 NO.
2. MCC & CONTROL BUILDING (TWO STORIED).	01 NO.
3. PLC BUILDING(SINGLE STORIED).	01 NO.
4. BLOWER ROOMS(SINGLE STORIED).	01 NO.
5. TRANSFER POINT(TP-01).	01 NO.
6. TRANSFER POINT(TP-02).	01 NO.
7. TRANSFER POINT(TP-03).	01 NO.

MAJOR STRUCTURE LIST	QTY.
1. PIPE CONVEYOR(PC-100), GALLERIES & ITS SUPPORTING STRUCTURE.	LOT
2. PIPE CONVEYOR(PC-200), GALLERIES & ITS SUPPORTING STRUCTURE.	LOT
3. PIPE CONVEYOR(PC-300), GALLERIES & ITS SUPPORTING STRUCTURE.	LOT
4. PIPE & CABLE SUPPORTING STRUCTURE.	LOT

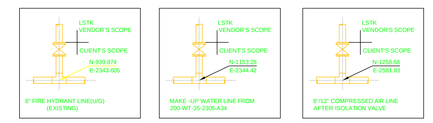
LEGENDS:-

SCOPE OF LSTK VENDOR OF RAILWAY LINE:–

1) PROPOSED RAILWAY LINE

SCOPE OF LSTK VENDOR OF AUT PROJECT:–

1) PROPOSED LAYOUT OF PIPE CONVEYOR
2) PROPOSED LAYOUT OF ALUMINA UNLOADING YARD
3) HOOK UP POINTS FOR UTILITY REQUIREMENT
4) PROPOSED LAYOUT OF AIR SLIDE



NOTES:-

1. ALL DIMENSIONS,CO–ORDINATES AND LEVELS ARE IN METRES UNLESS OTHERWISE STATED.
2. READ THIS DRAWING IN CONJUNCTION WITH DRAWING NO, : 14L08–DWG–M–PL–002.
3. THE PROPOSED ROUTING, LEVELS OF EQUIPMENT AS SHOWN ARE INDICATIVE ONLY. LSTK VENDOR HAS TO FINALIZE THE SAME IN CONSULTATION WITH DCPL AND NALCO TO SUIT THE SITE CONDITION.
4. INDEPENDENT SUPPORTING STRUCTURE FROM GROUND SHALL HAVE TO PROVIDE THE BIDDER FOR SUPPORTING THE EQUIPMENT ABOVE THE SILOS.
5. ANY STRENGTHENING AS REQUIRED FOR INTERFACING WITH THE EXISTING SYSTEM SHALL BE UNDER SCOPE OF LSTK VENDOR.
6. LSTK VENDOR SCOPE SHALL ALSO INCLUDE
   a) CONCRETE PAVEMENT FOR RAILWAY TRACK INCLUDING RAILWAY TRACK FOUNDATION.
   b) UNLOADING PITS UNDER RAILWAY TRACK AND FOUNDATION.
   c) TUNNEL OF THE AIR SLIDE OR CONVEYOR.
   d) CONNECTING CHANNEL BETWEEN UNDERGROUND PIT AND CONVEYOR CHANNEL.
7. PLACEMENT OF RAILS WITH CLAMPS ON CONCRETE PAVEMENT FOR BETTER HOUSEKEEPING AS WELL AS EFFECTIVE RECLAMATION OF SPILLED ALUMINA ARE NOT INCLUDED THIS SCOPE OF WORK. IT IS UNDER THE SCOPE OF RAILWAY LINE PROJECT.
8. THE PROPOSED RAILWAY SIDING IS UPCOMING. HOWEVER, LSTK VENDOR SHOULD HAVE THE UNDERSTANDING REGARDING THE RAILWAY SLIDING. POSITION MAY VARY.
9. THE TENTATIVE LOCATION OF PROPOSED ALUMINA UNLOADING AND RAILWAY SIDING AND RAILWAY LINE ON THE PLOT PLAN HAVE BEEN SHOWN, HOWEVER THE EXACT PHYSICAL LOCATION AT SITE MAY BE FINALIZED AFTER JOINT SURVEY AT SITE WITH RAILWAY CONTRACTOR AND LSTK VENDOR.
10. CROSSING OF CABLE AND PIPE RACK SHALL BE ASCERTAINED BY THE LSTK VENDOR FROM THE ACTUAL SITE MEASUREMENT.
11. RELOCATION OF DOL STRATER, ELECTRICAL PANEL, CABLE TRAY ROUTING AND ALSO MODIFICATION OF SUPPORTING STRUCTURE AND SIDE SHEETING FOR THE INTERFACING OF THE EXISTING SYSTEM SHALL BE DONE BY LSTK VENDOR AS PER THE ACTUAL SITE REQUIREMENT.
12. SUFFICIENT CLEARANCE IN BETWEEN BOTTOM OF PIPE CONVEYOR GALLERY AND TOP OF EXISTING PIPE CUM CABLE RACK ARE TO BE MAINTAINED.
13. LSTK VENDOR SHALL FINALIZE THE ROUTES, LEVELS AND SUPPORT LOCATIONS AFTER SITE SURVEY FOR OVERGROUND AND UNDERGROUND AREA IN CONSULTATION WITH DCPL AND NALCO TO SUIT THE SITE CONDITION.
14. STRUCTURES AND LEVELS AS SHOWN IN THE DRAWING ARE INDICATIVE ONLY.
15. THE HANDLING FACILITIES OF EQUIPMENT ABOVE SILO TOP SHALL BE PROVIDED & SUITABLY LOCATED BY LSTK VENDOR.

FOR TENDER PURPOSE

REV. NO	DATE	DESCRIPTION /REVISION NOTES	DRAWN	CHECKED	VERIFIED	APPROVED
I	July15/15	FOR TENDER PURPOSE	SD	DN/SM	AKM	DKG
H	Apr29/15	FOR TENDER PURPOSE	SD	DN/SM	AKM	DKG
G	Apr23/15	FOR TENDER PURPOSE	SD	DN/SM	AKM	DKG
F	Apr20/15	FOR TENDER PURPOSE	SC	DN/SM	AKM	DKG
E	Apr14/15	FOR TENDER PURPOSE	SD	DN/SM	AKM	DKG
D						

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS
KOLKATA MUMBAI CHENNAI NEW DELHI

PROJECT : ALUMINA UNLOADING AND TRANSPORTATION

PROPOSED LAYOUT OF ALUMINA UNLOADING AND TRANSPORTATION SYSTEM IN SMELTER PLANT

DWG. NO. 14L08–DWG–M–PL–001 | REV. I

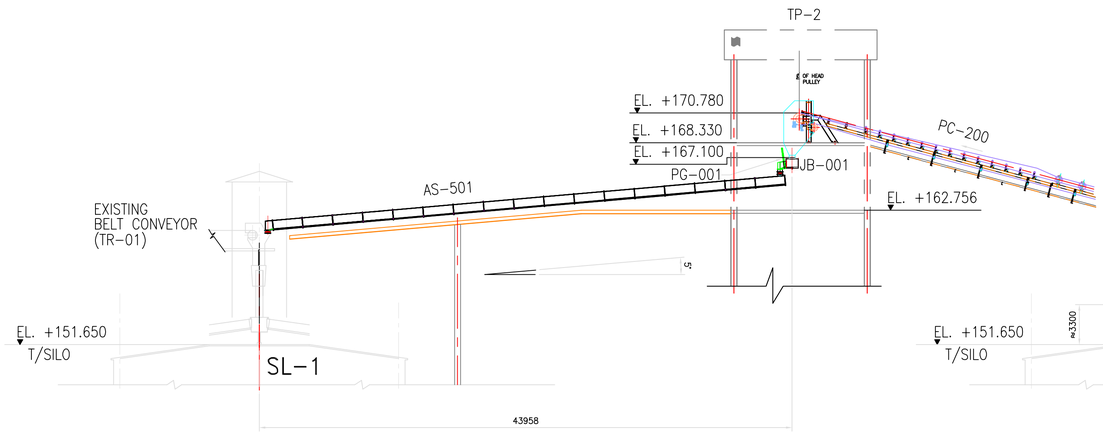
JOB NO: 14L08 | SCALE: 1:2000 | PROJECTION:

APPROV.	MECH.	INST.	ELEC.	STRL.	ARCH.	REVIEWED

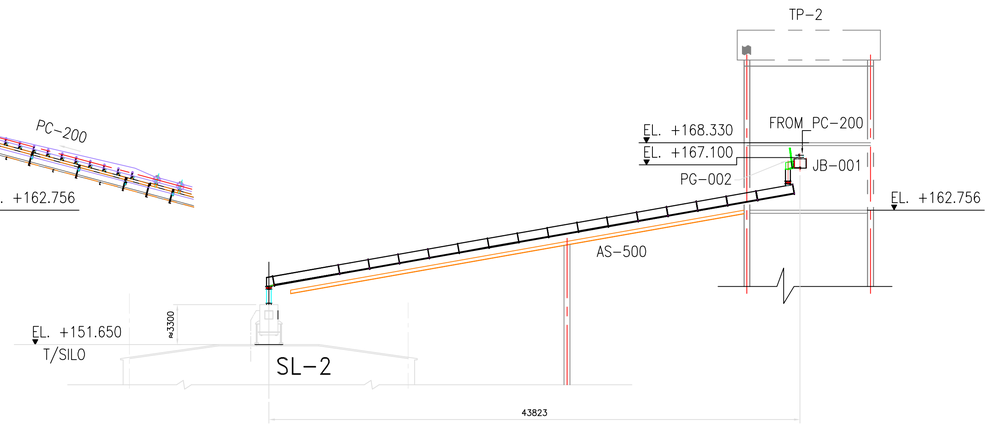
RELEASE STATUS	DATE	SIGNATURE
PRELIMINARY		
FOR TENDER ONLY	04/07/15	DKG
FOR CONSTRUCTION		
ARCHITECTURAL		
CIVIL & STRUCTURAL		
ELECTRICAL		
INSTRUMENTATION		
MECHANICAL		

REVIEWED

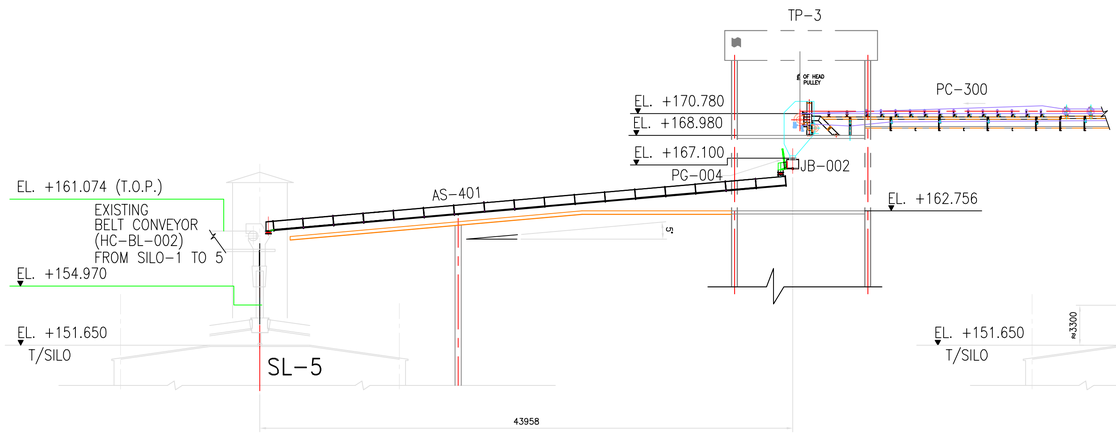
A0 (29–96) [1189 x 841]



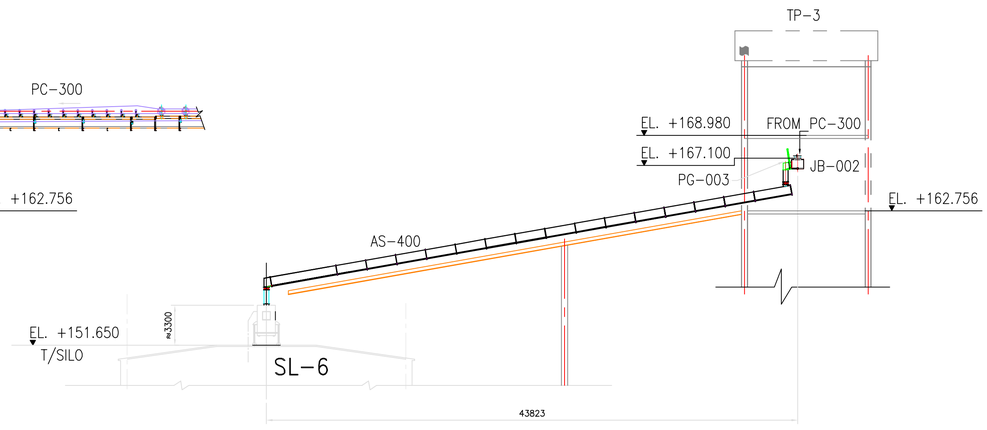
VIEW G-G



VIEW H-H



VIEW E-E



VIEW F-F

NOTE:-

1. ALL DIMENSIONS ARE IN MM. AND LEVELS ARE IN M. UNLESS OTHERWISE STATED.
2. STRUCTURES AND LEVELS AS SHOWN IN THE DRAWING ARE INDICATIVE ONLY.
3. LSTK VENDOR SHALL FINALIZE THE ROUTES, LEVELS AND SUPPORT LOCATIONS AFTER SITE SURVEY FOR OVERGROUND AND UNDERGROUND AREA IN CONSULTATION WITH DCPL AND NALCO.
4. FOR GENERAL LAYOUT REFER 14L08-DWG-M-PL-001,R-I.

REV.NO	DATE	DESCRIPTION /REVISION NOTES	DRAWN	CHECKED	VERIFIED	APPROVED
G	July17/15	FOR TENDER PURPOSE	SD	DN/SM	AKM	DKG
F	July14/15	FOR TENDER PURPOSE	SD	DN/SM	AKM	DKG
E	Apr24/15	FOR TENDER PURPOSE	SD	DN/SM	AKM	DKG
D	Apr16/15	FOR TENDER PURPOSE	SD	DN/SM	AKM	DKG
C	Apr14/15	FOR TENDER PURPOSE	SD	DN/SM	AKM	DKG
B						

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS
KOLKATA MUMBAI CHENNAI NEW DELHI

FOR TENDER PURPOSE

APPROV.	MECH.	INST.	ELEC.	STRL.	ARCH.	NATURE OF REVISION & DESCRIPTION	CHECKED	DRAWN	REV.	DATE
	REVIEWED									

RELEASE STATUS	DATE	SIGNATURE
PRELIMINARY		
FOR TENDER ONLY	Jan09/15	DKG
FOR CONSTRUCTION		

REVIEWED	
ARCHITECTURAL	
CIVIL & STRUCTURAL	
ELECTRICAL	
INSTRUMENTATION	
MECHANICAL	

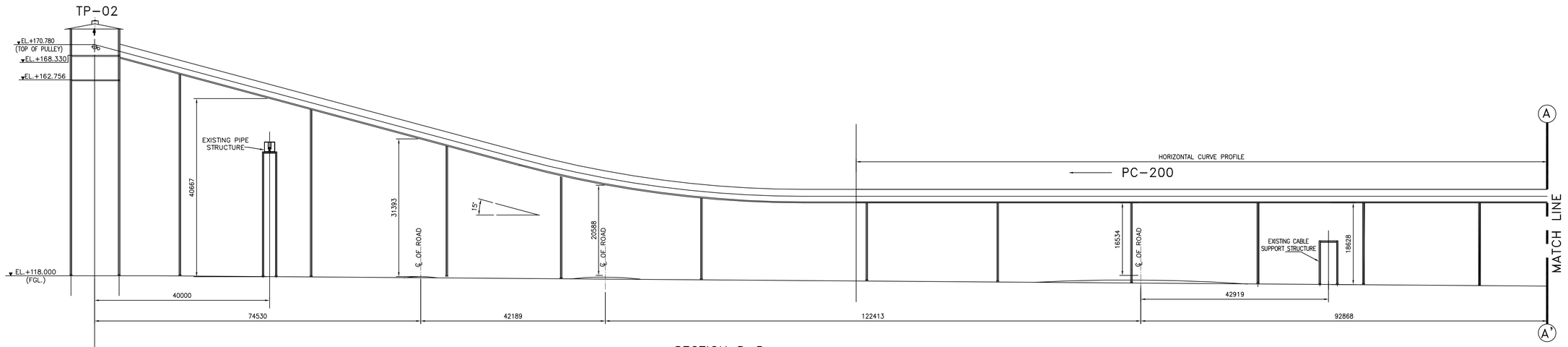
PROJECT : ALUMINA UNLOADING AND TRANSPORTATION

VIEW PROFILE FOR UNLOADING AND CONVEYING SYSTEM

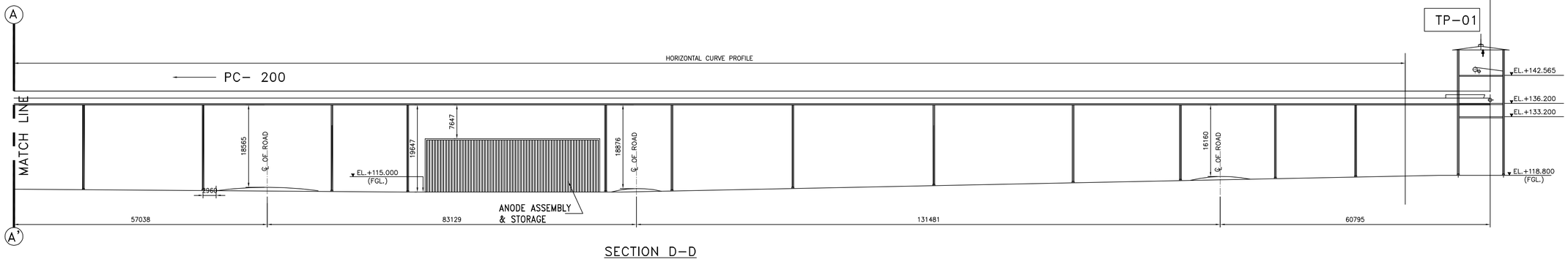
DWG. NO. 14L08-DWG-M-PL-002 REV. G

JOB NO: 14L08 | **SCALE: 1:250** | **PROJECTION:**

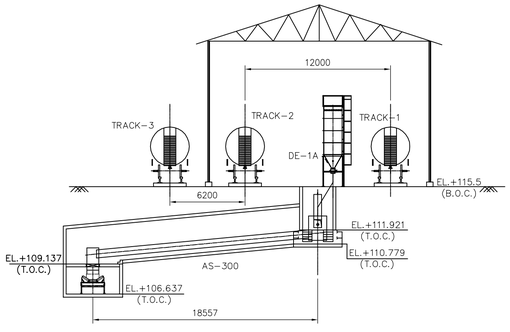
DT.: JUL17/15
14L08-DWG-M-PL-002 REV-G
A1 (09-96) [841 x 594]



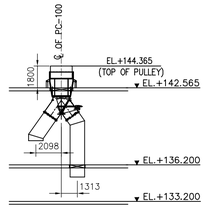
SECTION D-D



SECTION D-D



SECTION B-B
(1:2)



SECTION X-X
(1:2)

NOTE:-

1. ALL DIMENSIONS ARE IN MM. AND LEVELS ARE IN M. UNLESS OTHERWISE STATED.
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4. FOR GENERAL LAYOUT REFER 14L08-DWG-M-PL-001,R-I.

REV.NO	DATE	DESCRIPTION /REVISION NOTES	DRAWN	CHECKED	VERIFIED	APPROVED
D	JUL17/15	TENDER PURPOSE ONLY	SD	DN	DN	DG
C	May15/15	TENDER PURPOSE ONLY	SD	DN	DN	DG
B	Apr24/15	TENDER PURPOSE ONLY	SD	PBB	DN	DG
A	Apr14/15	TENDER PURPOSE ONLY	SC	PBB	DN	DG

FOR TENDER PURPOSE

APPROV.	MECH.	INST.	ELEC.	STRL.	ARCH.	NATURE OF REVISION & DESCRIPTION	CHECKED	DRAWN	REV.	DATE
	REVIEWED									

RELEASE STATUS	DATE	SIGNATURE
PRELIMINARY		
FOR TENDER ONLY		
FOR CONSTRUCTION		
REVIEWED: ARCHITECTURAL		
REVIEWED: CIVIL & STRUCTURAL		
REVIEWED: ELECTRICAL		
REVIEWED: INSTRUMENTATION		
REVIEWED: MECHANICAL		

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS
KOLKATA MUMBAI CHENNAI NEW DELHI

PROJECT : ALUMINA UNLOADING AND TRANSPORTATION

VIEW PROFILE FOR UNLOADING AND CONVEYING SYSTEM

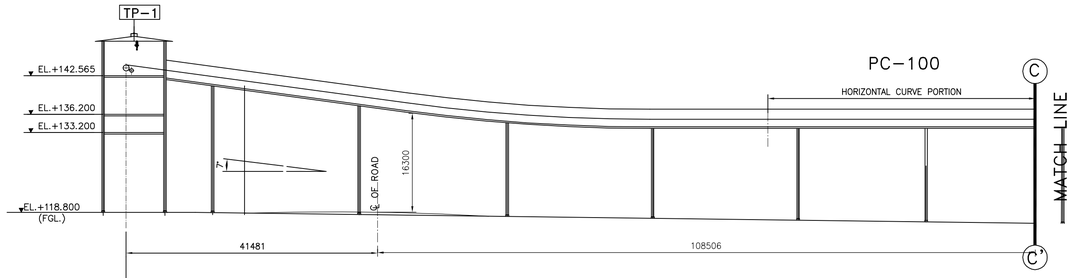
DWG. NO. 14L08-DWG-M-PL-003 REV. D

JOB NO: 14L08 | **SCALE: 1:500** | **PROJECTION:**

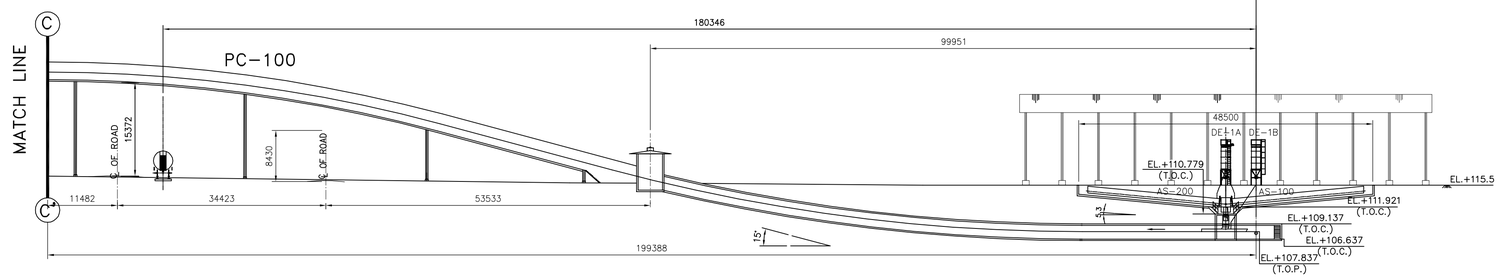
DT. : JUL17/15

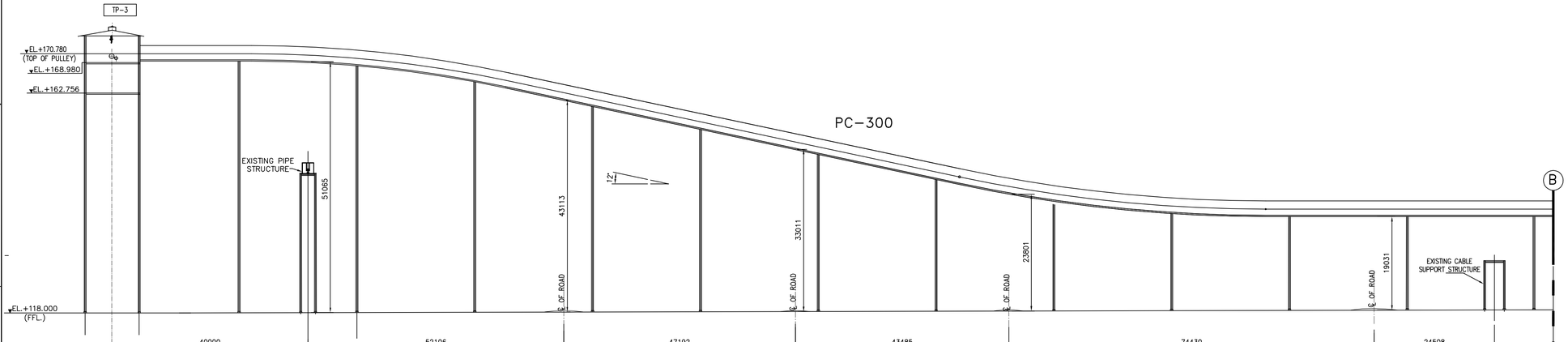
14L08-DWG-M-PL-003 REV.-D

A1 (09-96) [841 x 594]

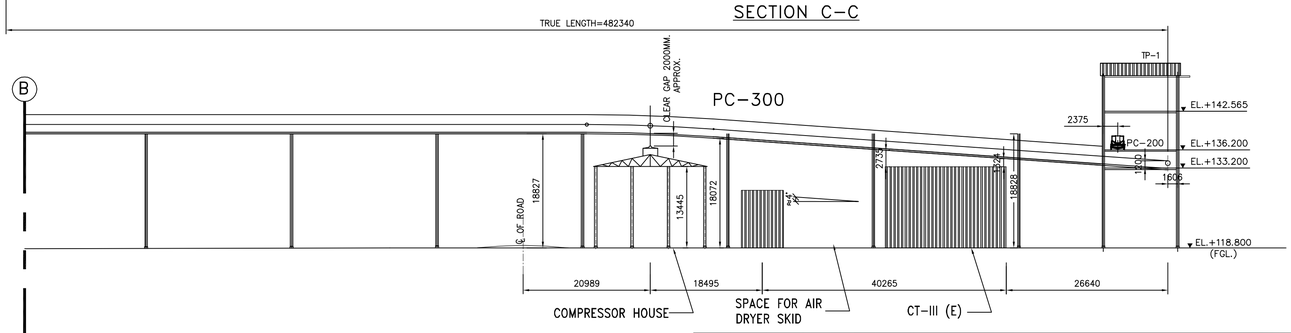


SECTION A-A





SECTION C-C



SECTION C-C

NOTE:-

1. ALL DIMENSIONS ARE IN MM. AND LEVELS ARE IN M. UNLESS OTHERWISE STATED.
2. STRUCTURES AND LEVELS AS SHOWN IN THE DRAWING ARE INDICATIVE ONLY.
3. LSTK VENDOR SHALL FINALIZE THE ROUTES, LEVELS AND SUPPORT LOCATIONS AFTER SITE SURVEY FOR OVERGROUND AND UNDERGROUND AREA IN CONSULTATION WITH DCPL AND NALCO.
4. FOR GENERAL LAYOUT REFER 14L08-DWG-M-PL-001,R-I.

REV.NO	DATE	DESCRIPTION /REVISION NOTES	DRAWN	CHECKED	VERIFIED	APPROVED
D	JUL17/15	TENDER PURPOSE ONLY	SD	DN	DN	DG
C	May15/15	TENDER PURPOSE ONLY	SD	DN	DN	DG
B	Apr24/15	TENDER PURPOSE ONLY	SD	SM	DN	DG
A	Apr14/15	TENDER PURPOSE ONLY	SC	PBB	DN	DG

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS
KOLKATA MUMBAI CHENNAI NEW DELHI

FOR TENDER PURPOSE

APPROV.	MECH.	INST.	ELEC.	STRL.	ARCH.	NATURE OF REVISION & DESCRIPTION	CHECKED	DRAWN	REV.	DATE
	REVIEWED									

RELEASE STATUS	DATE	SIGNATURE
PRELIMINARY		
FOR TENDER ONLY		
FOR CONSTRUCTION		

REVIEWED		
ARCHITECTURAL		
CIVIL & STRUCTURAL		
ELECTRICAL		
INSTRUMENTATION		
MECHANICAL		

PROJECT : ALUMINA UNLOADING AND TRANSPORTATION

VIEW PROFILE FOR UNLOADING AND CONVEYING SYSTEM

DWG. NO. 14L08-DWG-M-PL-004 REV. D

JOB NO: 14L08 | **SCALE: 1:500** | **PROJECTION:**

DT. : JUL17/15

14L08-DWG-M-PL-004 REV.-D

A1 (09-96) [841 x 594]

DWG. NO. 14L08-DWG-PR-PFD-001(SH.1 OF 2) REV. A

TRACK-1 1 2
TRACK-2 1 2
TRACK-1 3 4
TRACK-2 3 4

AS-100
CAP.-500T/HR.

TO DE-1A

SG-001 SG-002

AS-200
CAP.-500T/HR.

TO ATM

EF-100B

BAG FILTER
DE-BF-1B

DC-100B

DE-1B

RV-100B

TO PC-100

AIR RECIVER
(AR- 2B)

AFTER FILTER
(AFL-1)

OIL FILTER
(OFL- 1)

AIR DRYER
(AD-1)

PRE FILTER
(PFL-1)

AIR RECIVER
(AR- 1A)

AIR COMPRESSOR
1W+1S

TO ATM

EF-100A

BAG FILTER
DE-BF-1

DC-100A

AIR RECIVER
(AR- 2A)

DE-1A

RV-100A

TO AIR SLIDE AS-300

AIR SLIDE

AS-300
CAP.-1000T/HR.

TO DE-1B

EH-1
HOIST
CAP: 2TON

TO DE-1B

PC-100

FOR CONT. REF. DWG. NO.-
14L08-DWG-PR-PFD-001(SH.1 OF 2)

AIRSLIDE BLOWERS
(BL-100, 200 & 300)

EH-2
HOIST
CAP: 3TON

KA-100 KA-101 KA-102 KA-103

SCREW COMPRESSORS

KA-104 KA-105 KA-106 KA-107 KA-108

SCREW COMPRESSORS

TO DRAIN

SUMP PUMP
P-1&P-2(1W+1S)

SUMP PIT

PRESSURISATION VENTILATION FAN (LOCATED IN BLOWER ROOM)
(FN-100 & 200)
(1W+1S)

LEGENDS:

BL	–	BLOWER
AS	–	AIR SLIDE
PC	–	PIPE CONVEYOR
KA	–	SCREW CONVEYOR
EH	–	ELECTRIC HOIST
DC	–	DUST COLLECTOR
EF	–	EXHAUST FAN
PG	–	PRESSURE GAUAGE
JB	–	JUNCTION BOX
SG	–	MANUAL OPERATED SLIDE GATE

FOR TENDER PURPOSE ONLY

PROCESS FLOWSHEET FOR WAGON UNLOADING SYSTEM

ALUMINA UNLOADING AND TRANSPORTATION

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS
KOLKATA MUMBAI MADRAS NEW DELHI

DKG										
APPROV.	MECH.	INST.	ELEC.	STRL.	ARCH.	FOR TENDER PURPOSE ONLY	DN	ABM	A	APR29/15
REVIEWED						NATURE OF REVISION & DESCRIPTION	CHECKED	DRAWN	REV.	DATE

RELEASE STATUS	DATE	SIGNATURE
PRELIMINARY		
FOR TENDER ONLY		
FOR CONSTRUCTION		
REVIEWED: ARCHITECTURAL		
REVIEWED: CIVIL & STRUCTURAL		
REVIEWED: ELECTRICAL		
REVIEWED: INSTRUMENTATION		
REVIEWED: MECHANICAL		

DRAWN : ABM	CHECKED : SM	SCALE	NIL
REVIEWED : DN		DATE	29.04.15
APPROVED : DKG		JOB NO.	14L08

DWG. NO. 14L08-DWG-PR-PFD-001(SH.1 OF 2) REV. A

14L08-DWG-PR-PFD-001(SH.1 OF 2)Rev-A Apr.29/15

A1 (09-96) [841 x 594]

COMP. AIR
REQUIREMENT 50 m3/hr @ 5kg/cm2(g)
(SUPPLY FROM CLIENT)

TO ATM

EF-200

DC-200

RV-200

DE-2

COMP. AIR
REQUIREMENT 50 m3/hr@5kg/cm2(g)
(SUPPLY FROM CLIENT)

TO ATM

EF-300

DC-300

RV-300

TO JB-001

DE-3

EH-4
HOIST
CAP: 4TON

TP-2

PC-200
PIPE CONVEYOR
CAP-1000 TPH

PG-001
PG-002

JUNCTION
BOX
JB-001

TO SILO # 1

TO SILO # 2

EH-3
HOIST
CAP: 4TON

TP-1

PC-100
PIPE CONVEYOR
CAP-1000 TPH

FROM AS-300
FOR CONT. REF. DWG. NO.-
14L08-DWG-PR-PFD-001(SH. 2 OF 2)

BW-001
WEIGH SCALE

PNEUMATIC TYPE
DIVERTING GATE
DG-100

EH-5
HOIST
CAP: 4TON

PC-300
PIPE CONVEYOR
CAP-1000 TPH

TP-3

COMP. AIR
REQUIREMENT 50 m3/hr @ 5kg/cm2(g)
(SUPPLY FROM CLIENT)

TO ATM

DC-400

EF-400

RV-400

TO JB-002

DE-4

PG-004
PG-003

JUNCTION BOX
JB-002

AS-400
CAP-1000 TPH

BL-400

PASSENGER CUM GOODS
LIFT(RACK & PINION TYPE)
CAP
1TON

AS-401
CAP-1000 TPH

BL-401

EXISTING BELT CONV
HC-BL-002

FROM
EXISTING BELT CONV
TR1

AS-501
CAP-1000 TPH

BL-501

AS-500
CAP-1000 TPH

BL-500

VENDOR

EXISTING
JUNCTION BOX
OVER FLOW
HIGH LEVEL SENSOR
AIR SLIDE
MAIN SLIDE
BREATHER VALVE
DEDUSTING SYSTEM
LEVEL SENSOR (4NOS.)
FLOW CONTROL VALVE
AIR LIFT
SILO FLUIDISED BOTTOM EXTRACTION SYSTEM

EXISTING SILO # 1

EXISTING SILO # 2

EXISTING SILO # 5

EXISTING SILO # 6

EXISTING

MODIFICATION REQUIRED FOR EXISTING JUNCTION BOX IS IN THE SCOPE OF LSTK VENDOR

MODIFICATION REQUIRED FOR EXISTING JUNCTION BOX IS IN THE SCOPE OF LSTK VENDOR

NOTES:-

1. COMPRESSED/INSTRUMENT AIR WILL BE SUPPLIED BY CLIENT AT THREE LOCATIONS TP-1,TP-2,TP-3.
2. READ THIS DRAWING IN CONJUNCTION WITH OVERALL PLOT PLAN 14L08-DWG-M-PL-001,REV-I
3. WATER TAPPING POINT(FIRE WATER LINE) SHALL BE TAKEN BY THE LSTK VENDOR FROM EXISTING FIRE WATER LINE FROM DESIGNATED LOCATION.
4. IN CASE ANY MODIFICATION IF REQUIRED, ON EXISTING EQUIPMENT HOOK UP & COMMISSIONING SHALL BE ON THE SCOPE OF LSTK VENDOR.
5. LOCATION OF SILOS TO BE REFERRED FROM OVERALL LAYOUT DRG. NO. 14L08-DWG-M-PL-001.

LEGENDS:

BL – BLOWER
AS – AIR SLIDE
PC – PIPE CONVEYOR
KA – SCREW CONVEYOR
EH – ELECTRIC HOIST
DC – DUST COLLECTOR
EF – EXHAUST FAN
PG – PRESSURE GAUAGE
JB – JUNCTION BOX

FOR TENDER PURPOSE ONLY

NATURE OF REVISION & DESCRIPTION	CHECKED	DRAWN	REV.	DATE
FOR TENDER PURPOSE ONLY	SN	ABM	C	JUL17/15
FOR TENDER PURPOSE ONLY	SN	ABM	B	JUN24/15
FOR TENDER PURPOSE ONLY	SN	ABM	A	APR29/15

DKG

APPROV. | MECH. | INST. | ELEC. | STRL. | ARCH. — REVIEWED

RELEASE STATUS	DATE	SIGNATURE
PRELIMINARY		
FOR TENDER ONLY		
FOR CONSTRUCTION		

REVIEWED: ARCHITECTURAL; CIVIL & STRUCTURAL; ELECTRICAL; INSTRUMENTATION; MECHANICAL

PROCESS FLOWSHEET FOR UNLOADING AND CONVEYING TO SILOS SYSTEM

ALUMINA UNLOADING AND TRANSPORTATION

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS
KOLKATA MUMBAI MADRAS NEW DELHI

DRAWN : ABM	CHECKED : SM	SCALE	NIL
REVIEWED : DN		DATE	29.04.15
APPROVED : DKG		JOB NO.	14L08

DWG. NO. 14L08-DWG-PR-PFD-001(SH.2 OF 2) REV. C

14L08-DWG-PR-PFD-001(SH.2 OF 2),Rev-C JUL17/15
A1 (09-96) [841 x 594]

TRACK-1 1 2
TRACK-2 1 2
TRACK-1 3 4
TRACK-2 3 4

AS-100 CAP.-500T/HR.
AS-200 CAP.-500T/HR.
TO DE-1A
SG-001
SG-002
LSH 100
LSL 100
LT 100
LI 100

TO ATM
RC
HS 100B
H/A STA/STO
EF-100B
FROM TIMER
S
PI 100B
PT 100B
AIR RECIVER (AR- 2B)
BAG FILTER DE-BF-1B
DC-100B
HH H L
PDIA 100B
PDT 100B
LS 100B
LAH 100B
DE-1B
S/S
HS 101B
RV-100B
TO PC-100
AFTER FILTER (AFL-1)
OIL FILTER (OFL- 1)
PDI 101
PDAH
AIR DRYER (AD-1)
PRE FILTER (PFL-1)
AIR RECIVER (AR- 1A)
AIR COMPRESSOR 1W+1S

TO ATM
RC
HS 100A
H/A STA/STO
EF-100A
FROM TIMER
S
PI 100
PT 100
AIR RECIVER (AR- 2A)
BAG FILTER DE-BF-1
DC-100A
HH H L
PDIA 100A
PDT 100A
LS 100A
LAH 100A
DE-1A
S/S
HS 101A
RV-100A
TO AIR SLIDE AS-300

AIR SLIDE
AS-300 CAP.-1000T/HR.
TO DE-1B
EH-1
HOIST CAP: 2TON
TO DE-1B
PC-100
FOR CONT. REF. DWG. NO.- 14L08-DWG-PR-PFD-001(SH.2OF2)

C
PSL 108
PSL 108
PG-108

PG-100 PG-101 PG-102 PG-103 PG-104 PG-105 PG-106 PG-107

UV-109 UV-110 UV-111 UV-112 UV-113 UV-114 UV-115 UV-116

AIRSLIDE BLOWERS (BL-100, 200 & 300)

UV-100 UV-101 UV-102 UV-103 UV-104 UV-105 UV-106 UV-107 UV-108

HS 100 KA-100
HS 101 KA-101
HS 102 KA-102
HS 103 KA-103
SCREW COMPRESSORS

EH-2
HOIST CAP: 3TON

HS 104 KA-104
HS 105 KA-105
HS 106 KA-106
HS 107 KA-107
HS 108 KA-108
SCREW COMPRESSORS

C
PSL 109
PSL 109
PG-109
PRESSURISATION VENTILATION FAN (LOCATED IN BLOWER ROOM)
(FN-100 & 200)
(1W+1S)

TO DRAIN
LI 101
LT 101
PS 101
SUMP PUMP P-1&P-2(1W+1S)
SUMP PIT

LEGENDS:

BL	BLOWER
AS	AIR SLIDE
PC	PIPE CONVEYOR
KA	SCREW CONVEYOR
EH	ELECTRIC HOIST
DC	DUST COLLECTOR
EF	EXHAUST FAN
FN	FAN IN BLOWER
SG	MANUAL OPERATED SLIDE GATE.
LT	LEVEL TRANSMITTER
LS	LEVEL SWITCH
PG	PRESSURE GAUGE
PT	PRESSURE TRANSMITTER
PDT	DIFF. PRESSURE TRANSMITTER
FT	FLOW TRANSMITTER
TE	TEMP. ELEMENT
HS	HAND OPERATED SWITCH
UV	ON/OFF VALVE
PS	PRESSURE SWITCH

C

FOR TENDER PURPOSE ONLY

NATURE OF REVISION & DESCRIPTION	CHECKED	DRAWN	REV.	DATE
FOR TENDER PURPOSE ONLY	DN	ABM	C	JUL13/15
FOR TENDER PURPOSE ONLY	DN	ABM	B	JUNE24/15
FOR TENDER PURPOSE ONLY	DN	ABM	A	APR29/15

APPROV.	MECH.	INST.	ELEC.	STRL.	ARCH.
DKG	DN	PB			
DKG	DN	PB			
DKG	DN	PB			

REVIEWED

RELEASE STATUS	DATE	SIGNATURE
PRELIMINARY		
FOR TENDER ONLY		
FOR CONSTRUCTION		
ARCHITECTURAL		
CIVIL & STRUCTURAL		
ELECTRICAL		
INSTRUMENTATION		
MECHANICAL		

PROCESS AND INSTRUMENTATION DIAGRAM WAGON UNLOADING SYSTEM

ALUMINA UNLOADING AND TRANSPORTATION

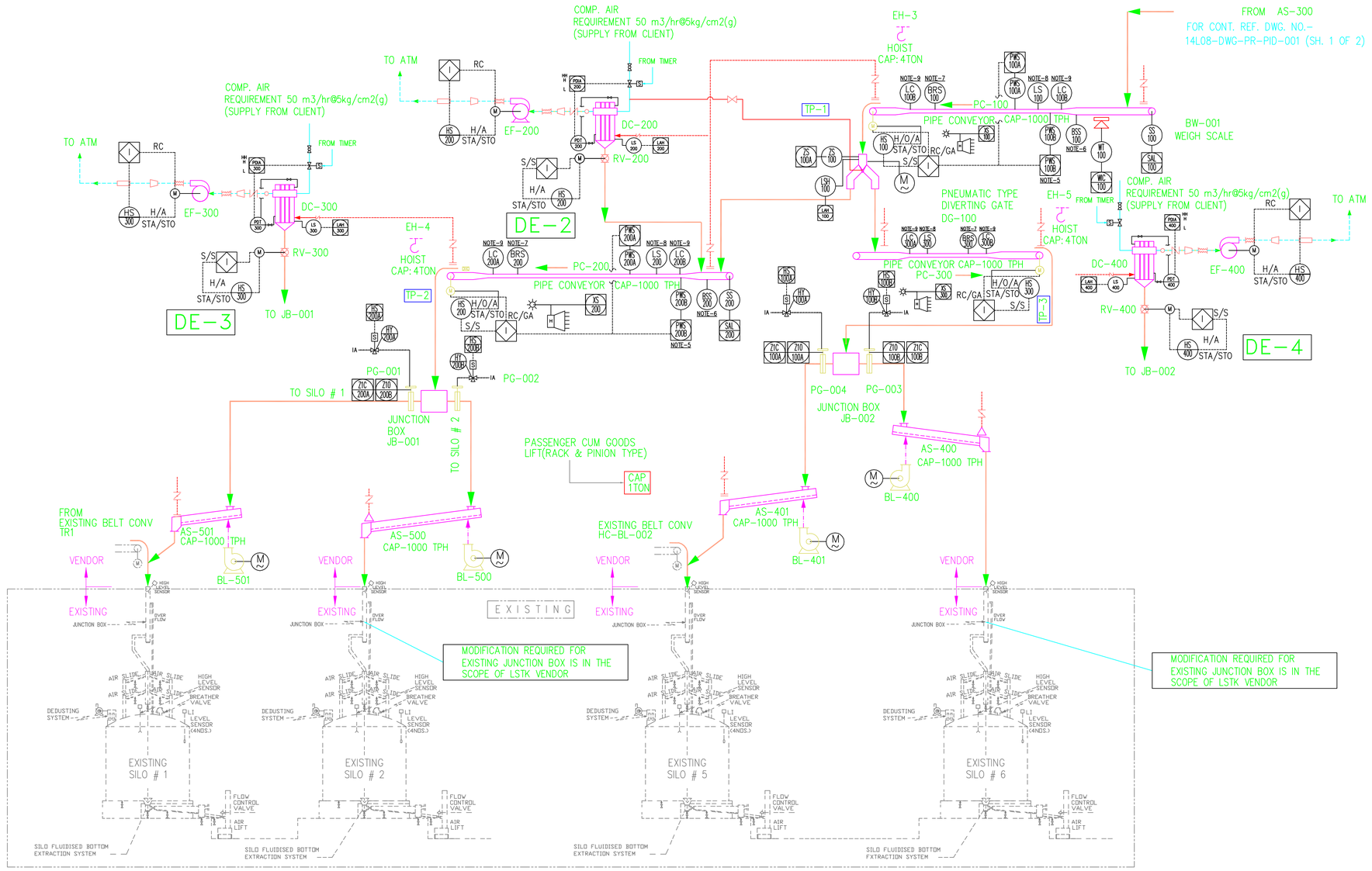
NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS
KOLKATA MUMBAI MADRAS NEW DELHI

DRAWN : ABM	CHECKED : SN	SCALE	NIL
REVIEWED : DC		DATE	29.04.15
APPROVED : DKG		JOB NO.	14L08

DWG. NO. 14L08-DWG-PR-PID-001(SH.1 OF 2) REV. C

14L08-DWG-PR-PID-001(SH.1 OF 2)Rev-B JUNE24/15
A1 (09-96) [841 x 594]



LEGENDS:

BL	– BLOWER
AS	– AIR SLIDE
PC	– PIPE CONVEYOR
KA	– SCREW CONVEYOR
EH	– ELECTRIC HOIST
DC	– DUST COLLECTOR
EF	– EXHAUST FAN
PG	– PRESSURE GAUAGE
JB	– JUNCTION BOX
SG	– MANUAL OPERATED SLIDE GATE
LT	– LEVEL TRANSMITTER
LS	– LEVEL SWITCH
PG	– PRESSURE GAUGE
PT	– PRESSURE TRANSMITTER
PDT	– DIFF. PRESSURE TRANSMITTER
FT	– FLOW TRANSMITTER
TE	– TEMP. ELEMENT
HS	– HAND OPERATED SWITCH
WT	– WEIGHT TRANSMITTER
XS	– PILOT LIGHT
ZS	– POSITION SWITCH
SS	– SPEED SWITCH

NOTES:-

1. COMPRESSED/INSTRUMENT AIR WILL BE SUPPLIED BY CLIENT AT THREE LOCATIONS TP-1,TP-2,TP-3.
2. READ THIS DRAWING IN CONJUNCTION WITH OVERALL PLOT PLAN 14L08-DWG-M-PL-001; REV-I.
3. WATER TAPPING POINT(FIRE WATER LINE) SHALL BE TAKEN BY THE BIDDER FROM EXISTING WATER LINE IN SUITABLE LOCATION.
4. IN CASE ANY MODIFICATION IF REQUIRED, ON EXISTING EQUIPMENT HOOK UP & COMMISSIONING SHALL BE CARRIED OUT BY THE BIDDER.
5. ADDRESSABLE PULLCORD SWITCH FOR PIPE CONVEYOR.
6. ADDRESSABLE BELTSWAY SWITCH.
7. ALL SAFETY EQUIPMENT REQUIRED ON PIPE CONVEYOR SHALL BE PROVIDED AND INSTALLED INCLUDING BELT RIP SWITCH.
8. VERTICAL TAKE-UP TOWER HEIGHT LIMIT SWITCHES.
9. TAKE-UP ROPE LOAD CELL HEAD AND TAIL END AND TAKE-UP CARRIAGE BELT MISALIGNMENT SWITCHES.
10. TECHOMETER/ ENCODER FOR SPEED COMPARISION OF HEAD & TAIL PULLEY SHALL BE PROVIDED.
11. ALL SAFETY EQUIPMENT & PLC BASED CONTROL PANEL FOR WAGON HAULAGE UNIT ,START UP PUSH BUTTON AND ALSO AUTOMATIC ROPE TENSIONING ARRANGEMENT SHALL BE PROVIDED BY THE VENDOR.

FOR TENDER PURPOSE ONLY

APPROV.	MECH.	INST.	ELEC.	STRL.	ARCH.	NATURE OF REVISION & DESCRIPTION	CHECKED	DRAWN	REV.	DATE
	REVIEWED					FOR TENDER PURPOSE ONLY	DN	ABM	D	JUL17/15
DKG		DN	PB			FOR TENDER PURPOSE ONLY	DN	ABM	C	JUL13/15
DKG		DN	PB			FOR TENDER PURPOSE ONLY	DN	ABM	B	JUNE24/15
DKG		DN	PB			FOR TENDER PURPOSE ONLY	DN	ABM	A	APR29/15

RELEASE STATUS	DATE	SIGNATURE
PRELIMINARY		
FOR TENDER ONLY		
FOR CONSTRUCTION		

REVIEWED: ARCHITECTURAL; CIVIL & STRUCTURAL; ELECTRICAL; INSTRUMENTATION; MECHANICAL

PROCESS AND INSTRUMENTATION DIAGRAM
UNLOADING AND CONVEYING TO SILOS SYSTEM

ALUMINA UNLOADING AND TRANSPORTATION

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL–759145

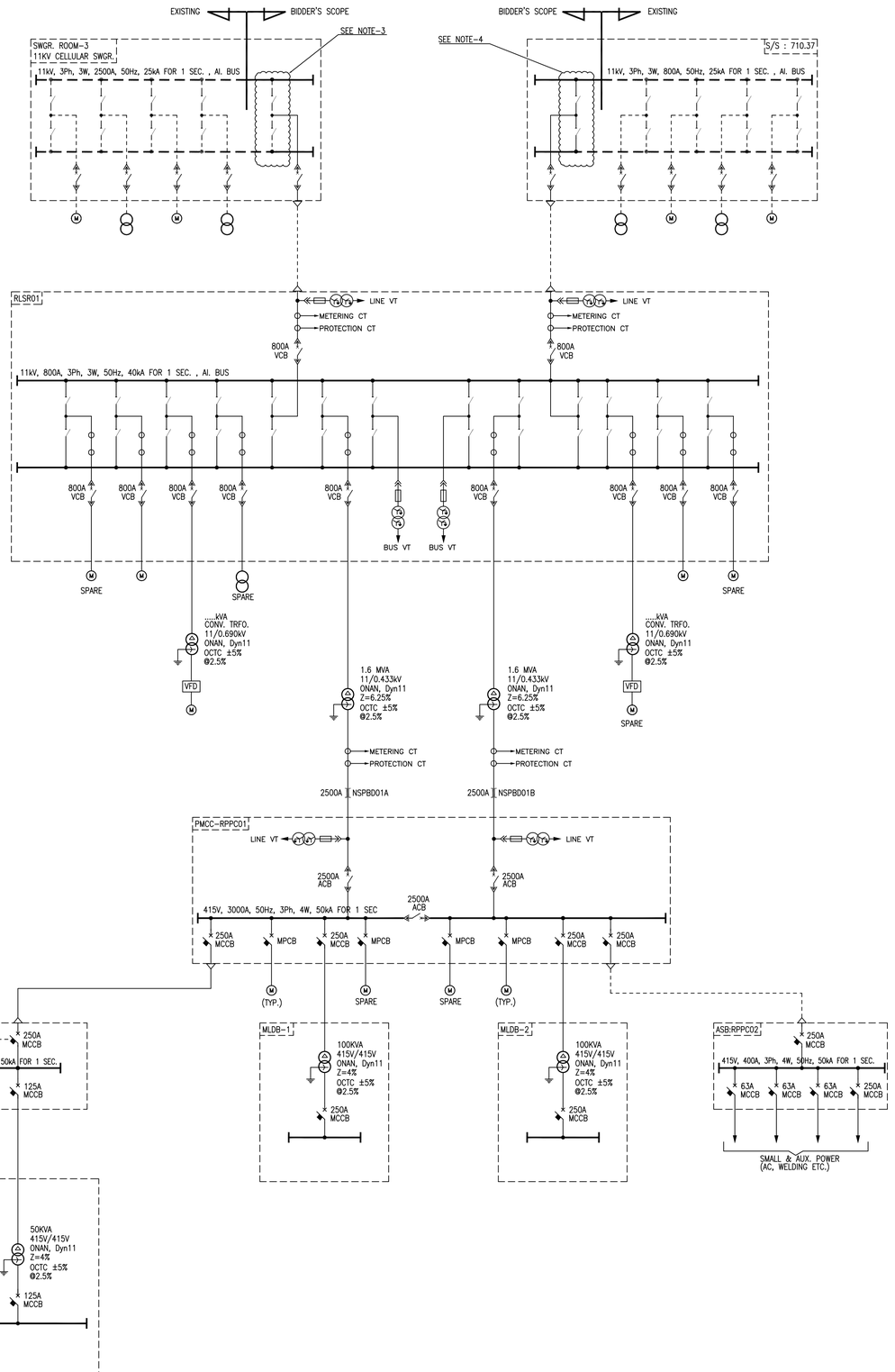
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS
KOLKATA MUMBAI MADRAS NEW DELHI

DRAWN :	ABM	CHECKED :	SM	SCALE	NIL
REVIEWED :	DC			DATE	29.04.15
APPROVED :	DKG			JOB NO.	14L08

DWG. NO.14L08-DWG-PR-PID-001(SH.2 OF 2) REV. D

14L08-DWG-PR-PID-001(SH.2 OF 2)Rev-D JUL17/15
A1 (09-96) [841 x 594]

DWG. NO. 14L08-DWG-E-0101 REV. 5



LEGENDS:

- ISOLATOR
- CIRCUIT BREAKER (VCB, ACB,)
- TWO WINDING TRANSFORMER
- M — MOTOR
- DRAWOUT
- NON SEGREGATED PHASE BUS DUCT
- MCCB/MPCB
- CABLE CONNECTION
- VT
- FUSE
- CT
- K1/2 — INTERLOCK

MLDB	MAIN LIGHTING DISTRIBUTION BOARD.
ELDB	EMERGENCY LIGHTING DISTRIBUTION BOARD.
PMCC	POWER & MOTOR CONTROL CENTRE.
ASB	AUX. SWITCH BOARD.

NOTES:

1. THE POWER DISTRIBUTION SCHEME SHOWN IN THE DRAWING IS INDICATIVE ONLY AND FOR GENERAL UNDERSTANDING OF THE WORK UNDER THE TENDERER'S SCOPE. ITEMS THAT ARE NOT SPECIFICALLY MENTIONED/SPECIFIED BUT ARE REQUIRED TO MAKE THE SYSTEM COMPLETE, SAFE IN ALL RESPECT SHALL BE DEEMED TO BE INCLUDED IN THE SCOPE OF THE TENDERER.
2. RATING AND QUANTITY OF DIFFERENT EQUIPMENTS (e.g. TRANSFORMER RATING & IMPEDANCE, RATING OF SWITCHBOARD, DISTRIBUTION OF LIGHTING & SMALL POWER, UPS & DC SYSTEM etc.) SHOWN IN THE DRAWING ARE INDICATIVE & MINIMUM . EXACT RATING AND QUANTITY SHALL BE DECIDED BY CONTRACTOR DURING DETAIL ENGINEERING WITH BACK UP CALCULATION & AS PER INPUT FROM OWNER AS APPLICABLE.
3. IN 11KV CELLULAR SWITCHGEAR, SPACE AVAILABLE FOR FUTURE FEEDER 3C10 SHALL BE USED FOR PROPOSED AUGMENTATION. TWO NOS. ISOLATORS ARE INSTALLED IN FEEDER 3C10. BUS WORK IS ALSO EXISTING UPTO THE ISOLATORS. NECESSARY BUS WORK AFTER THE ISOLATORS, BREAKER, CT ETC. SHALL BE PROVIDED BY LSTK CONTRACTOR.
4. 11KV SWITCHGEAR AT SUBSTATION-37 SHALL BE EXTENDED BY ADDING ONE NO. VCB FEEDER. EXTENSION OF 11KV FEEDER ALONG WITH THE BUS WORK AND INTERFACING WITH THE EXISTING SYSTEM SHALL BE INCLUDED IN BIDDER SCOPE.
5. BIDDER SHALL VERIFY THE EXISTING SYSTEM DATA FROM SITE.
6. AUTO CHANGEOVER SHALL BE PROVIDED AT EMERGENCY MCC, RPPC03 SO THAT IN CASE OF OUTAGE OF NORMAL AC POWER THE EMERGENCY SUPPLY SHALL AUTOMATICALLY TAKES OVER THE EMERGENCY LOADS.
7. RATING OF CONVERTER TRANSFORMER SHALL BE DECIDED BY EPC CONTRACTOR BASED ON THE REQUIREMENT AND SHALL BE JUSTIFIED BY BACK UP CALCULATION.

TENDER PURPOSE ONLY

REV.NO	DATE	DESCRIPTION / REVISION NOTES	DRAWN	CHECKED	VERIFIED	APPROVED
5	15.06.15	REVISED AS PER OWNER'S COMMENTS	NH	NB	BM	BB
4	18.02.15	REVISED AS PER OWNER'S COMMENTS	NH	NB	BM	BB
3	02.12.14	REVISED AS PER OWNER'S COMMENTS	NH	BM	BM	BB
2	14.11.14	REVISED AS PER OWNER'S COMMENTS	NH	BM	BM	BB
1	10.11.14	REVISED AS PER OWNER'S COMMENTS	NH	BM	BM	BB
0	26.09.14	PRELIMINARY	KKBose	BM	BM	BB

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS
KOLKATA MUMBAI CHENNAI NEW DELHI

RELEASE STATUS		DATE	SIGNATURE
PRELIMINARY			
✓ FOR TENDER ONLY		15.06.15	
FOR CONSTRUCTION			
REVIEWED	ARCHITECTURAL		
	CIVIL & STRUCTURAL		
	ELECTRICAL		
	INSTRUMENTATION		
	MECHANICAL		

PROJECT : ALUMINA UNLOADING AND TRANSPORTATION

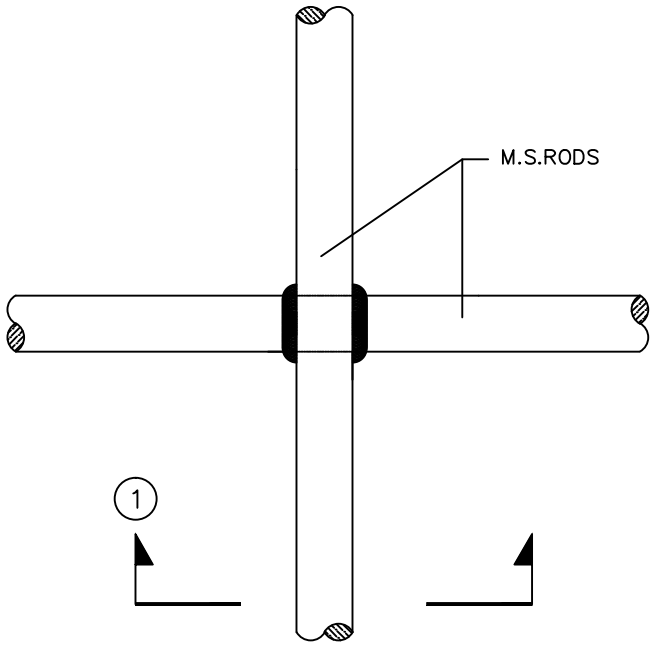
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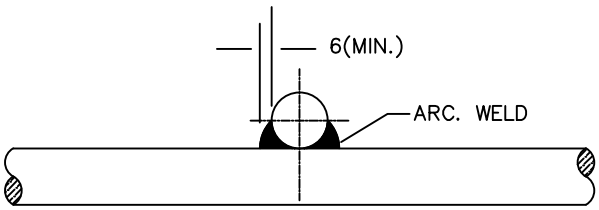
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JOB NO: 14L08 | **SCALE: NTS** | **PROJECTION:**

CAD FILE NAME:14L08-DWG-E-0101

A1 (09-96) [841 x 594]





SECTION – (1)

CROSS JOINT
BETWEEN M.S. RODS

FOR TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GROUNDING NOTES & DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

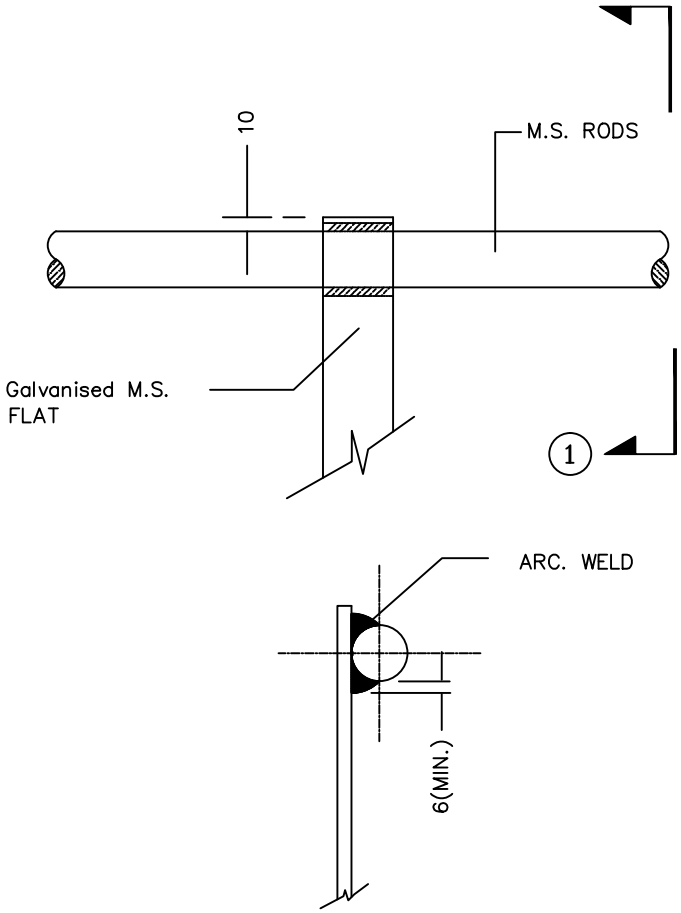
JOB NO. 14L08 | SCALE : N.T.S

DWG. NO. 14L08-DWG-E-0600 | REV. 0

SHT.-08 OF 30

File Name 14L08-DWG-E-0600

A4_DD (9-96) [210x297]



SECTION – (1)

CROSS JOINT
BETWEEN M.S. ROD & GALVANISED M.S. FLATS

FOR TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GROUNDING NOTES & DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

DWG. NO. 14L08-DWG-E-0600 | REV. 0

SHT.-09 OF 30

File Name 14L08-DWG-E-0600

A4_DD (9-96) [210x297]

CABLING NOTES AND DETAILS

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	REVWD.	CHKD.	REV.	DATE

CABLING NOTES & DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : NIL

DWG. NO. 14L08-DWG-E-0700 SH.-1 | REV. 0

File Name 14L08-DWG-E-0700

A4_DD (9-96) [210x297]

NOTES:–

1. THE CABLING WORK SHALL BE DONE IN ACCORDANCE TO THE STIPULATION OF THE SPECIFICATION.

2. THE CABLING WORK SHALL COMPRISE OF THE FOLLOWING AND/OR AS STIPULATED IN THE SPECIFICATION: –

   - ON TRAY : LAYING, DRESSING, CLAMPING OF CABLES ON TRAY, FIXING OF CABLE TAG INCLUDING THE SUPPLY OF CABLE CLAMPS, CABLE TAGS AND FIXING HARDWARES.

   - BURIED : EXACAVATION OF EARTH, FILLING BY SAND, PROVIDING BRICK PARTITION, LAYING AND DRESSING OF CABLE, FIXING OF CABLE TAG, SAND COVERING FOLLOWED BY FIXING OF PRECAST COVER, BACKFILLING BY GOOD EARTH FOLLOWED BY COARSE EARTH INCLUDING THE SUPPLY OF CABLE TAG, SAND, BRICK, PRECAST COVER.

   - SHALLOW TRENCH : LAYING, DRESSING, FIXING OF CABLE TAG, FILLING WITH SAND AND FIXING OF BRICK COLUMN INCLUDING SUPPLY OF SAND, BRICK AND CABLE TAG.

   - DUCT BANK : PULLING OF CABLE AND FIXING OF CABLE TAG.

3. TERMINATION WORK SHALL BE DONE IN ACCORDANCE TO THE STIPULATION OF THE SPECIFICATION INCLUDING SUPPLY OF LUGS, GLANDS FOR CONTROL CABLE.

4. ARMOUR/SCREEN OF MULTI CORE CABLES SHALL BE GROUNDED AT BOTH END.

5. ARMOUR/SCREEN, IF ANY, OF SINGLE CORE CABLE SHALL BE GROUNDED ONLY AT SOURCE END.

6. ALL WALL/FLOOR OPENINGS FOR CABLE ENTRY SHALL BE SUITABLY SEALED WITH FIRE RATING OF 90 MINUTE AFTER CABLE ERECTION.

7. CLAMPING OF ADJACENT CABLES ON THE SAME RACK SHALL BE STAGGERED TO AVOID FOULING OF THE CLAMPING BOLTS.

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	REVWD.	CHKD.	REV.	DATE

CABLING NOTES & DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

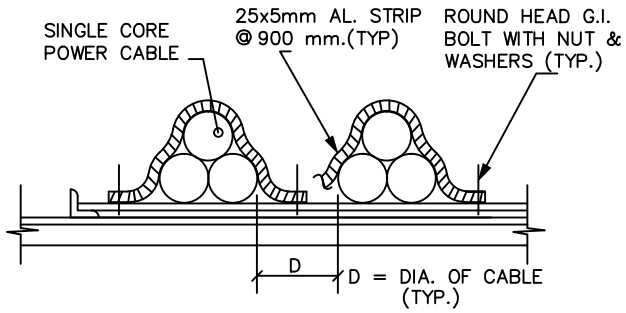
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DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

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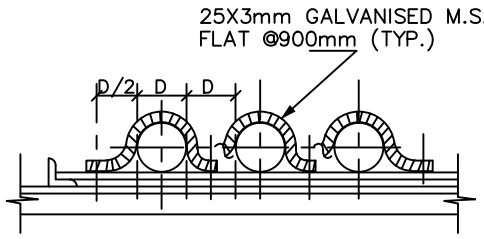
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File Name 14L08–DWG–E–0700

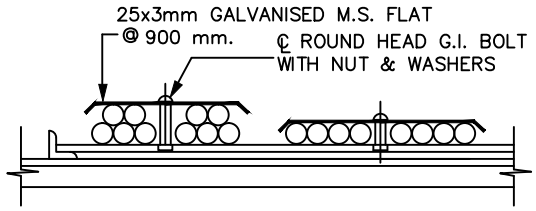
A4_DD (9–96) [210x297]



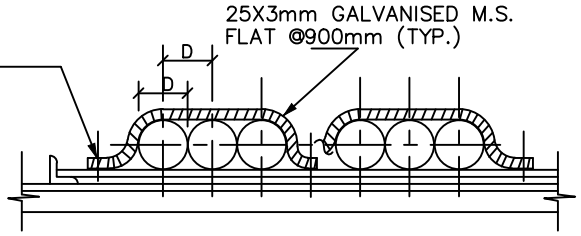
CABLE CLAMPS IN TREFOIL FORMATION FOR SINGLE CORE POWER CABLES



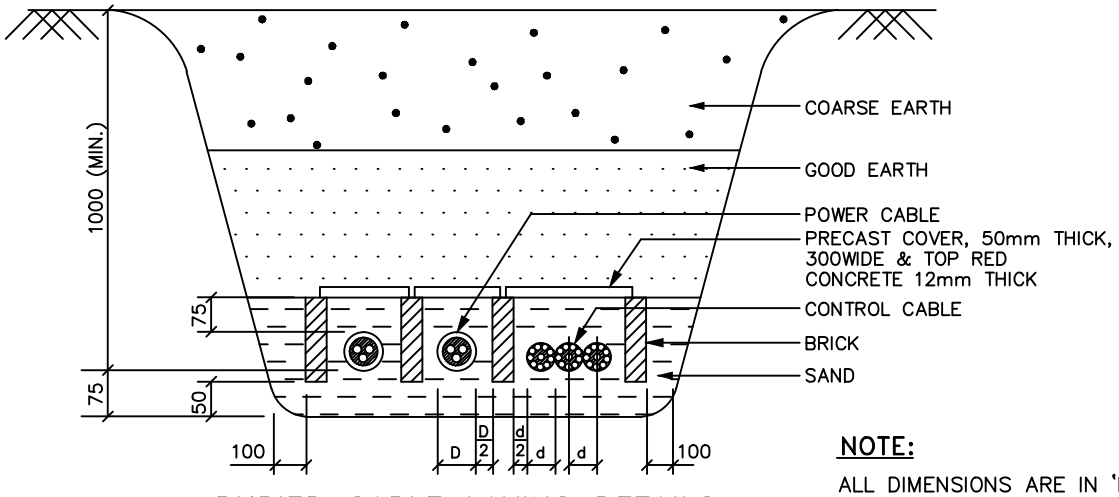
CABLE CLAMPS FOR MULTICORE POWER CABLES (NOT TOUCHING EACHOTHER)



CLAMPING ARRANGEMENT OF CONTROL CABLES



CABLE CLAMPS FOR MULTICORE POWER CABLES (TOUCHING EACHOTHER)



BURIED CABLE LAYING DETAILS

NOTE:

ALL DIMENSIONS ARE IN 'MM'.

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	REVWD.	CHKD.	REV.	DATE

CABLING NOTES & DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT

DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

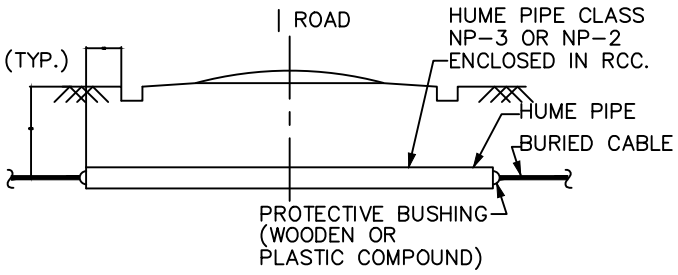
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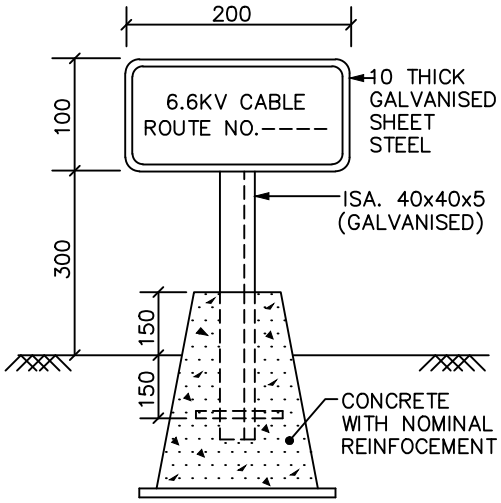
SH.-3

File Name 14L08-DWG-E-0700

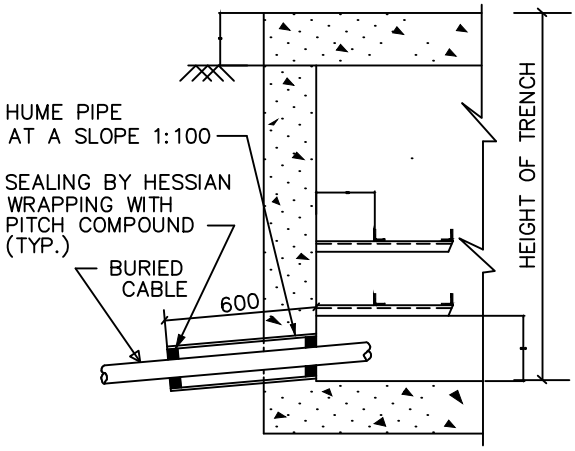
A4_DD (9-96) [210x297]



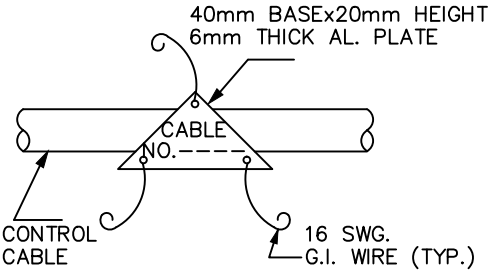
ROAD CROSSING OF BURIED CABLE



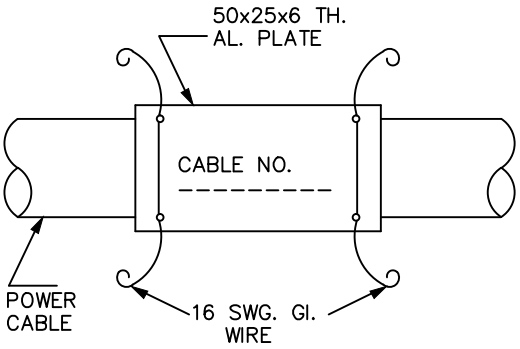
CABLE ROUTE MAKER
(VOLTAGE TO BE MARKED)



TYP. DETAILS OF BURIED CABLE ENTRY TO BLDG. OR CABLE TRENCH



CABLE TAG CONTROL CABLE



CABLE TAG POWER CABLE

NOTE:

ALL DIMENSIONS ARE IN 'MM'.

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	REVWD.	CHKD.	REV.	DATE

CABLING NOTES & DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

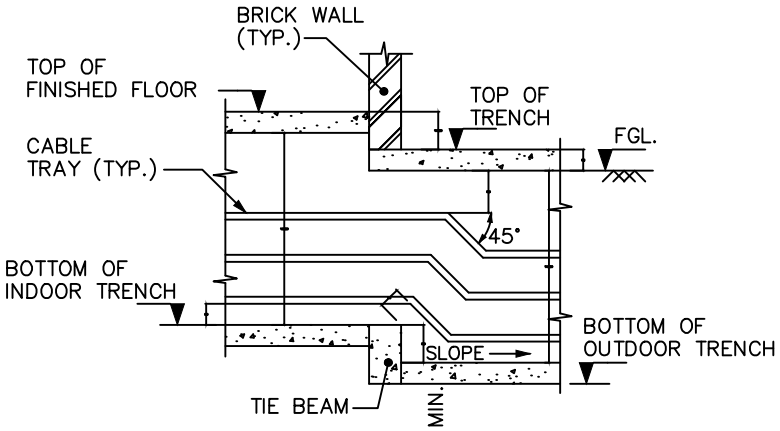
CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : NIL

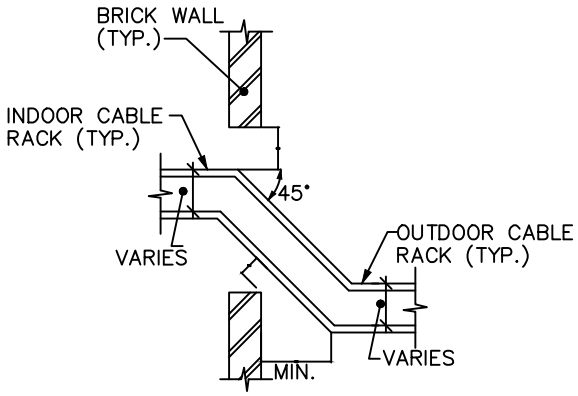
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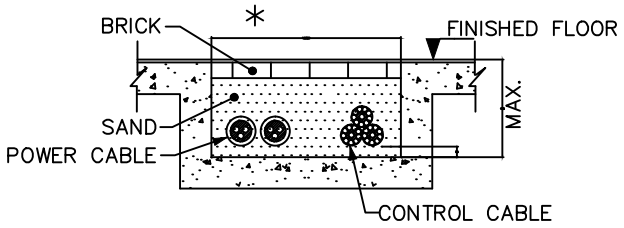
A4_DD (9-96) [210x297]



TYPICAL DETAILS OF CABLE TRENCH ENTRY TO BUILDING



TYPICAL DETAILS OF CABLE RACK ENTRY TO BUILDINGS



CABLE LAYING IN SHALLOW TRENCH (INDOOR)

NOTE:

1. ALL DIMENSIONS ARE IN 'MM'.
2. THE PORTION OF FLOOR ABOVE THE TRENCH MARKED '*' SHALL BE FINISHED WITH WEAK MORTER.

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	REVWD.	CHKD.	REV.	DATE

CABLING NOTES & DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : NIL

DWG. NO. 14L08-DWG-E-0700 SH.-5 | REV. 0

File Name 14L08-DWG-E-0700

A4_DD (9-96) [210x297]

ILLUMINATION NOTES & DETAILS

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS- ILLUMINATION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT

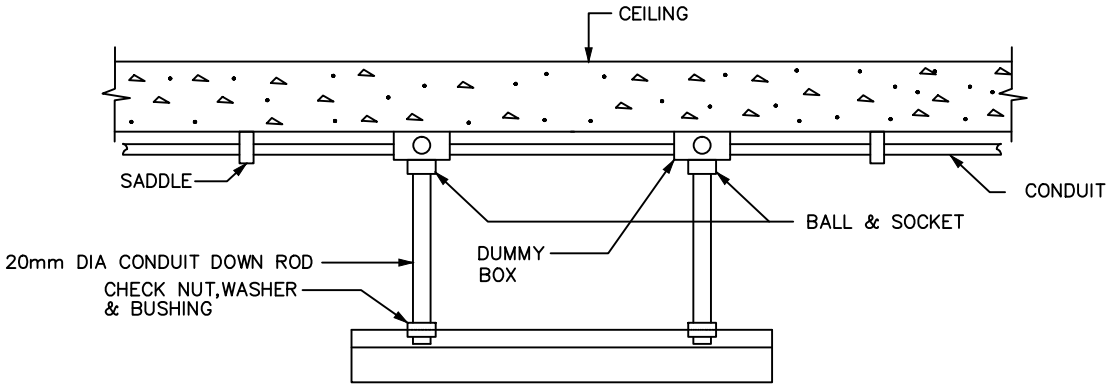
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CONSULTING ENGINEERS

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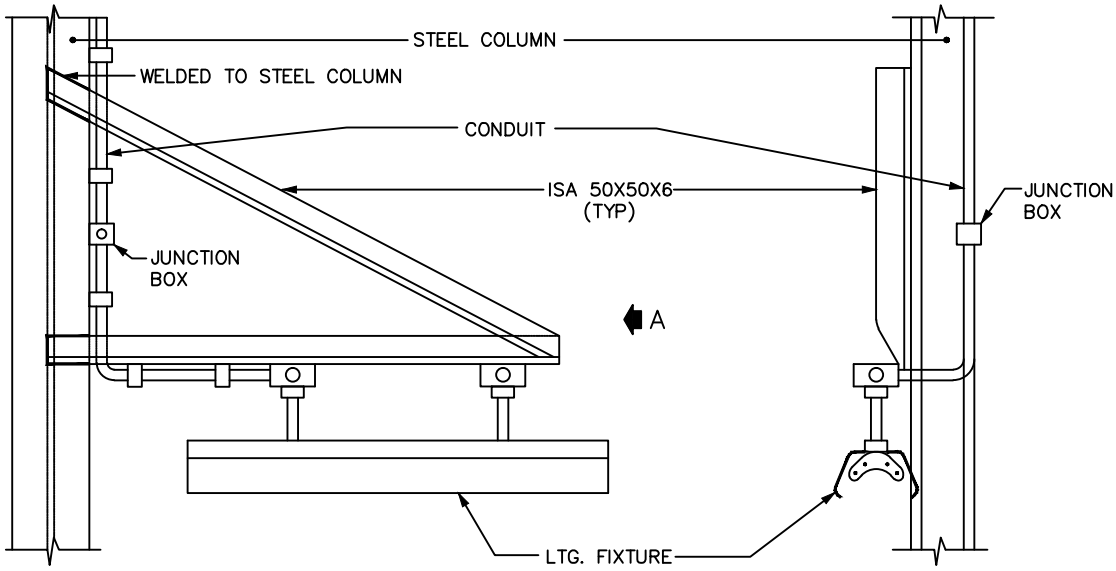
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File Name 14L08-DWG-E-0800

A4_DD (9-96) [210x297]



PENDANT/CEILING MOUNTING
TYPE – DA/DB



CANTILEVER MOUNTING
TYPE–SA/SB

VIEW–A

SURFACE/PENDANT MOUNTED
COMMERCIAL/DECORATIVE TYPE
LUMINAIRE WITH 1X28W T5FL/2X28W T5FL
[EQ. GE GET CI 2X28 C/S HF/EQV.]

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS– ILLUMINATION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

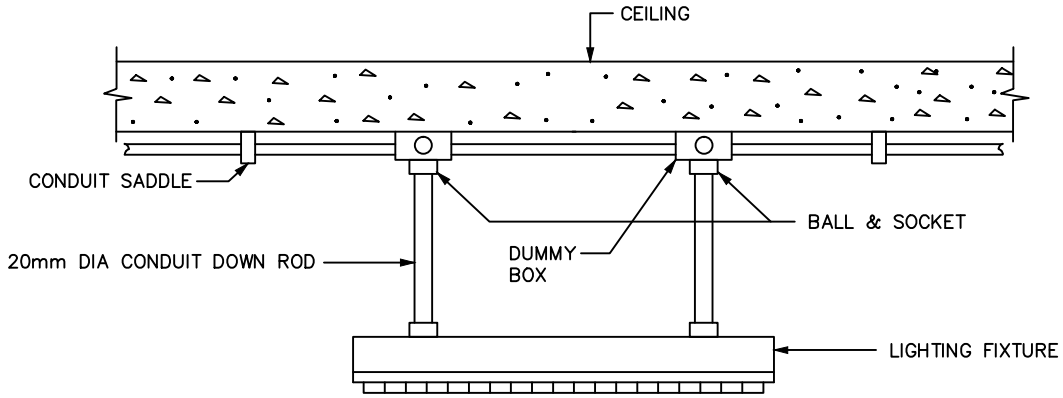
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DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

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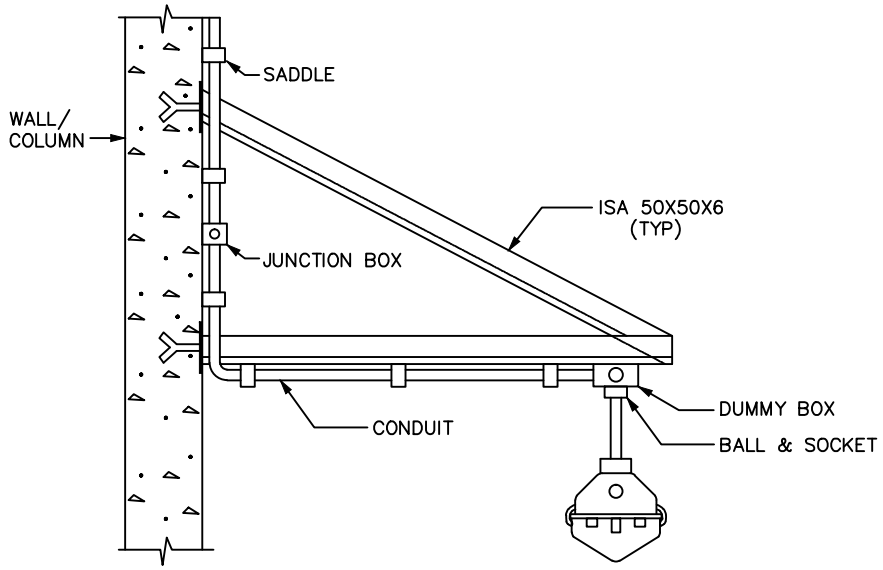
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File Name 14L08–DWG–E–0800

A4_DD (9–96) [210x297]



PENDANT/CEILING MOUNTING
TYPE – SA/SB/DA/DB



CANTILEVER MOUNTING
TYPE–SA/SB

SURFACE/PENDANT MOUNTED
WITH/WITHOUT AL REFLECTOR
COMMERCIAL/DECORATIVE TYPE
LUMINAIRE WITH 1X28W T5FL/2X28W T5FL
[EQ. GE GET CI 2X28 C/S HF/EQV.]

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS- ILLUMINATION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

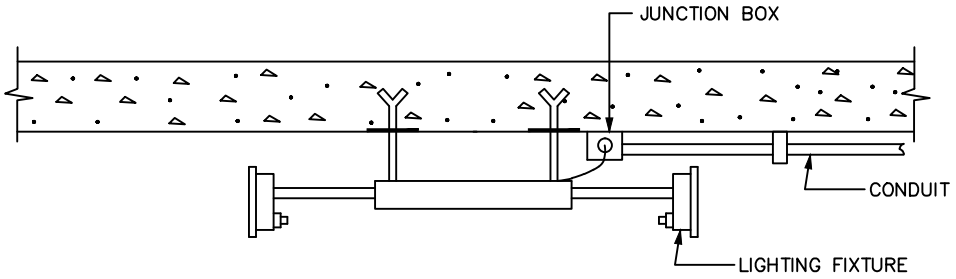
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DWG. NO. 14L08–DWG–E–0800 | REV. 0

SHT. -11

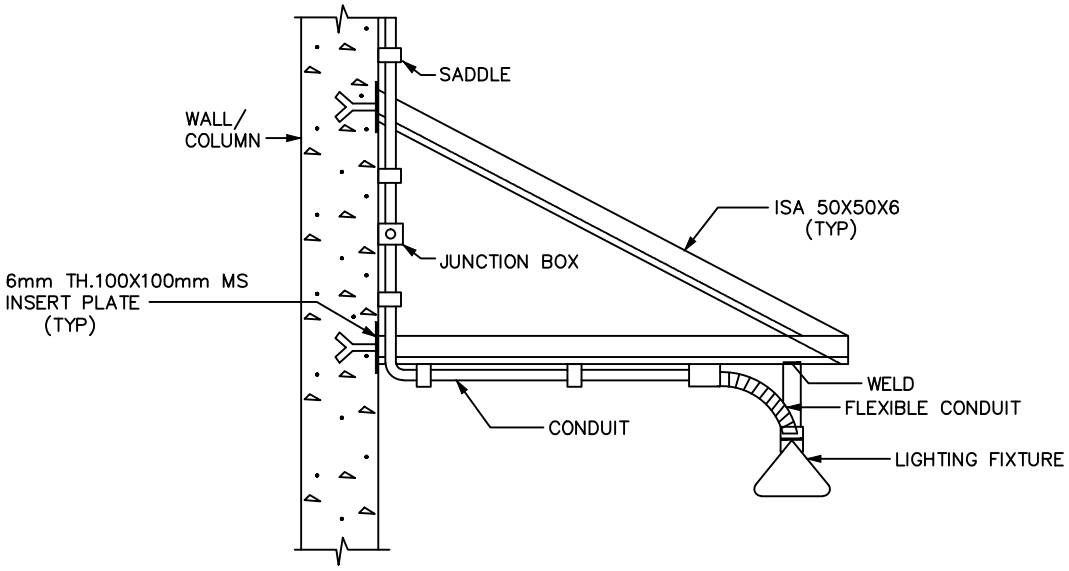
File Name 14L08–DWG–E–0800

A4_DD (9–96) [210x297]



CEILING MOUNTING

TYPE–DA/DB



WALL/COLUMN MOUNTING

TYPE–DA/DB

COMMERCIAL/DECORATIVE TYPE LUMINAIRE
WITH/WITHOUT AL REFLECTOR
WITH 2X28W T5FL
[EQ. GE GET CI 2X28 C/S HF/EQV.]

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS– ILLUMINATION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

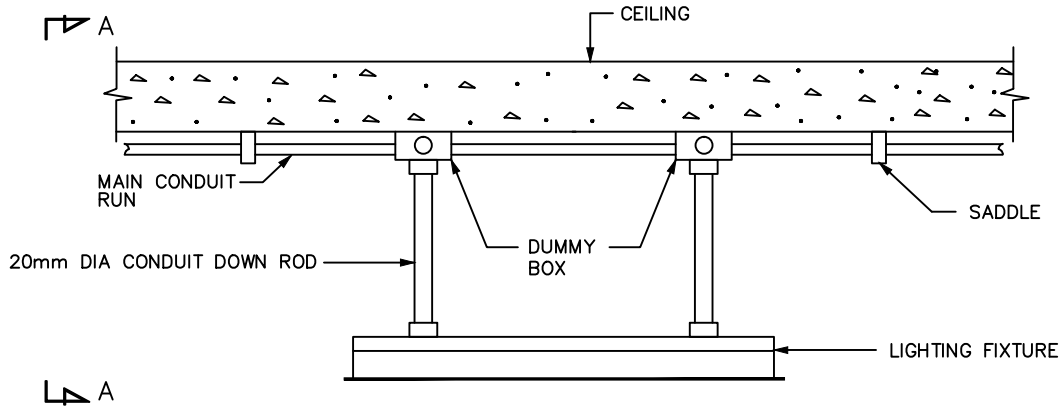
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DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

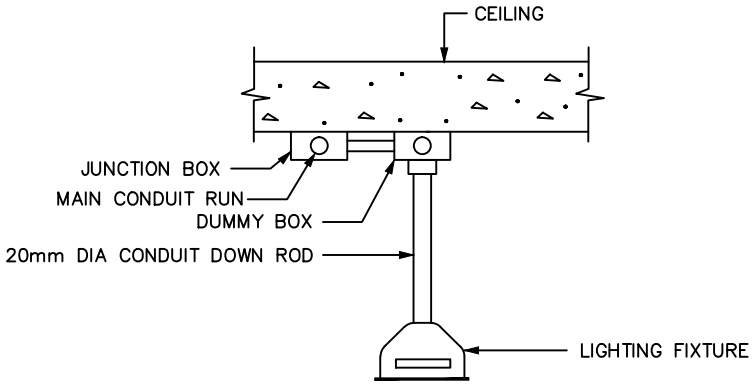
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File Name 14L08–DWG–E–0800

A4_DD (9–96) [210x297]





VIEW – A–A

PENDANT/CEILING MOUNTING

TYPE–DC

DECORATIVE/SURFACE/PENDANT MOUNTED
MIRROR OPTICS LUMINAIRE WITH 2X28W TL5.
[EQ. PHILIPS TYPE TCS150.]

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS– ILLUMINATION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

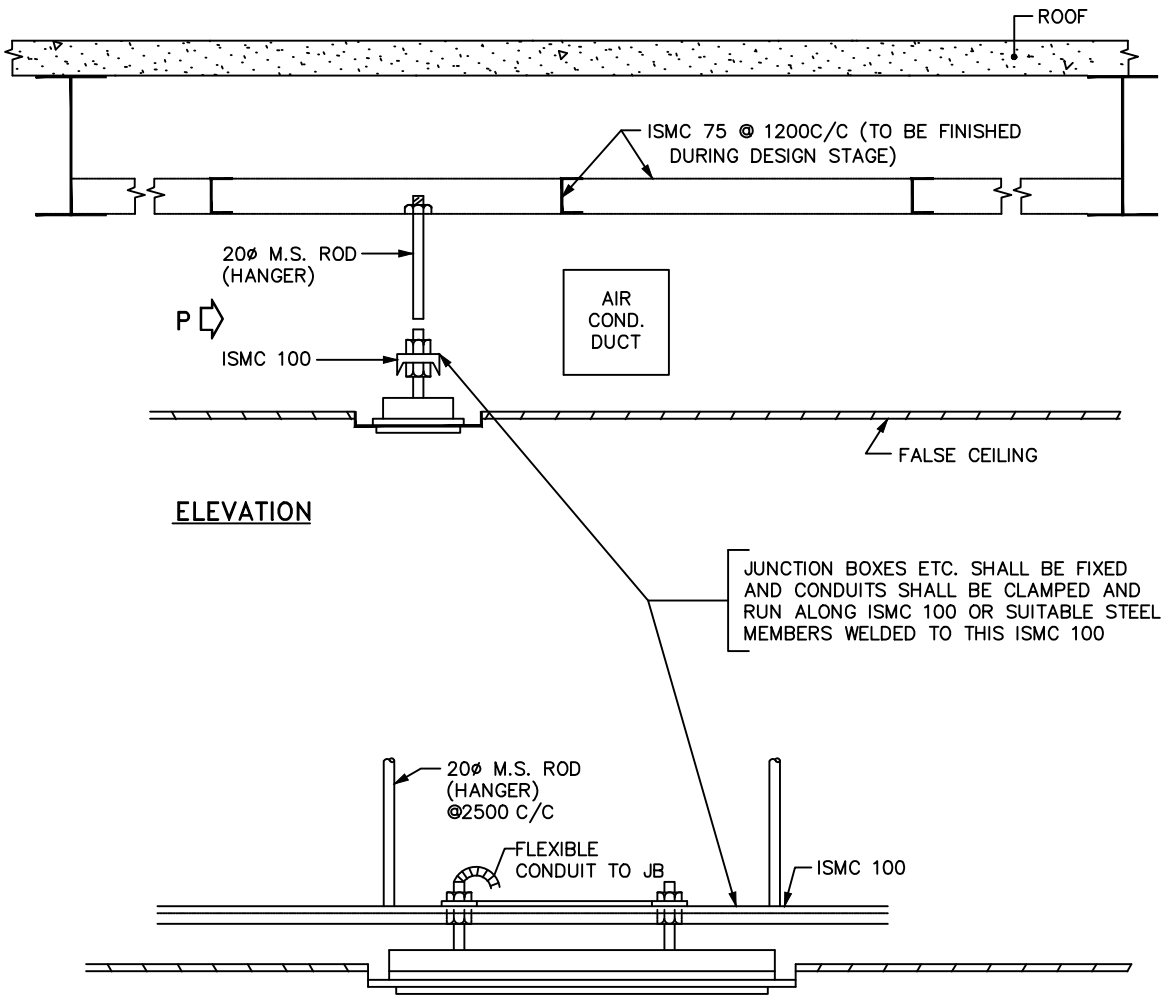
CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

DWG. NO. 14L08–DWG–E–0800 SHT. - 13 | REV. 0

File Name 14L08–DWG–E–0800

A4_DD (9–96) [210x297]



VIEW–P

RECESS MOUNTING

TYPE–DD

DECORATIVE, RECESS MOUNTED
MIRROR OPTICS LUMINAIRE WITH 2X28W TL5.
[EQ. PHILIPS TYPE TMS669/EQV.]

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS– ILLUMINATION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

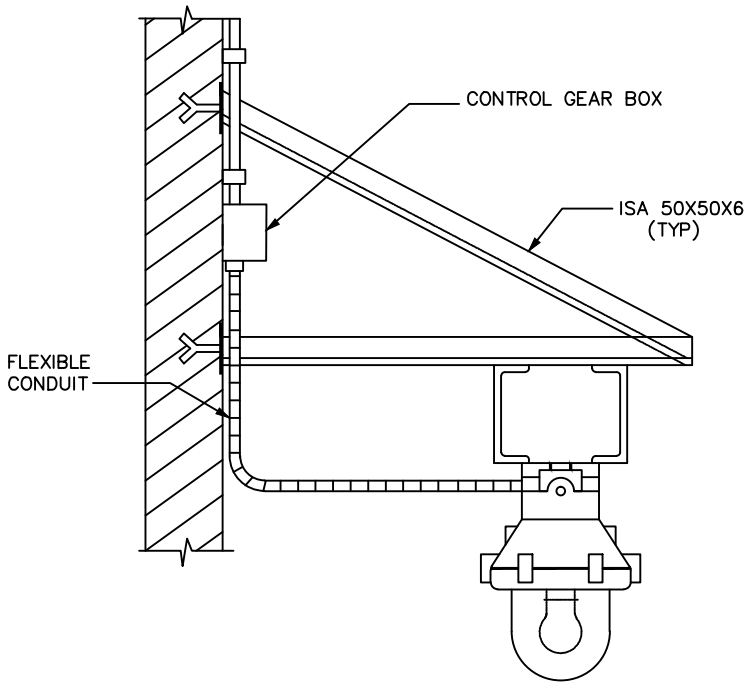
CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

DWG. NO. 14L08–DWG–E–0800 SHT. - 14 | REV. 0

File Name 14L08–DWG–E–0800

A4_DD (9–96) [210x297]



WALL MOUNTING

TYPE–MB

WELL GLASS LUMINAIRE WITH 150W HPSV
125W HPMV WITH EXTERNAL CONTROL GEAR BOX.
[EQ. PHILIPS TYPE HPK225/EQV.]

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS– ILLUMINATION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

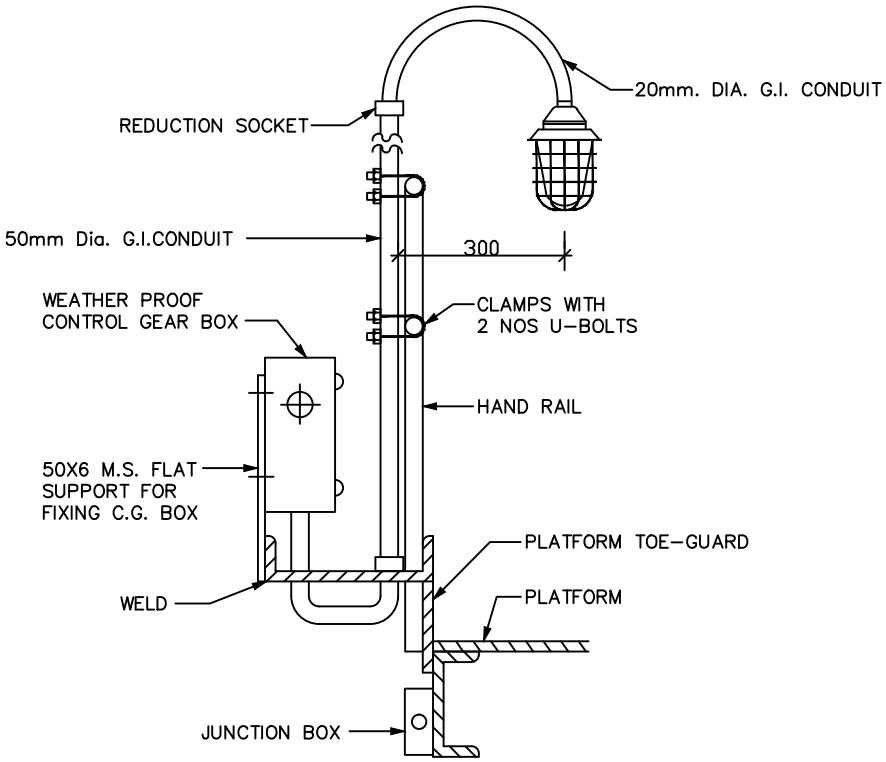
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DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

DWG. NO. 14L08–DWG–E–0800 SHT. -15 | REV. 0

File Name 14L08–DWG–E–0800

A4_DD (9–96) [210x297]



PLATFORM MOUNTING

TYPE-MB

WELL GLASS LUMINAIRE WITH 1X150W HPSV LAMP.
[EQ. PHILIPS TYPE HPK225/EQV.]

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS- ILLUMINATION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

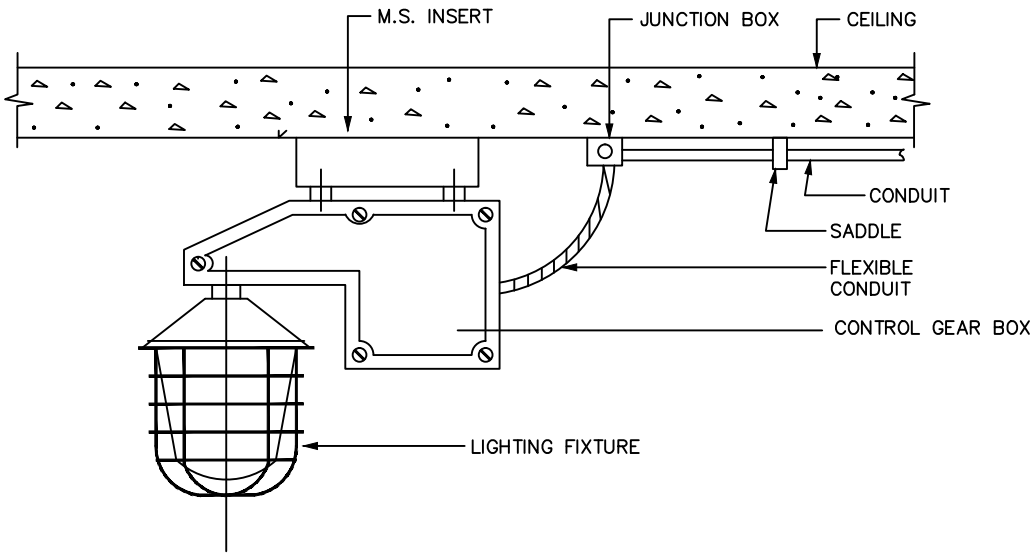
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JOB NO. 14L08 | SCALE : N.T.S

DWG. NO. 14L08-DWG-E-0800 SHT.-16 | REV. 0

File Name 14L08-DWG-E-0800

A4_DD (9-96) [210x297]



CEILING MOUNTING

TYPE–MC

WELL GLASS LUMINAIRE WITH 1X250W HPSV
[EQ. PHILIPS TYPE HPK225/EQV.]

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS– ILLUMINATION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

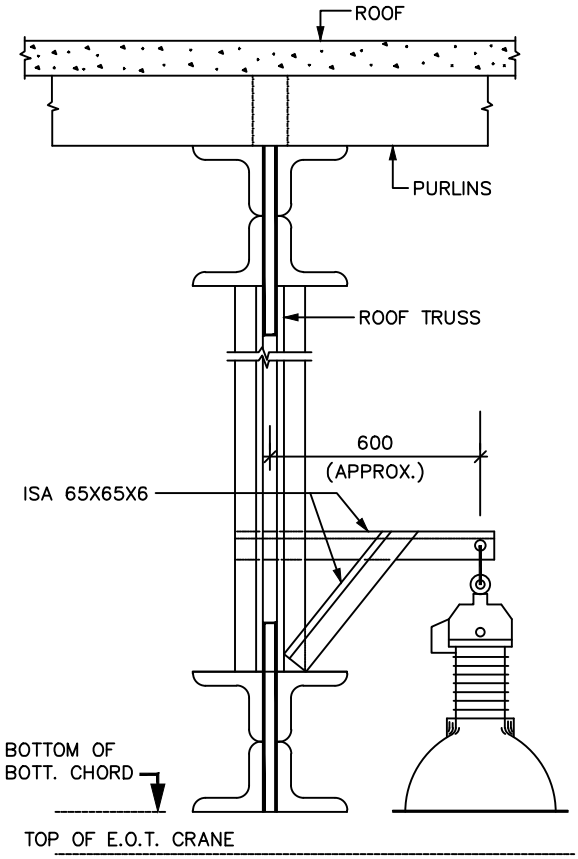
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JOB NO. 14L08 | SCALE : N.T.S

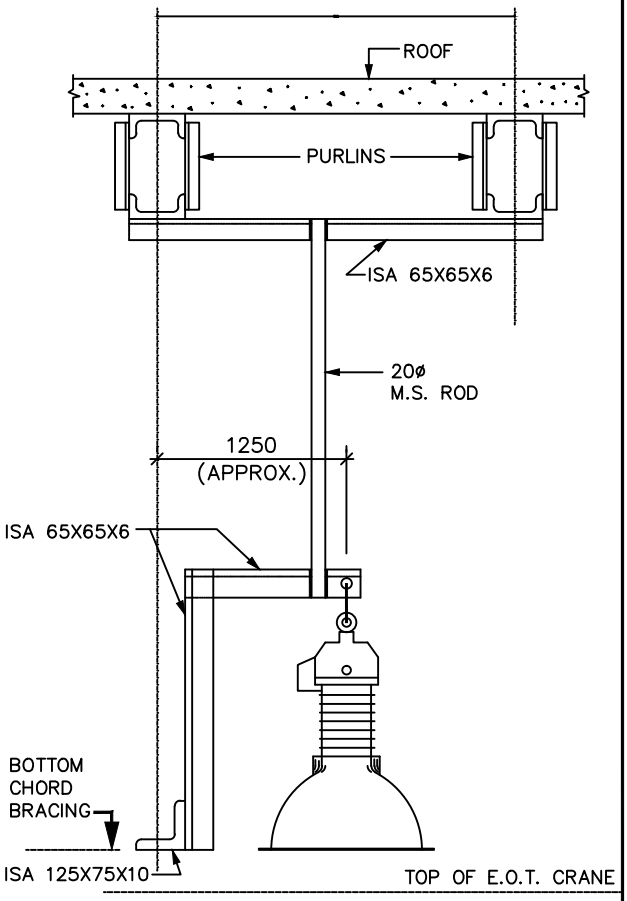
DWG. NO. 14L08–DWG–E–0800 SHT. -17 | REV. 0

File Name 14L08–DWG–E–0800

A4_DD (9–96) [210x297]



FIXING ARRANGEMENT
FROM ROOF TRUSS



FIXING ARRANGEMENT FROM
BOTTOM CHORD BRACING

TYPICAL FIXING ARRGT. IN POWER HOUSE FROM ROOF OF T.G. HALL TYPE–MC/MD

HIGH PERFORMANCE HIGH BAY AND MEDIUM BAY LUMINAIRE
WITH HPSV LAMPS (150 TO 400W)
[EQ. PHILIPS TYPE HPK 225]

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS– ILLUMINATION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

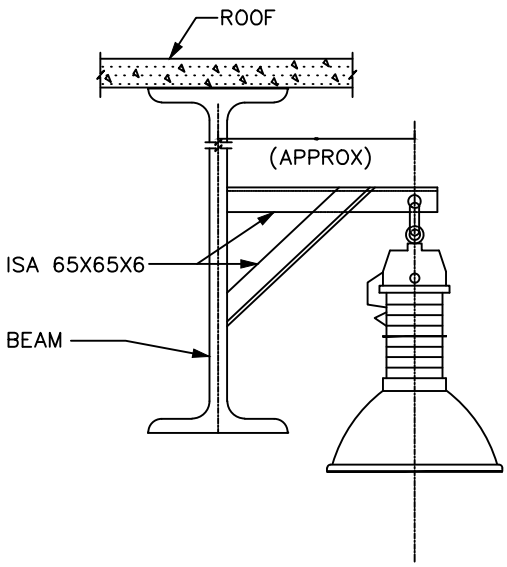
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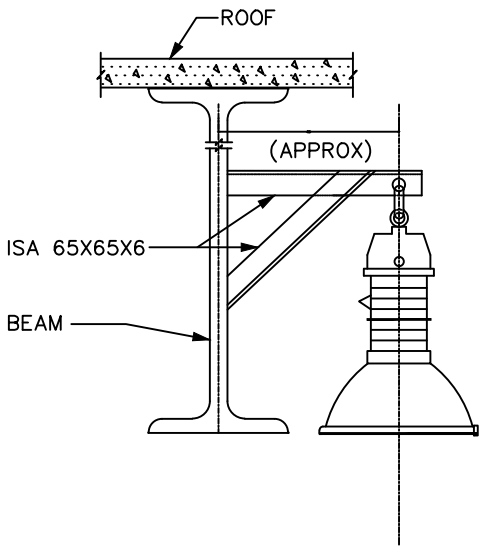
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DWG. NO. 14L08–DWG–E–0800 SHT. - 18 | REV. 0

File Name 14L08–DWG–E–0800

A4_DD (9–96) [210x297]





FIXTURE TYPE–MB/MC/MD

TYPICAL FIXING ARRGT. FROM BEAM

(IN AREA OTHER THAN POWER HOUSE T.G. HALL)

HIGH PERFORMANCE HIGH BAY AND MEDIUM BAY LUMINAIRE WITH HPSV LAMPS (150 TO 400W)
[EQ. PHILIPS TYPE HPK 225]

NOTE:

BOTTOM OF FIXTURE ELEVATION SHALL BE FLUSH WITH OR BELOW BOTTOM OF BEAM ELEVATION DEPENDING ON THE BOTTOM OF FIXTURE ELEVATION AND THE ASSOCIATED BEAM SIZE, IN ANY CASE BOTTOM OF FIXTURE ELEVATION SHALL NOT BE ABOVE THE ASSOCITED BOTTOM OF BEAM ELEVATION.

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS– ILLUMINATION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
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JOB NO. 14L08 | SCALE : N.T.S

DWG. NO. 14L08–DWG–E–0800 SHT. - 19 | REV. 0

File Name 14L08–DWG–E–0800

A4_DD (9–96) [210x297]

1. The electrical installation work shall met the requirements of Indian Electricity Rules, relevant IS codes of practice and safety codes, as ammended upto date. In addition, other rules or regulations as applicable to the work shall be followed.

2. These lighting notes and details shall be read and construed in conjunction with the Illumination Layout and drawings.

3. Except specifically approved by site office, installation of exposed conduits, mounting of lighting fixtures etc. shall be taken up only after all other services such as Piping, Air Ducting, Cable Tray/Busduct Hanger, Structural Bracings etc. in a particular area have been installed.

4. Unless otherwise shown, the mounting heights of lighting fixtures and accessories shall be generally as follows :

a)	i) Low-Bay Lighting Fixtures in general indoor Areas of Industrial plants.	:	3500 mm from bottom to finished floor
	ii) Medium Bay Type Fixtures.	:	3500 to less than 8000 mm from bottom to finished floor
	iii) High Bay Type Fixtures	:	8000 mm and above from Bottom to finished floor
	iv) General indoor lighting for residential, commercial area	:	2700 mm from bottom to finished floor
b)	Lights over door Openings	:	300 mm bottom of Fixture Above top of opening
c)	In Boiler Platform/Platform around reactor column, reformer, cracker etc.	:	Pendant below Boiler Platforms or with Brackets from Hand-Rail 2000mm above platform.
d)	Receptacles -		
	i) In control room/office	:	450 mm from finished floor to centre
	ii) Elsewhere	:	900 mm from finished floor to centre
e)	Local Switches	:	1500 mm from finished floor to centre
f)	Lighting Panels	:	1800 mm from finished floor to center
f)	Ceiling Fans	:	200 mm above lighting fixtures

5. Unless otherwise noted, lighting fixtures shall be fed from respective lighting panels. Normal AC lighting panels will be fed from Main lighting distribution boards (MLDB). Emergency AC lighting panels will be fed from Emergency Main lighting Distribution Boards (EMLDB). DC Emergency Lighting Distribution Boards (DCELDB) will be fed from Main DC Distribution Boards.

6. All outdoor lighting poles / towers shall be provided with fuse / MCBs at their base while receiving incoming cable.

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS- ILLUMINATION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

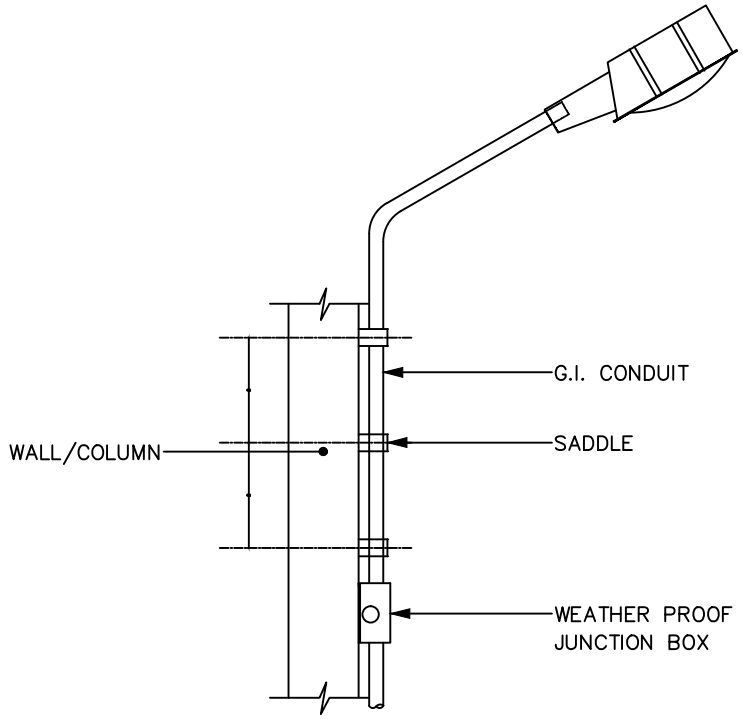
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JOB NO. 14L08 | SCALE : N.T.S

DWG. NO. 14L08-DWG-E-0800 SHT.-02 | REV. 0

File Name 14L08-DWG-E-0800

A4_DD (9-96) [210x297]



MOUNTED IN BUILDING WALL/COLUMN

TYPE–TA/TB

ROAD LIGHTING LUMINAIRE WITH HPSV
150/250W
[EQ. PHILIPS TYPE SGP325/EQV.]

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS– ILLUMINATION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

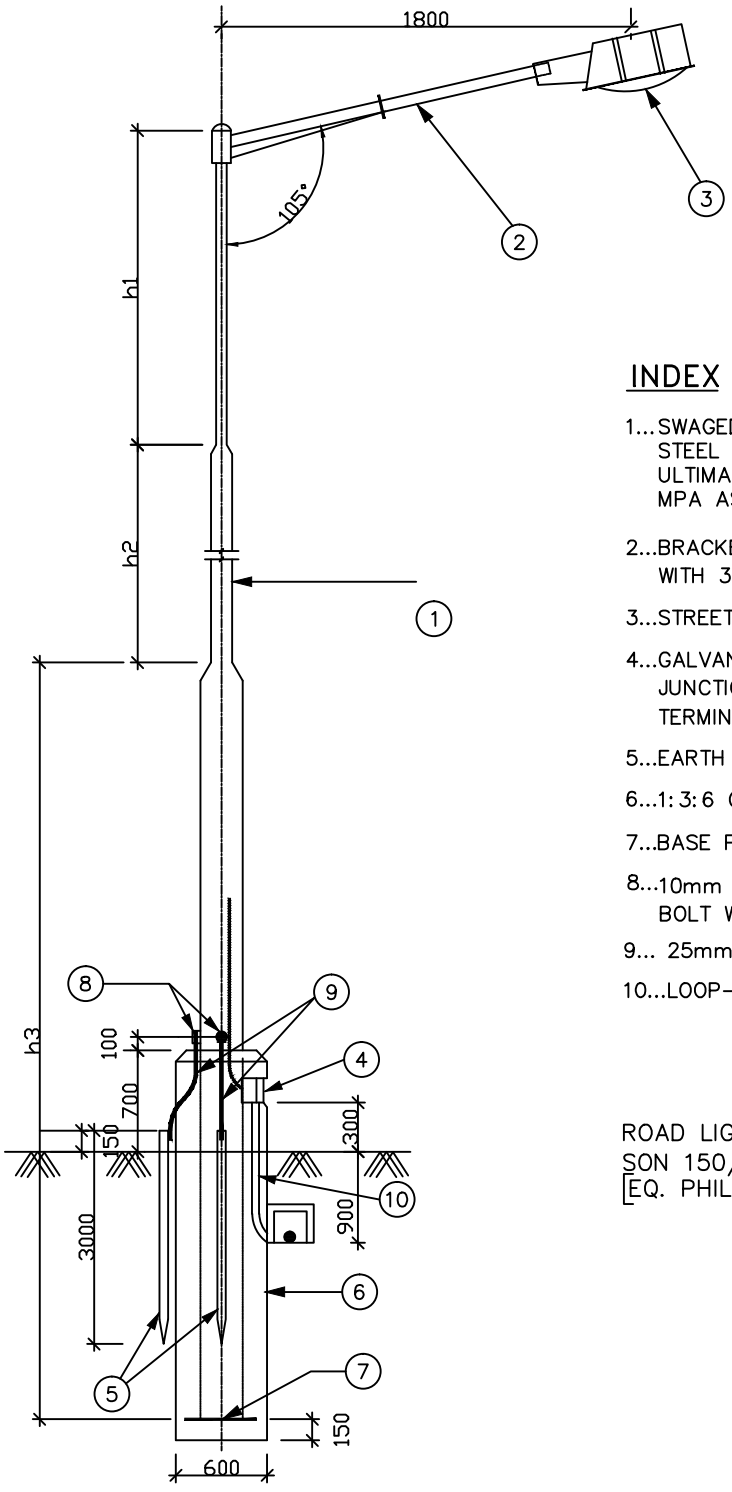
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JOB NO. 14L08 | SCALE : N.T.S

DWG. NO. 14L08–DWG–E–0800 SHT. -20 | REV. 0

File Name 14L08–DWG–E–0800

A4_DD (9–96) [210x297]



INDEX

1...SWAGED AND WELDED GALVANISED STEEL POLE MADE FROM STEEL OF ULTIMATE TENSILE STRENGTH 540 MPA AS PER IS 2713 PART–III.

2...BRACKET ARM OF 50MM. DIA. PIPE WITH 3.65MM. WALL THICKNESS.

3...STREET LIGHTING FIXTURE.

4...GALVANISED LOOP–IN LOOP–OUT JUNCTION BOX WITH SP MCB, TERMINAL BLOCK.

5...EARTH ELECTRODE.

6...1:3:6 CEMENT CONCRETE SQ. FOOTING.

7...BASE PLATE.

8...10mm DIA. GALVANISED M.S. EARTHING BOLT WITH WASHER.

9... 25mm X 3mm G.S. FLAT.

10...LOOP–IN LOOP–OUT GI PIPES.

ROAD LIGHTING LUMINAIRE WITH HPSV SON 150/250W LAMP.
[EQ. PHILIPS TYPE SGP325/EQV.]

SWAGED AND WELDED POLE WITH SINGLE ARM TYPE–TA/TB

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS– ILLUMINATION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

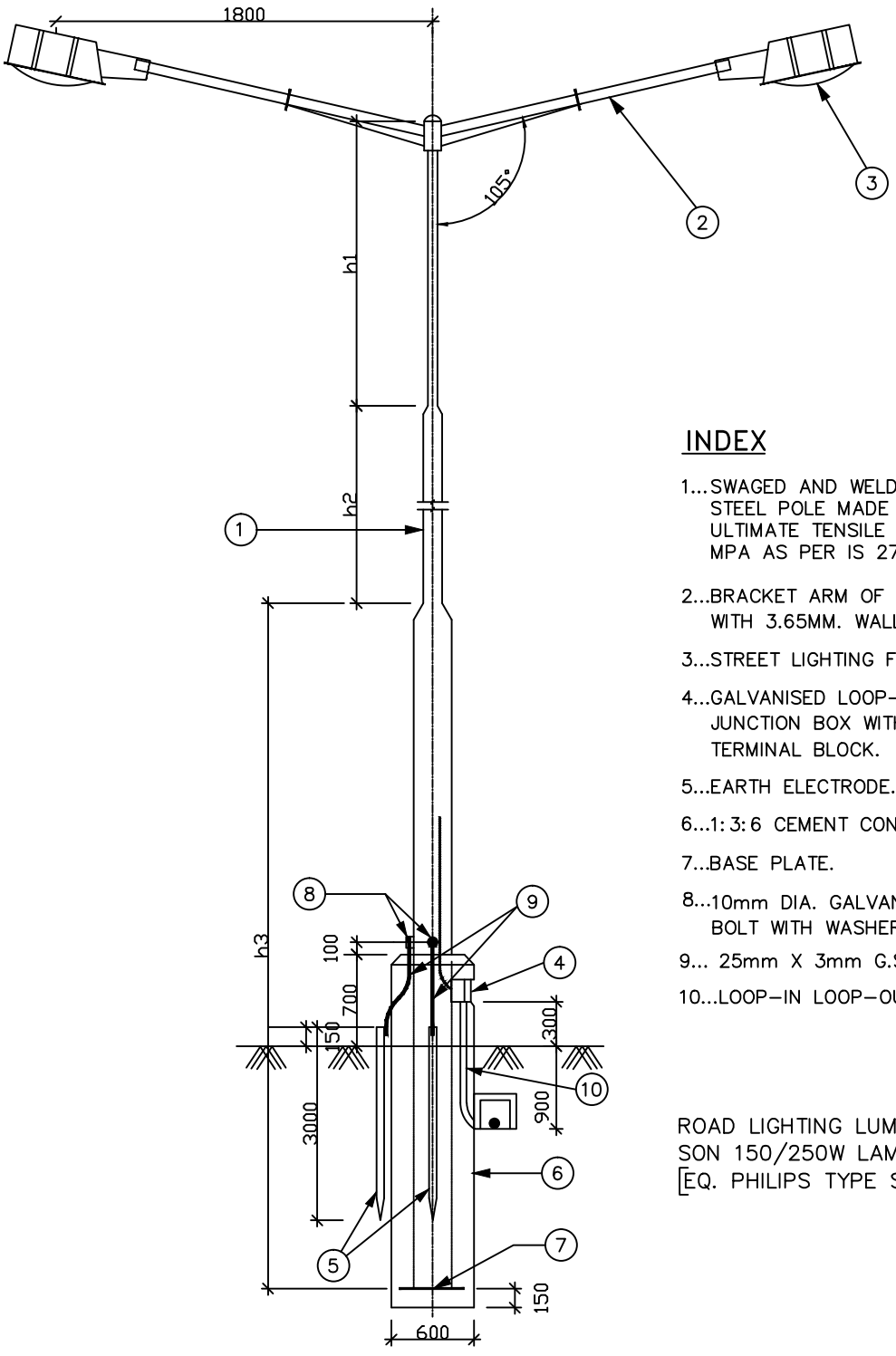
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JOB NO. 14L08 | SCALE : N.T.S

DWG. NO. 14L08–DWG–E–0800 SHT.-21 | REV. 0

File Name 14L08–DWG–E–0800

A4_DD (9–96) [210x297]



INDEX

1...SWAGED AND WELDED GALVANISED STEEL POLE MADE FROM STEEL OF ULTIMATE TENSILE STRENGTH 540 MPA AS PER IS 2713 PART–III.

2...BRACKET ARM OF 50MM. DIA. PIPE WITH 3.65MM. WALL THICKNESS.

3...STREET LIGHTING FIXTURE.

4...GALVANISED LOOP–IN LOOP–OUT JUNCTION BOX WITH SP MCB, TERMINAL BLOCK.

5...EARTH ELECTRODE.

6...1:3:6 CEMENT CONCRETE SQ. FOOTING.

7...BASE PLATE.

8...10mm DIA. GALVANISED M.S. EARTHING BOLT WITH WASHER.

9... 25mm X 3mm G.S. FLAT.

10...LOOP–IN LOOP–OUT GI PIPES.

ROAD LIGHTING LUMINAIRE WITH HPSV SON 150/250W LAMP.
[EQ. PHILIPS TYPE SGP325/EQV.]

SWAGED AND WELDED POLE WITH DOUBLE ARM

TYPE–TA/TB

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS– ILLUMINATION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

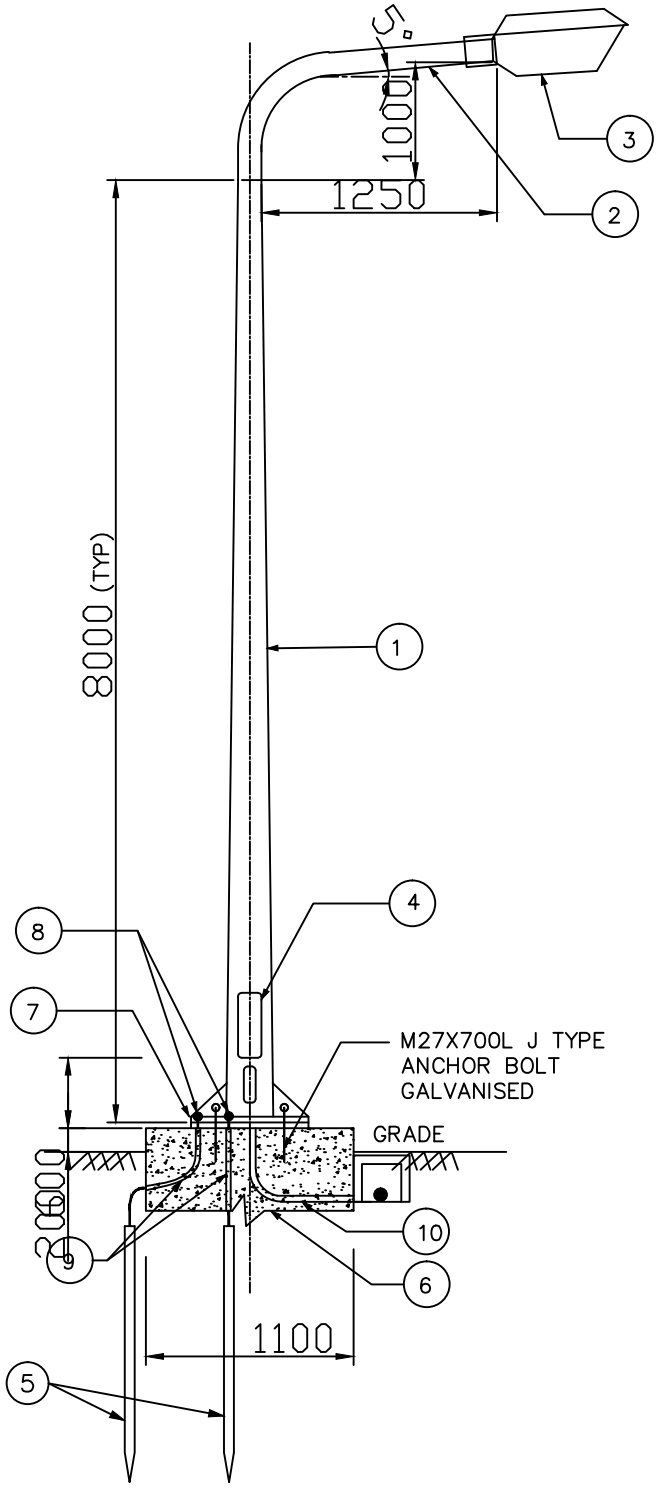
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DWG. NO. 14L08–DWG–E–0800 SHT.-22 | REV. 0

File Name 14L08–DWG–E–0800

A4_DD (9–96) [210x297]



POLYGONAL SINGLE PIECE POLE

TYPE–TA/TB

INDEX

1... SINGLE PIECE MS GALVANISED STRUCTURE CONTINUOUSLY TAPERED POLYGONAL CROSS SECTION LIGHT POLE AS PER BS 5649.

2... BRACKET ARM OF 50MM. DIA. PIPE WITH 3.65MM. WALL THICKNESS.

3... STREET LIGHTING FIXTURE.

4... 550 X 200 HINGED DOOR OPENING FOR SP MCB, TERMINAL BLOCK.

5... EARTH SPRIKE.

6... 1:3:6 CEMENT CONCRETE SQ. FOOTING.

7... 450 X 450 BASE PLATE.

8... 10mm DIA. GALVANISED M.S. EARTHING BOLT WITH WASHER.

9... 8 SWG GI WIRE THROUGH 25ø GI CONDUIT.

10... LOOP–IN LOOP–OUT GI PIPES.

ROAD LIGHTING LUMINAIRE WITH HPSV SON 150/250W LAMP.
[EQ. PHILIPS TYPE SGP325/EQV.]

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS– ILLUMINATION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

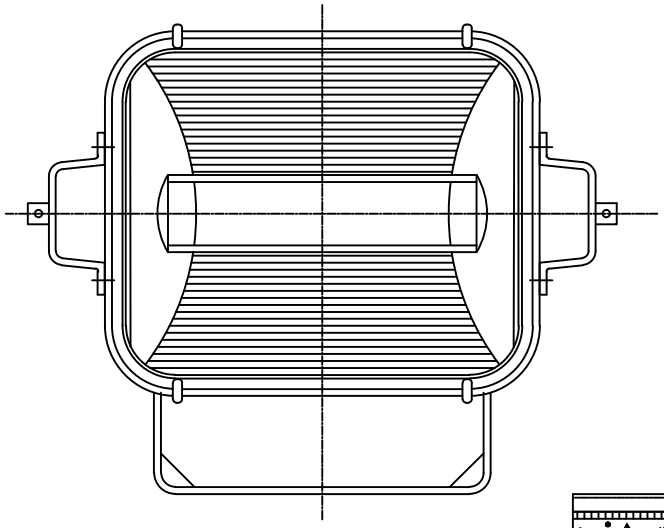
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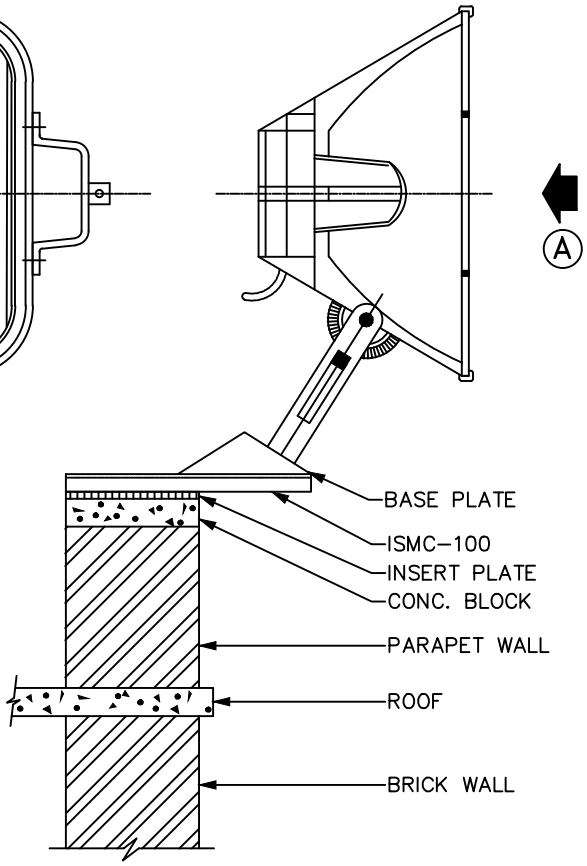
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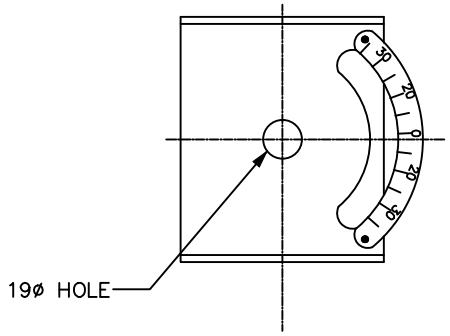


VIEW–A



TYPICAL MOUNTING ARRANGEMENT OF FLOOD LIGHT FIXTURE ON THE ROOF

TYPE–PC/PD/BC/BD



BASE PLATE

COMPACT. STURDY NON–INTEGRAL HIGH PERFORMANCE FLOOD LIGHT LUMINAIRE WITH HPSV 2XSON–T 250W/400W OR METAL HALIDE 2XHPI–T 250W/400W LAMP.
[EQ. PHILIPS TYPE RVP 302/EQV.]

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS– ILLUMINATION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

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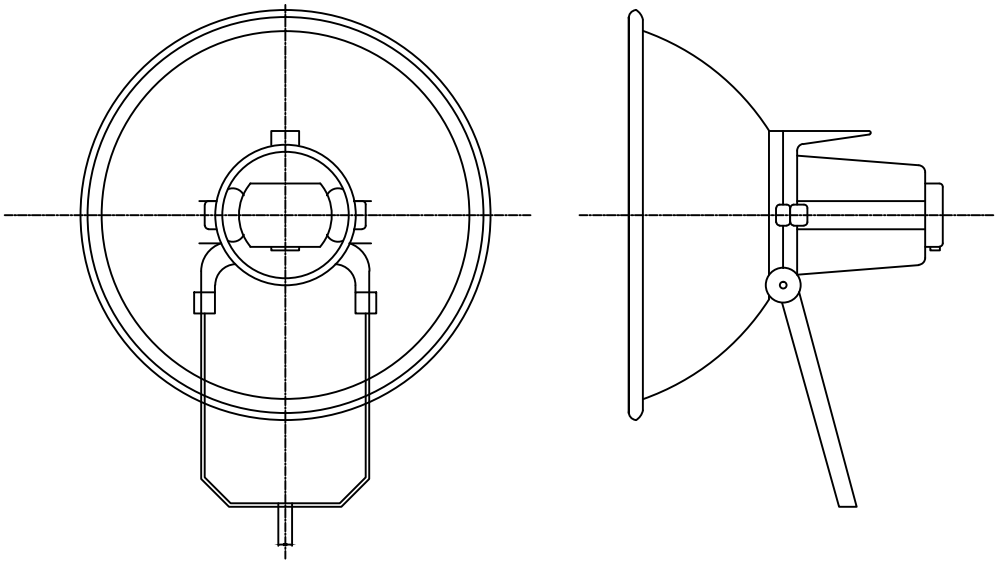
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DWG. NO. 14L08–DWG–E–0800 | REV. 0

SHT. -24

File Name 14L08–DWG–E–0800

A4_DD (9–96) [210x297]



TYPE– PD/BD

FLOOD LIGHT SUITABLE FOR USE WITH HPSV
UPTO 400W & METAL HALIDE UPTO 400W LAMPS.
[EQ. PHILIPS TYPE RVP302/EQV.]

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS– ILLUMINATION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

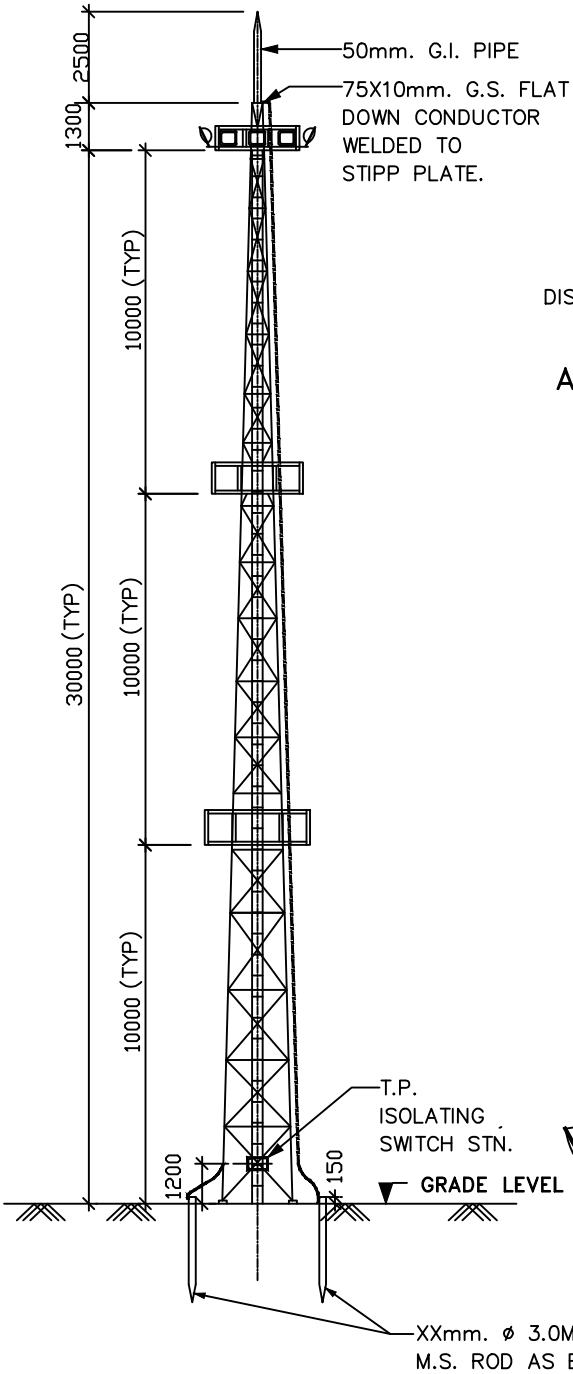
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CONSULTING ENGINEERS

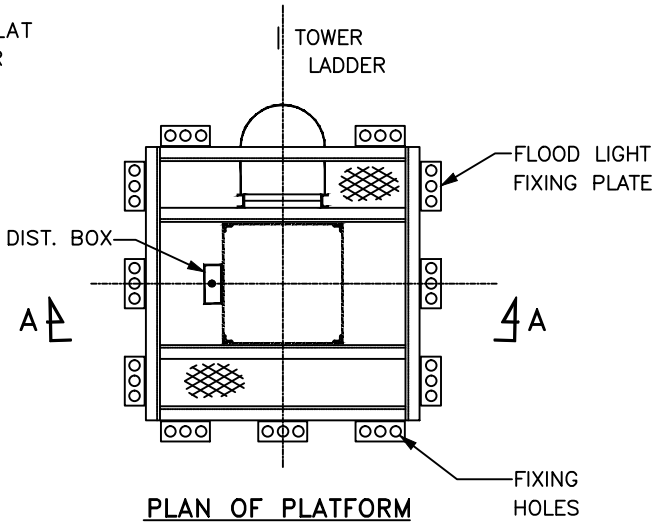
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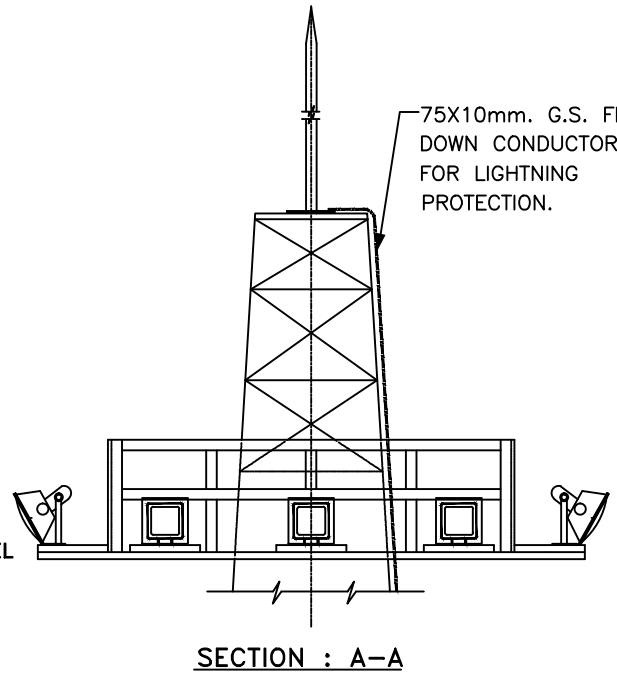
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A4_DD (9–96) [210x297]





PLAN OF PLATFORM



SECTION : A–A

FLOOD LIGHT TOWER ELEVATION

NOTE :

Anticlimbing features shall be provided with the stair up to 1500mm above ground level.

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS– ILLUMINATION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

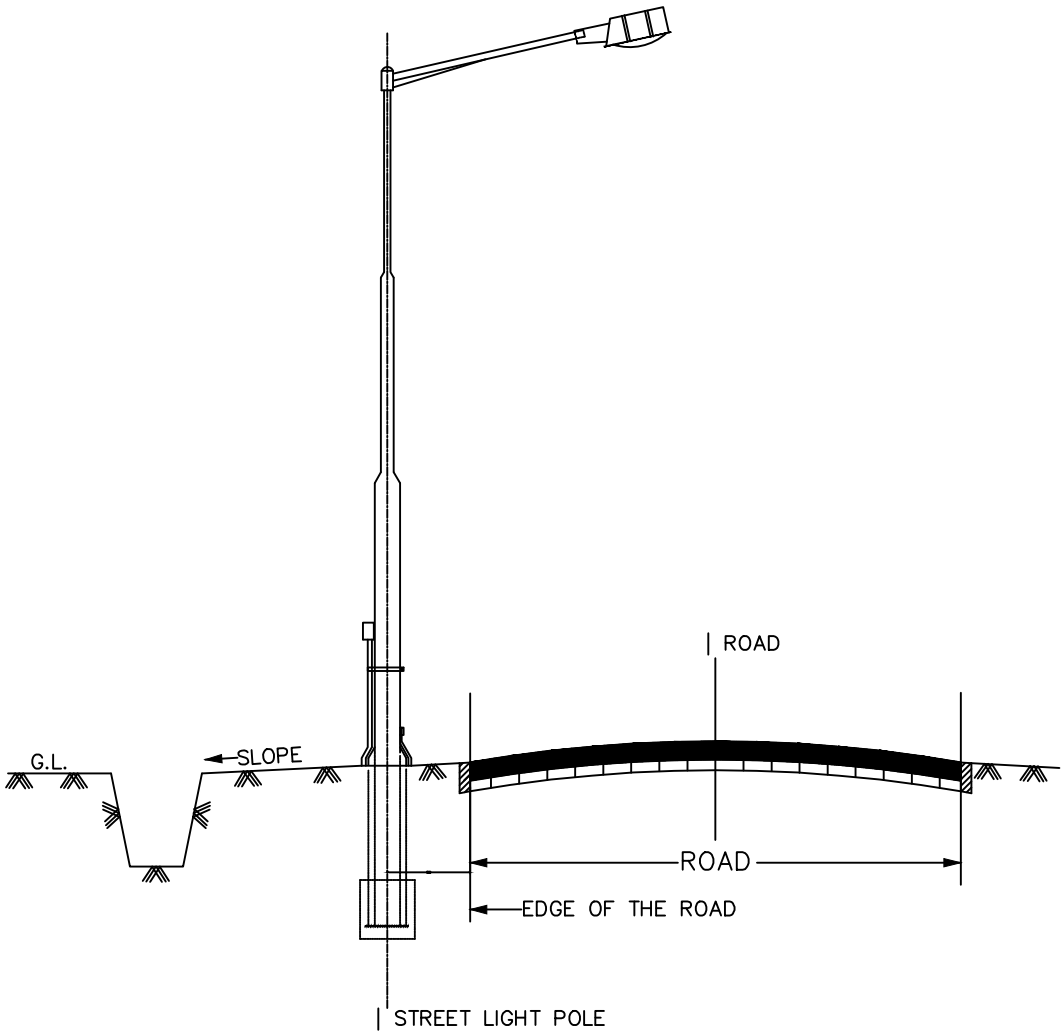
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DWG. NO. 14L08–DWG–E–0800 SHT.-26 | REV. 0

File Name 14L08–DWG–E–0800

A4_DD (9–96) [210x297]



TYPICAL ARRANGEMENT OF STREET LIGHT POLE

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS- ILLUMINATION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

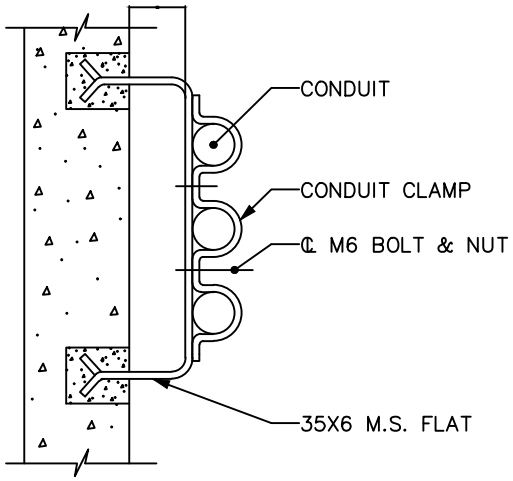
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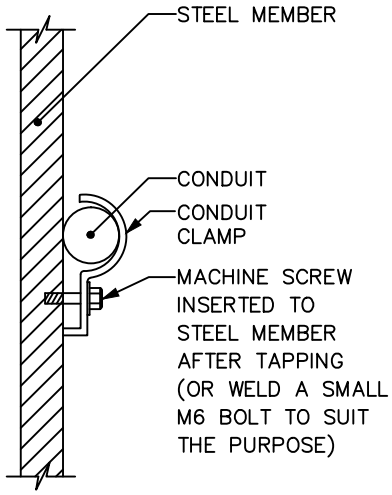
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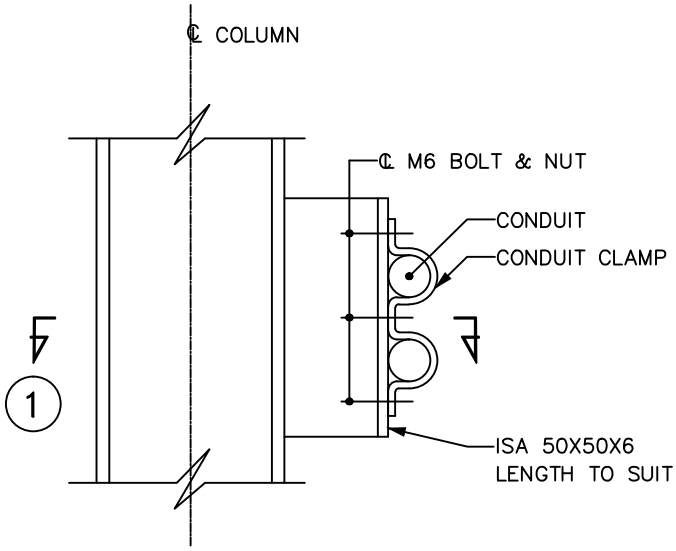
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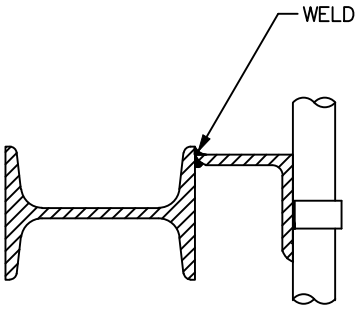
GROUP OF CONDUITS RUN
ON CONCRETE SURFACE



SINGLE CONDUIT RUN
ON STEEL MEMBER



ELEVATION



SECTION– (1)

GROUP OF CONDUIT RUN ON
STEEL MEMBER ARRANGEMENT–A

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS– ILLUMINATION

ALUMINA UNLOADING AND
TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

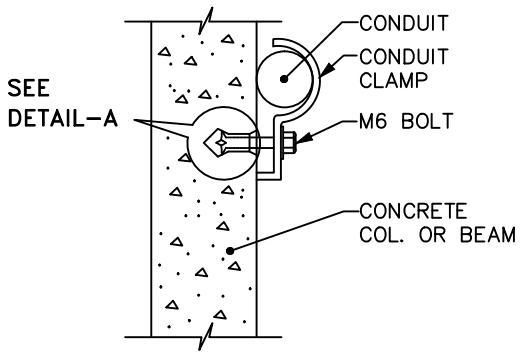
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CONSULTING ENGINEERS

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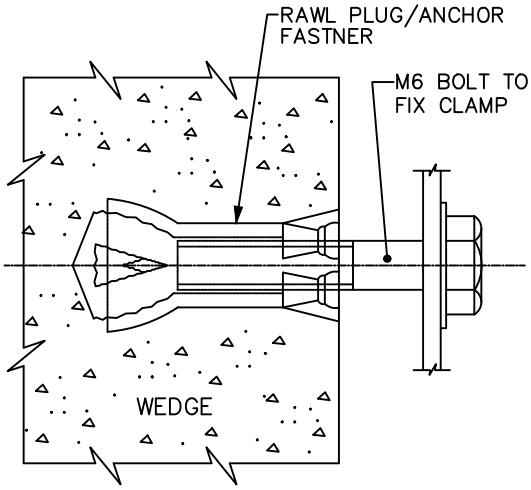
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File Name 14L08–DWG–E–0800

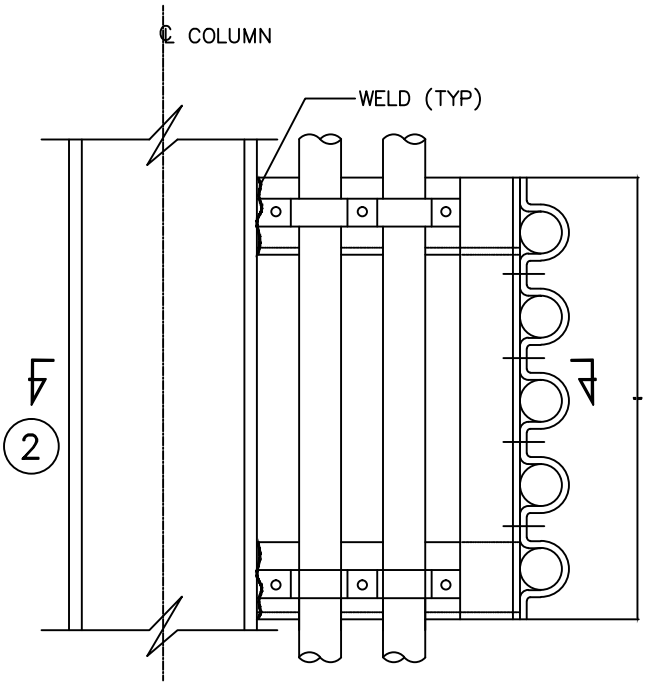
A4_DD (9–96) [210x297]



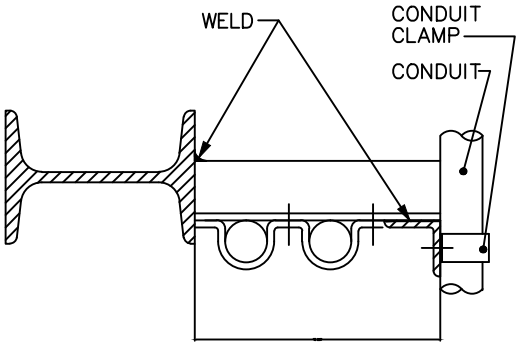
SINGLE CONDUIT RUN ON CONCRETE SURFACE



DETAIL–A



ELEVATION



SECTION–(2)

GROUP OF CONDUIT RUN ON STEEL MEMBER ARRANGEMENT–B

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS– ILLUMINATION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

DWG. NO. 14L08–DWG–E–0800 SHT.-29 | REV. 0

File Name 14L08–DWG–E–0800

A4_DD (9–96) [210x297]

7. Separate neutral wire shall be provided for each circuit. Wiring throughout the installation shall be such that there is no break in the neutral wire in the form of switch or fuse.

8. All exposed conduit runs in battery room, chemical feed station area, water treatment building etc. shall be suitably painted with electrolytic / chemical proof paints.

9. The entire metallic conduit system whether embedded or exposed, shall be electrically continuous and thoroughly grounded.

10. Lighting fixtures shall not be suspended directly from junction box in the main conduit run.

11. Separate conduits shall be used for wiring lighting circuits of different lighting distribution system such as normal AC lighting/emergency AC lighting/emergency DC lighting/ low voltage lighting.

12. A.C. and D.C. circuits shall not be run in the same conduit and junction boxes. Circuits fed from different transformers and different batteries (D.C. Source) shall not be run through same conduit and junction boxes.

13. Receptacle circuits shall be kept separate and distinct from lighting and fan circuits.

14. Wires/cable shall be spliced only at junction boxes with ring-tongue lugs or approved equal.

15. For cable/wire numbering, PVC sleeve with cable/wire Tag number of different colour code shall be used.

16. For roads/outdoor areas, main runs from street/area lighting panels shall be by means of AYWY/AYFY/A2XFY cables, directly buried in ground with proper protection as per details shown or through duct bank.

17. When buried cables cross road/railway track, additional protection to be provided in form of hume/G.I. Pipe/HDPE pipes. GI pipes / Hume pipes shall not be used for single core cable run.

18. All wiring in hazardous areas shall be carried out either with armoured cables or cables drawn in screwed solid or seamless conduit.

19. For classified hazardous areas (other than mines) having flammable gases and vapors only, all the items and accessories of illumination system shall have enclosure as approved for the hazardous area classification (Zone 0, Zone 1 and Zone 2) as per code of standard IS-5571 and 5572.

    Lamps containing free metallic sodium (e.g. low pressure sodium vapour lamps) are not permitted for use in hazardous areas.

20. In underground mines, the lighting system shall have a mid or neutral point connected with earth and the voltage shall not exceed 125 volts between phases.

    On the surface of a mine or in an open cast mine, the voltage may be raised to 250 volts, if the neutral of mid point of the system is connected with earth and the voltage between the phases does not exceed 250 volts.

    Where portable hand-lamps are used in under ground working of mine, the voltage shall not exceed 30 volts.

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS- ILLUMINATION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

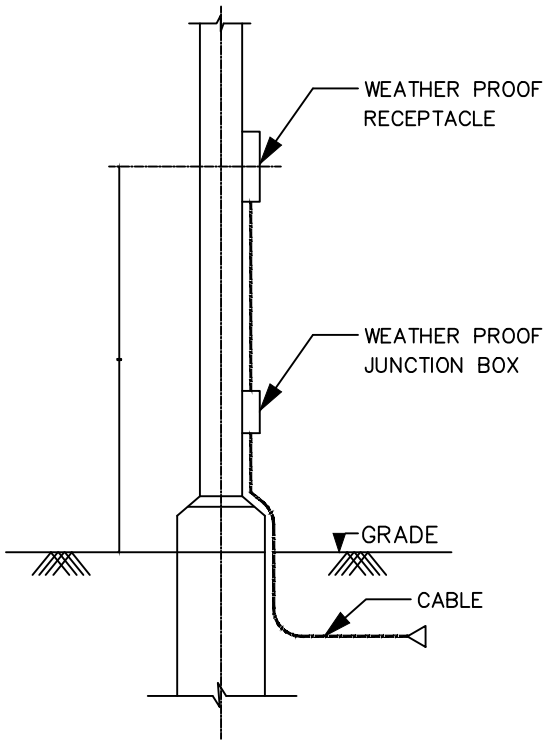
CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

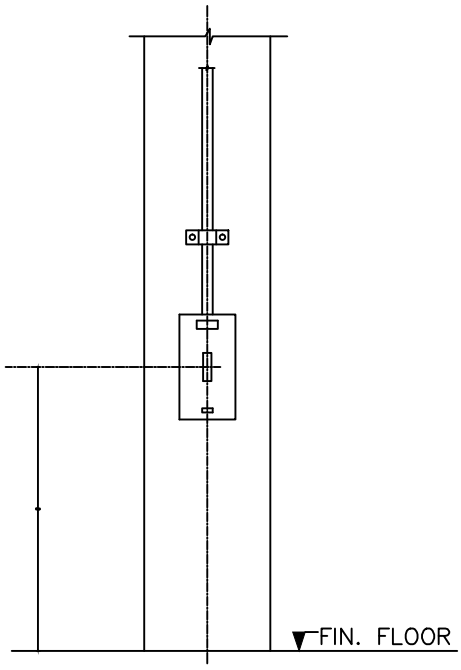
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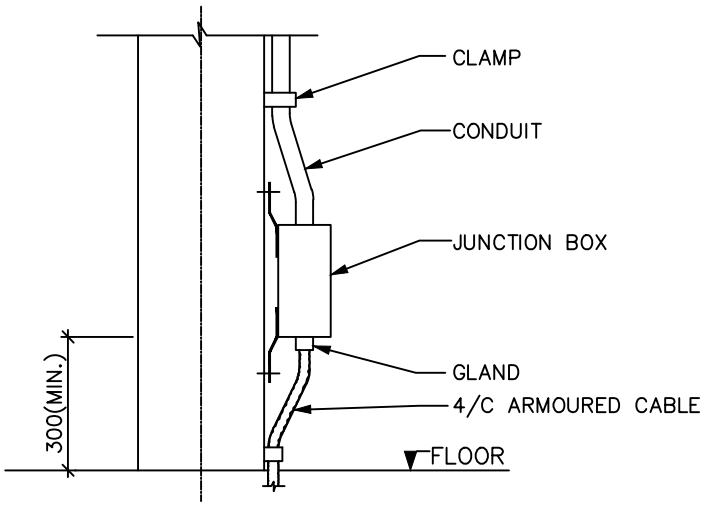
A4_DD (9-96) [210x297]



OUTDOOR RECEPTACLE



SWITCH ON COLUMN



JUNCTION BOX
MOUNTING (TYP.)

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS- ILLUMINATION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

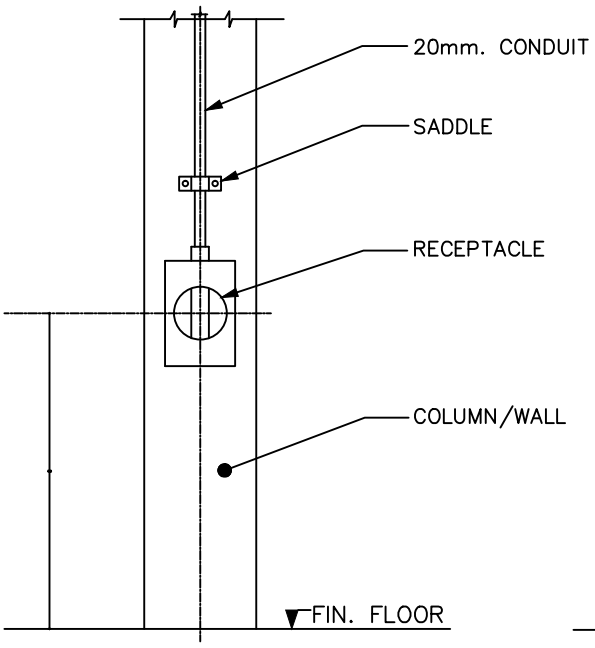
CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

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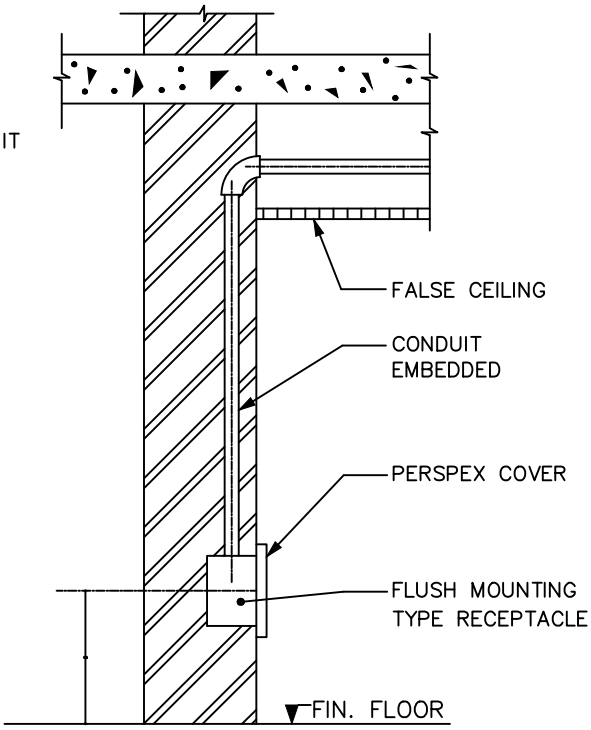
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A4_DD (9-96) [210x297]



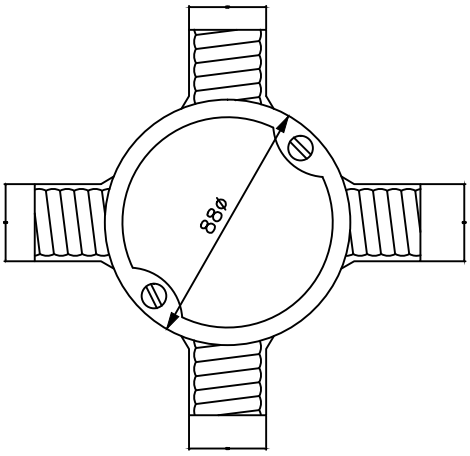
RECEPTACLE – TYPE 'RB'

(STRUTURE MOUNTING)



RECEPTACLE – TYPE 'RA'

(WALL MOUNTING)



JUNCTION BOX ROUND (TYP.)

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS– ILLUMINATION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT

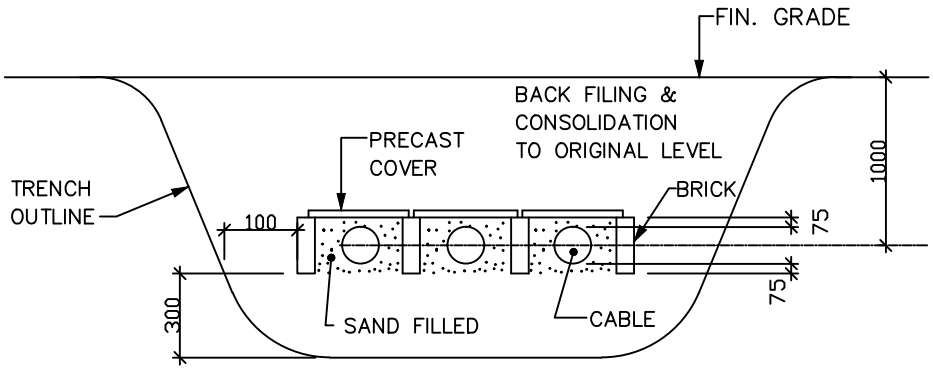
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CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

DWG. NO. 14L08–DWG–E–0800 SHT.-31 | REV. 0

File Name 14L08–DWG–E–0800

A4_DD (9–96) [210x297]



TYP. DETAIL FOR BURRIED CABLE

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS- ILLUMINATION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

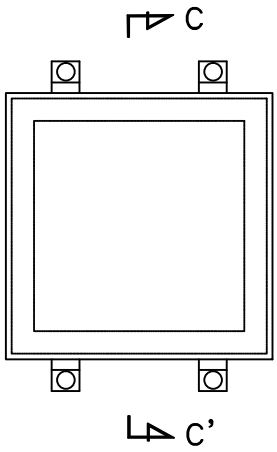
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DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

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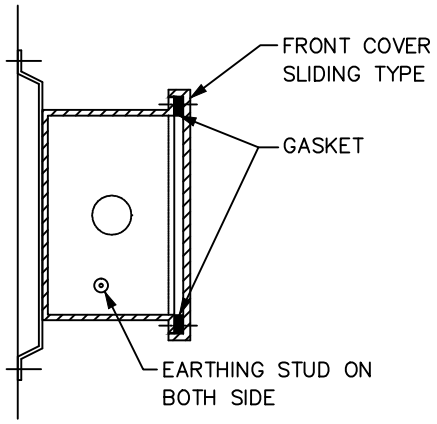
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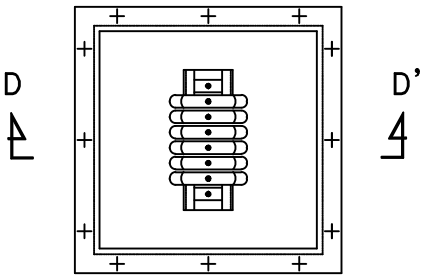
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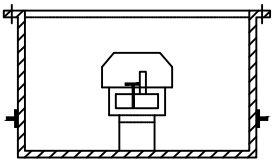
TYP. FIXING DETAIL
OF JUNCTION BOX



SECTION : C–C'



JUNCTION BOX (TYP.)
FRONT VIEW



SECTION : D–D'

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS– ILLUMINATION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

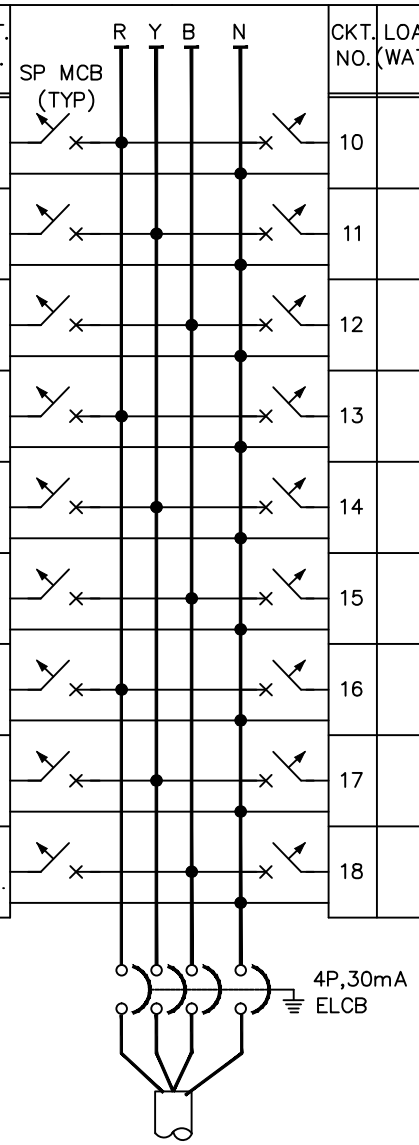
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DWG. NO. 14L08–DWG–E–0800 SHT.-33 | REV. 0

File Name 14L08–DWG–E–0800

A4_DD (9–96) [210x297]

LOCATION	NO.& TYPE OF FIXTURE	LOAD (WATT)	CKT. NO.		CKT. NO.	LOAD (WATT)	NO.& TYPE OF FIXTURE	LOCATION
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			2		11			
			3		12			
			4		13			
			5		14			
			6		15			
			7		16			
			8		17			
			9		18			



3–LINE DIAGRAM : LIGHTING PANEL

NOTES:

1. THE NUMBER OF OUTGOING FEEDERS SHALL BE DECIDED BASED ON REQUIREMENT.
2. THE MCB AND ELCB RATING SHALL BE SELECTED BASED ON APPLICATION.

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS– ILLUMINATION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

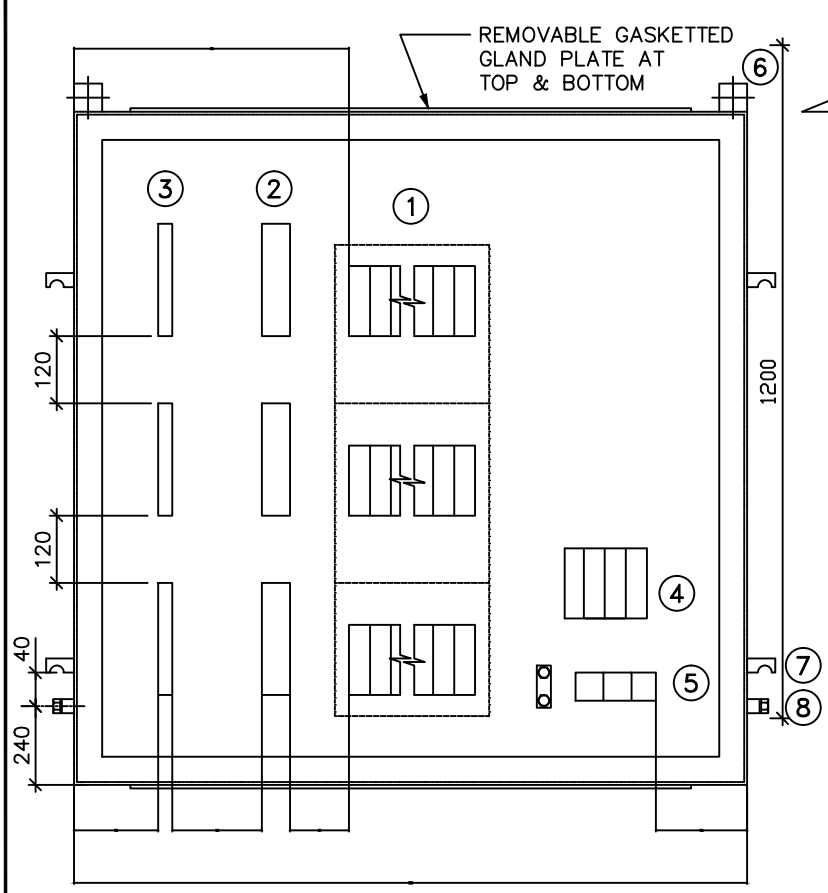
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DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

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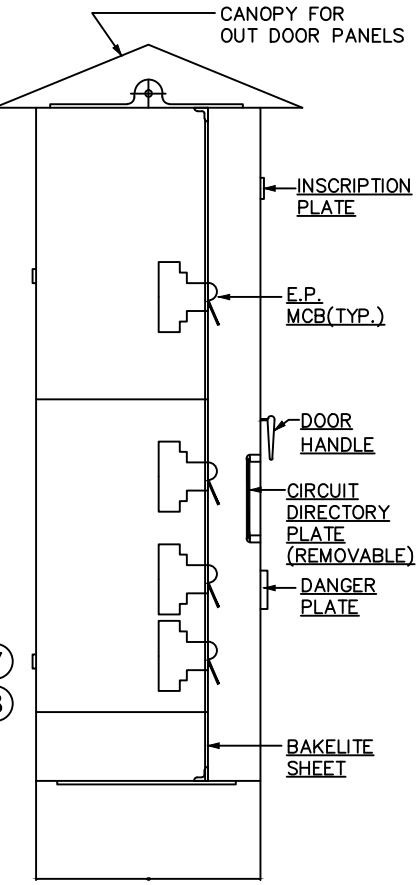
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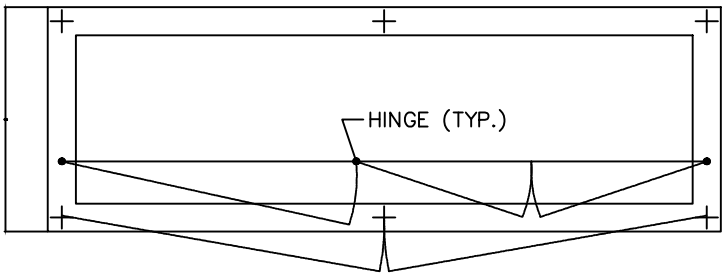
A4_DD (9–96) [210x297]



FRONT VIEW
(DOOR REMOVED)



SECTIONAL SIDE VIEW



FOUNDATION PLAN

LEGEND :

1. MINIATURE CKT. BKR.
2. PHASE TERMINALS STRIP
3. NEUTRAL BUS WITH NUT, BOLT & WASHER
4. ELCB
5. TERMINAL BLOCK
6. LIFTING LUG
7. FIXING LUG
8. EARTHING STUD WITH NUTS

GENERAL ARRANGEMENT : LIGHTING PANEL

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS- ILLUMINATION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

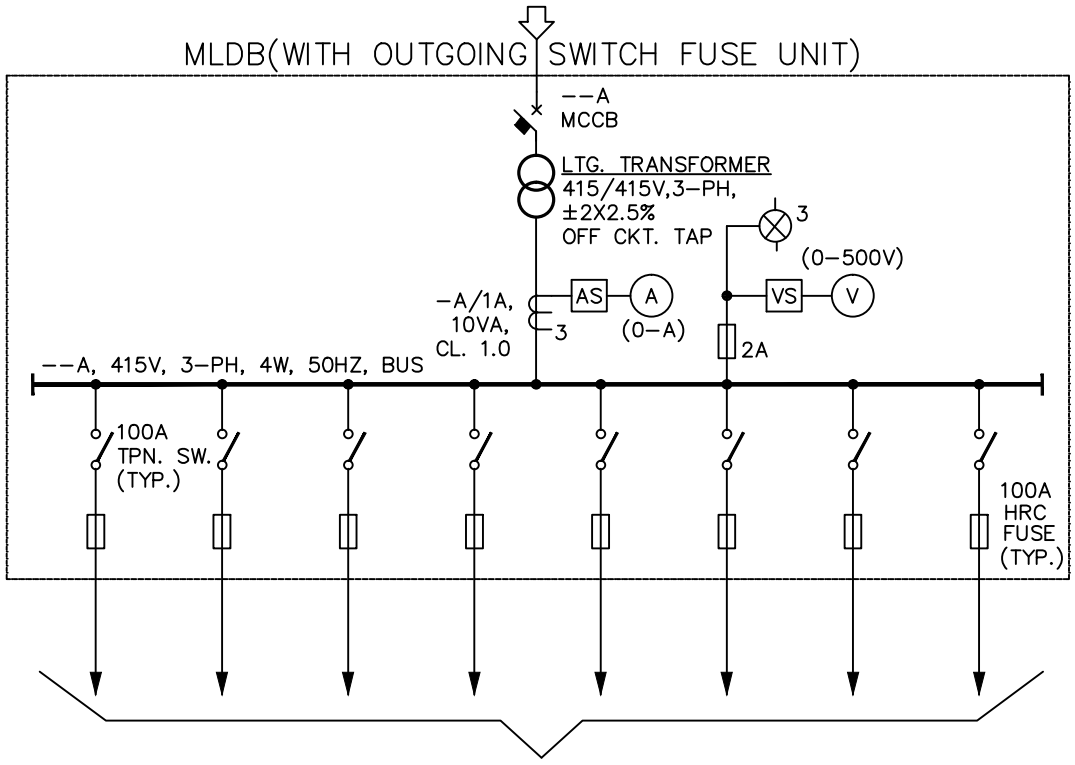
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CONSULTING ENGINEERS

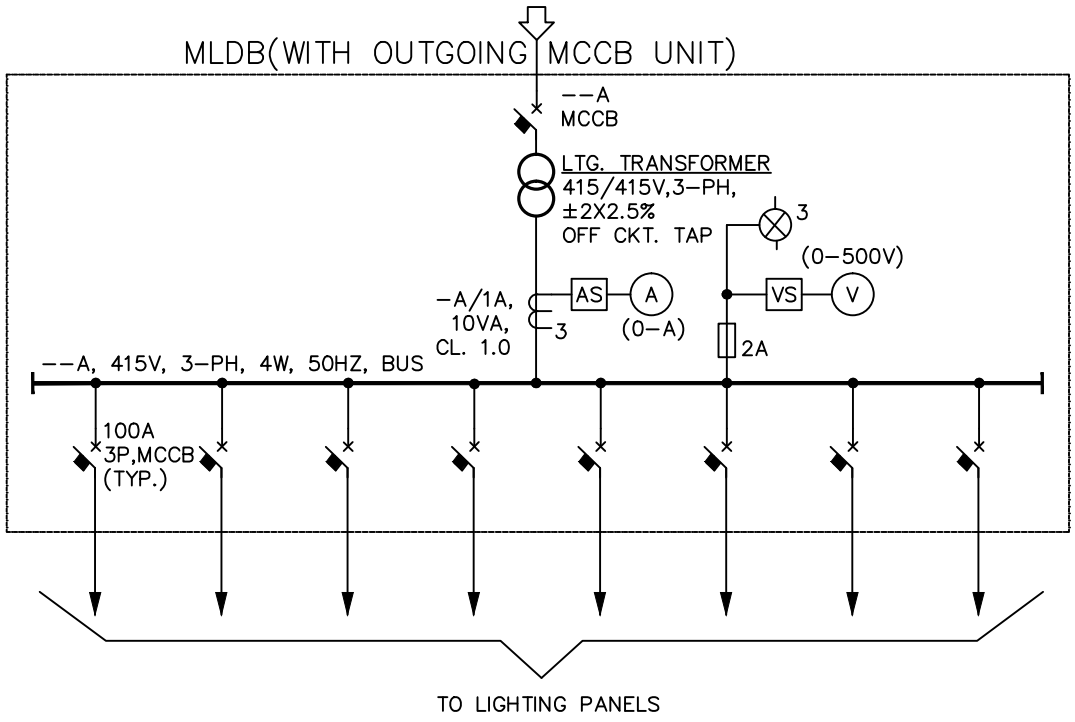
JOB NO. 14L08 | SCALE : N.T.S

DWG. NO. 14L08-DWG-E-0800 SHT.-35 | REV. 0

File Name 14L08-DWG-E-0800

A4_DD (9-96) [210x297]





SLD : MAIN LIGHTING DISTRIBUTION BOARD(MLDB)

NOTE :-

TRANSFORMER RATING AND %Z SHALL BE SO SELECTED THAT THE FAULT LEVEL SHALL BE WITHIN AVAILABLE MCB OF LIGHTING PANELS.THE BUSBAR CONTINUOUS CURRENT RATING, CT RATIO,AMMETER RANGE ETC SHALL BE SELECTED ACCORDINGLY

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS- ILLUMINATION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

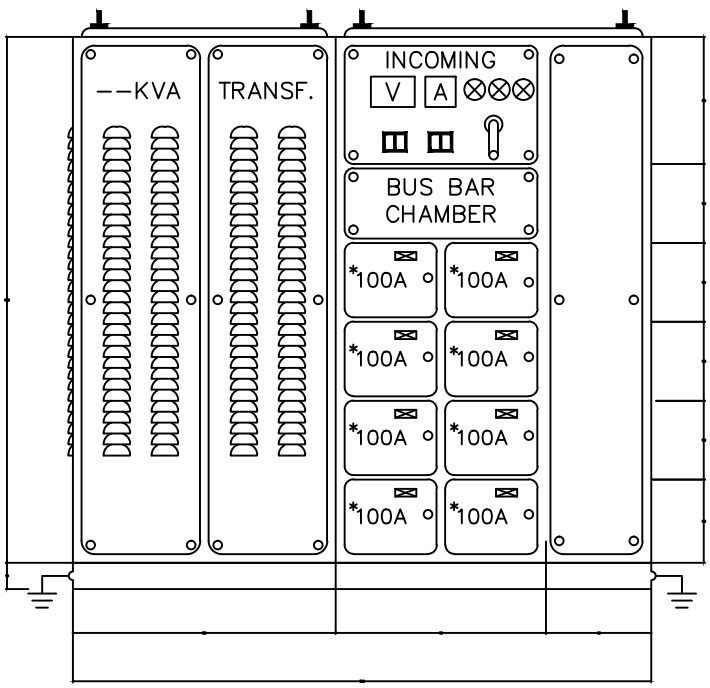
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DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

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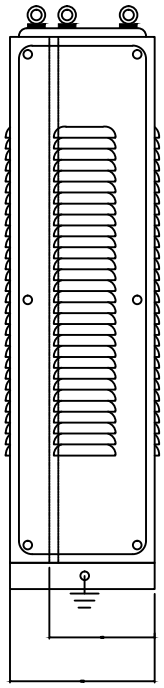
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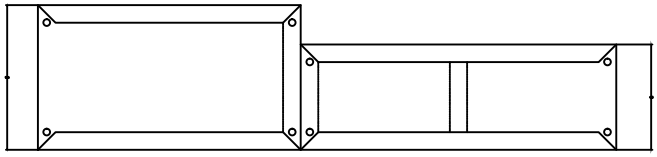
A4_DD (9-96) [210x297]



FRONT VIEW



SIDE VIEW



FOUNDATION PLAN

*TPN SWITCH FUSE/TP MCCB.

GENERAL ARRANGEMENT : MAIN LIGHTING DISTRIBUTION BOARD (MLDB)

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS- ILLUMINATION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

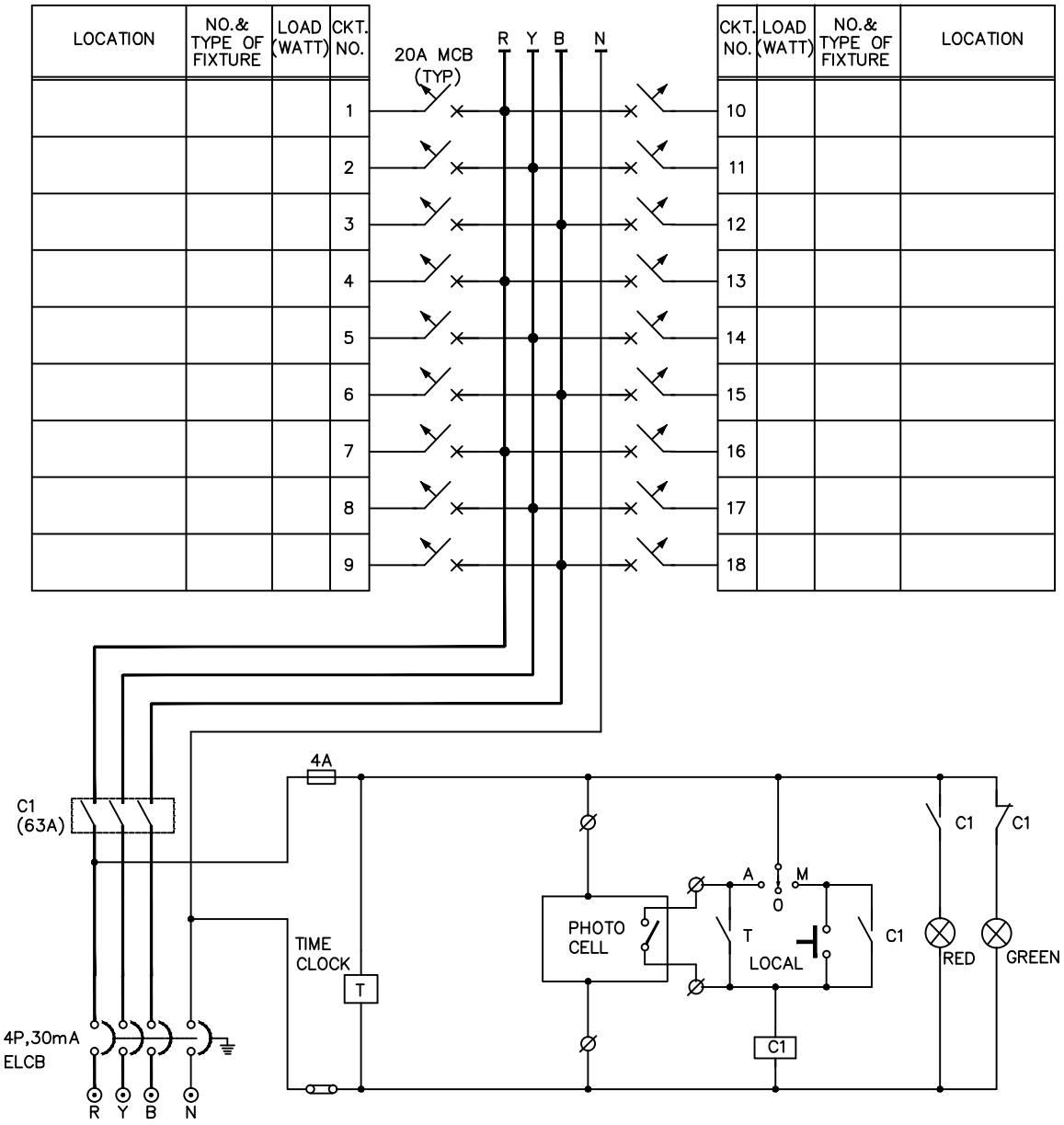
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DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

DWG. NO. 14L08-DWG-E-0800 SHT.-37 | REV. 0

File Name 14L08-DWG-E-0800

A4_DD (9-96) [210x297]



NOTES :

1. FIXTURES ON STREET LIGHTING POLES SHALL BE FED FROM THE SLPs.
2. FIXTURES ON FLOOD LIGHTING TOWERS SHALL ALSO BE FED FROM THE SLPs VIA ISOLATING SWITCH IN FLP MOUNTED AT THE BASE OF FLOOD LIGHTING TOWER.
3. SP AND 3P MCB SHALL BE USED FOR SINGLE PHASE AND 3-PHASE DISTRIBUTION RESPECTIVELY.

SCHEMATIC : STREET LIGHT PANELS (SLP)

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS- ILLUMINATION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

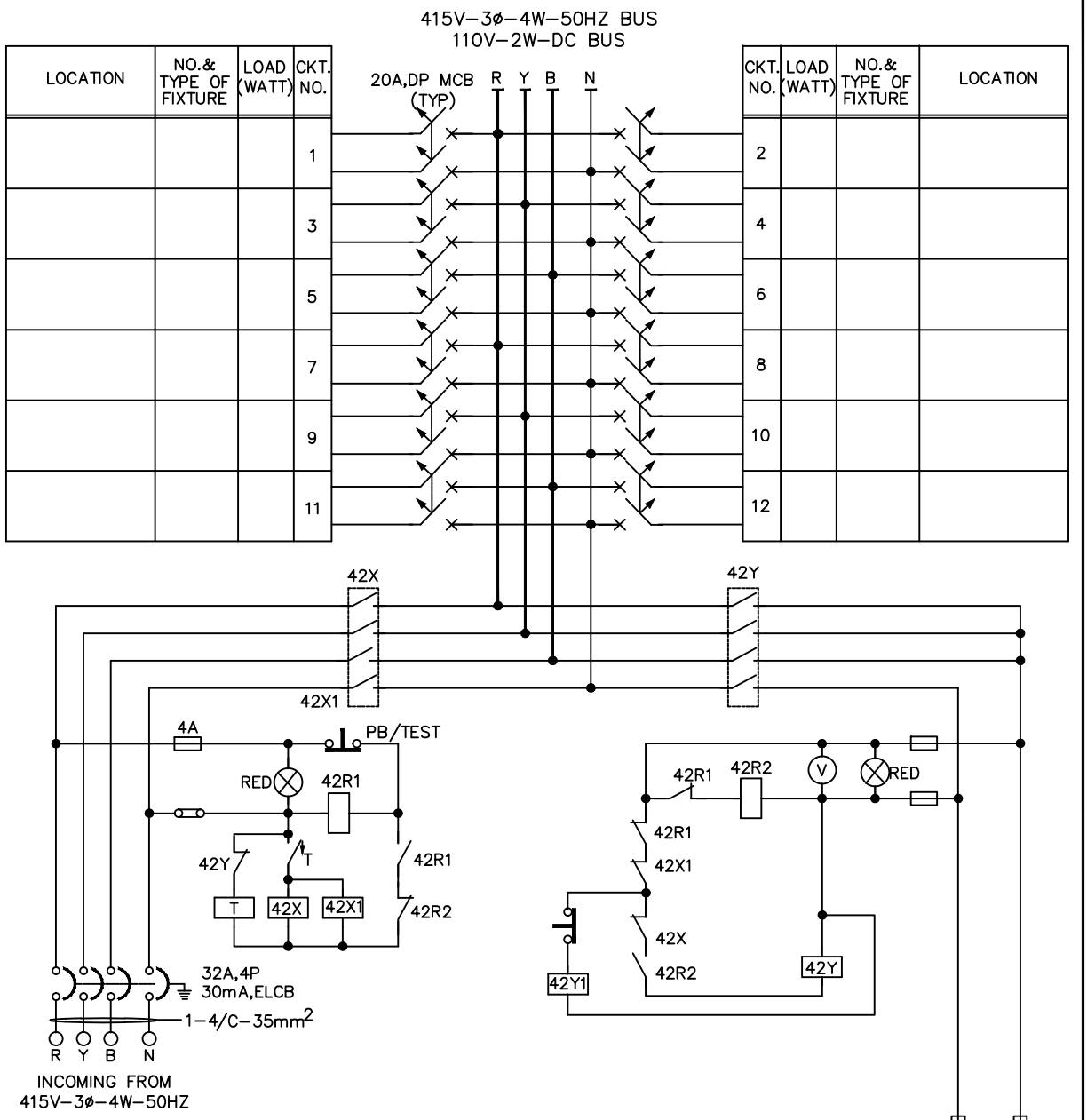
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DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

DWG. NO. 14L08-DWG-E-0800 SHT.-38 | REV. 0

File Name 14L08-DWG-E-0800

A4_DD (9-96) [210x297]



LEGEND:–

42X & 42X1	:	AC. CONTACTOR 3–POLE, 32A
42Y	:	DC. CONTACTOR 4–POLE, 100A
42R1	:	AUX. CONTACTOR 240V AC.
42R2	:	AUX. CONTACTOR 110V DC
42Y1	:	AUX. CONTACTOR 110V DC.
T	:	TIMER

NOTES:–

1.. CKT. SHOWN HERE IS IN RESET AND DE–ENERGISED POSITION.

2.. ALL SWITCH FUSE UNITS AC AND DC. CONTACTORS, RELAYS, LAMPS, METERS SHOWN IN THIS DRG. SHALL BE FURNISHED WITH EMERGENCY LTG. BOARD.

3.. THE FAULT LEVEL SHALL BE WITHIN AVAILABLE MCB.

SCHEMATIC : EMERGENCY LTG. DIST. BOARD (3ø)

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS– ILLUMINATION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

DWG. NO. 14L08–DWG–E–0800 SHT.-39 | REV. 0

File Name 14L08–DWG–E–0800

A4_DD (9–96) [210x297]

21.. Number of receptacles in an area shall be decided based on utility of this area. However, unless otherwise noted, number of receptacles shall generally be selected based on following guidelines:

a) For Residential Building, 6A and 16/6A single-phase receptacles shall be considered as per NBC.

b) For general area (e.g. Electrical room, Pump room, Control room) of Plant Building, 16/6A receptacle shall be considered.

c) One (1) number 63A three-phase receptacle shall be provided at each generator busduct area, at each generator-transformer area, station-transformer area, transformer area at switchyard, boiler area, major pump rooms.

d) 63A three-phase receptacle shall be provided at each turbine bay, at each boiler area, etc. for use of welding machine.

d) In industrial plants, 63A three-phase receptacles shall be decided based on the application requirement.

e) 24V single-phase receptacle shall be used in boiler platform area and vessels platforms (e.g. reactor, reformers etc.) hazardous classified area. The number shall be decided based on application and area.

22.. Unless otherwise noted, the minimum size of cables, wires, conduits, junction boxes shall generally be as below :

A) CABLES :

i) From Main Lighting Distritbution Boards to 400 V normal AC lighting panels : 1x3-1/2C, 95 Sq.mm AL PVC/XLPE

ii) From Emergency MAIN Lighting Dist. Boards (EMLDB) to 400 V Emergency AC lighting Panels : 1x3-1/2C, 95 Sq.mm AL PVC/XLPE

iii) From Main Lighting Distribution Boards (MLDB) to 400V AC/110V DC Emergency Lighting Distribution Boards (DCELDB) : 1x3-1/2C, 95 Sq.mm AL PVC/XLPE

iv) From 110V Main DC Distribution Boards to 110V DC Emergency Lighting Distribution Board (DCELDB) : 1 x 2C, 35 Sq.mm Al PVC / XLPE

v) From PMCC/MCC/DB to 100A 3 phase receptacles : 1 x 3-1/2C, 95 Sq.mm Al PVC /XLPE

vi) From PMCC/MCC/DB to 63A 3 phase receptacles : 1 x 4C, 35 Sq.mm Al PVC / XLPE

vii) From SLP (Street Lighting Panel) to tower junction box : 1 x 4C, 16 Sq.mm Al PVC / XLPE

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS- ILLUMINATION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

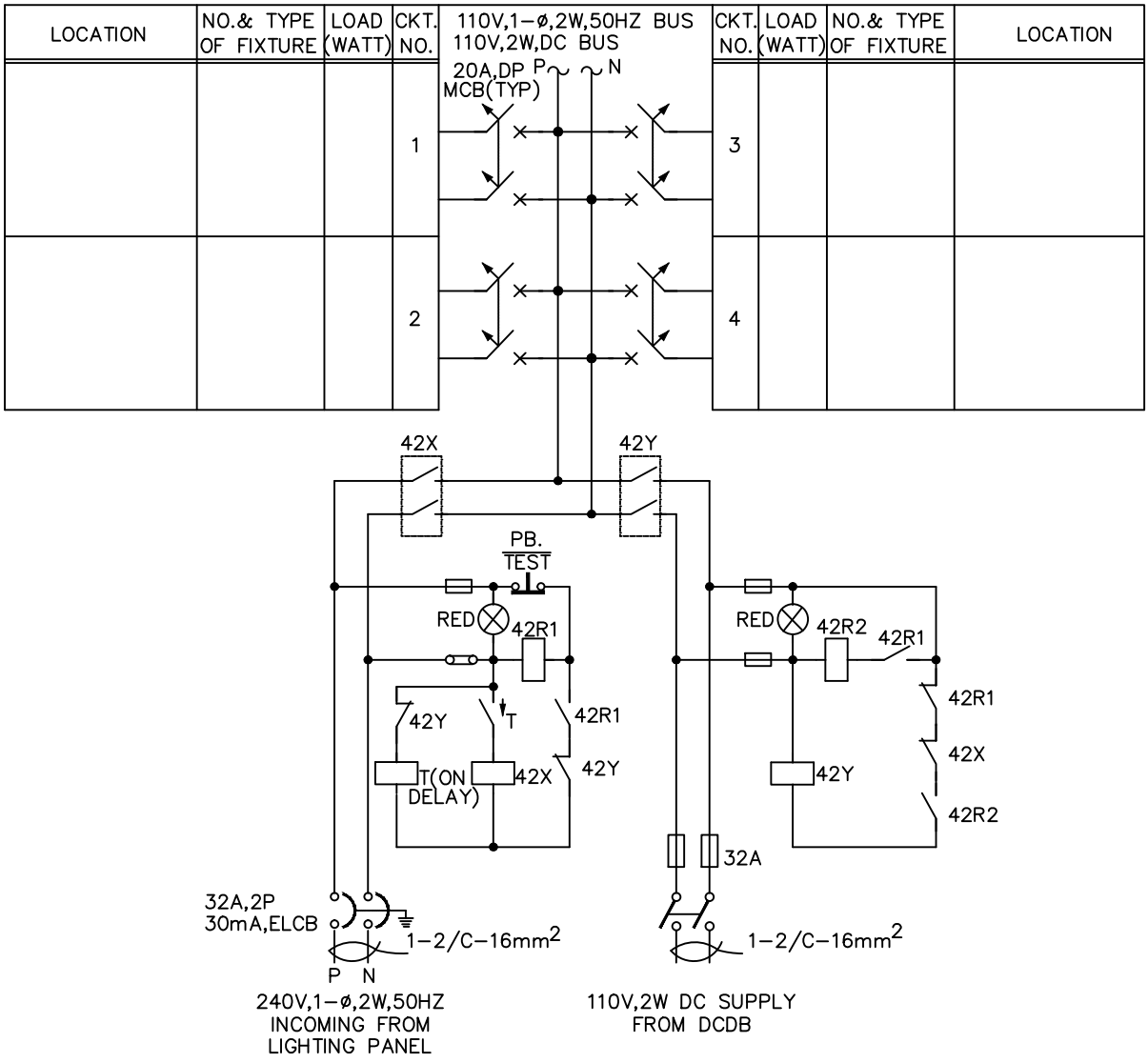
CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

DWG. NO. 14L08-DWG-E-0800 SHT.-04 | REV. 0

File Name 14L08-DWG-E-0800

A4_DD (9-96) [210x297]



LEGEND :-

42X : AC CONTACTOR, 2-POLE, 32A
42Y : DC CONTACTOR, 2-POLE, 32A
42R1: AUX. CONTACTOR 240V AC.
42R2: AUX. CONTACTOR 110V DC.
T : TIMER

NOTES :-

1. CKT. SHOWN HERE IS IN RESET AND DE-ENERGISED POSITION.
2. ALL SWITCH FUSE UNITS, AC AND DC CONTACTORS, RELAYS, LAMPS, METERS SHOWN IN THIS DRG. SHALL BE FURNISHED WITH EMERGENCY LTG. BOARD.
3. THE FAULT LEVEL SHALL BE WITHIN AVAILABLE MCB.

SCHEMATIC : D.C EMERGENCY LTG. DIST. BOARD (1ø)

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS- ILLUMINATION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

DWG. NO. 14L08-DWG-E-0800 SHT.-40 | REV. 0

File Name 14L08-DWG-E-0800

A4_DD (9-96) [210x297]

viii) From SLP to light pole junction box (for single phase) : 1 x 2C, 16 Sq.mm Al PVC / XLPE

ix) From SLP to light pole junction box (for three phase) : 1 x 4C, 16 Sq.mm Al PVC / XLPE

B) WIRES :

Wires shall generally be PVC insulated 650V grade. Each wire shall be of following sizes :

i)	From lighting panels (LPs) to junction boxes (JBs)	: 10 mm² Al (stranded) or 6 mm² Cu (stranded)
ii)	From junction boxes (JBs) to lighting fixtures	: 2.5 mm² Cu
iii)	From junction boxes to flood light fixtures	: 2.5 mm² Cu.
iv)	From Lighting Panels to 24V AC supply modules (complete with 230/24V built in transformer & 24V receptacle)	: 10 mm² Al (stranded) or 6 mm² Cu (stranded)
v)	Point wiring of light/ ceiling fan/exhaust fan/ call bell	: 1.5 mm² Cu (stranded)
vi)	230V, 6A receptacle	: 1.5 mm² Cu (stranded)
vii)	From LP to 230V, 16/6A 1st receptacles	: 4 mm² Cu (stranded)
viii)	From 230V, 16/6A 1st receptacle to 230V 16/6A second receptacle	: 2.5 mm² Cu (stranded)
ix)	From LP to 230V, 20/16A receptacles	: 4 mm² Cu (stranded)
x)	230V window/split AC starter unit upto 2 Ton capacity	: 4 mm² Cu (stranded)
xi)	Circuit wiring from LP to switchboard	: 2.5 mm² Cu (stranded)
xii)	From street light panel to lighting pole JB (if conduit used)	: 16 mm² Al (stranded) or 6 mm² Cu (stranded)
xiii)	From street light pole junction box to street light fixture	: 2.5 mm² Cu (stranded)

C) CONDUITS :

a) Unless otherwise noted, in residential and commercial building, PVC conduit shall generally be used for concealed conduiting purpose both in masonry wall as well as in concrete portion. Two numbers 18 SWG GI fish wires shall be drawn inside each conduit while embedding in concrete portion. At both ends of each conduit a minimum 400 mm length of fish wires shall be kept by coiling, for pulling of wires. All exposed conduits above false ceiling shall be Galvanized Iron (GI) or Enameled Iron (EI).

b) In plant area GI conduit shall be used at surface. Unless otherwise noted, in Non-Plant building rigid PVC conduit shall be used at surface.

c) Conduits shall generally be Galvanized Iron (GI) / Enameled Iron (EI)/ PVC of following minimum sizes:

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NOTES & DETAILS- ILLUMINATION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

DWG. NO. 14L08-DWG-E-0800 SHT.-05 | REV. 0

File Name 14L08-DWG-E-0800

A4_DD (9-96) [210x297]

Wire size	Conduit size					
	20mm	25mm	32mm	40mm	50mm	
i) 10 sq. mm AL	--	2	5	7	8	Maximum no of wires admissible for conduit
ii) 6 sq. mm Cu	2	3	7	--	--	
iii) 4 sq. mm Cu	3	5	10	--	--	
iv) 2.5 sq. mm Cu	4	6	10	--	--	
v) 1.5 sq. mm Cu	4	6	10	--	--	

D) JUNCTION BOXES :

Conduit Size (mm)	Junction box size (mm)			
	4-way	3=Way	Straight Through	90 Deg
i) 20/25	150 x 150 x 100	150 x 100 x 100	88Φ	88Φ
ii) 32/40	254 x 200 x 127	254 x 200 x 127	150 x 150 x 100	---
iii) 50	254 x 200 x 127	254 x 200 x 127	254 x 200 x 127	---

23. All lighting panels/distribution boards, junction boxes, receptacles fixtures, conduits, etc. shall be grounded in compliance with the provision of I.E. rules and as detailed below :

i) Lighting Panels : 35 x 6 mm G.S. Flat

ii) Distribution Boards : 50 x 6 mm G.S. Flat

iii) Power Receptacles Junction Boxes etc. : 12 SWG G.I. wire

iv) Lighting fixtures, switches conduits, etc. : 16 SWG G.I. wire

v) Street Light Poles and Towers for floodlighting : 25 x 3 mm G.S. Flat

24. A continuous ground conductor of 16 SWG G.I. wire shall run along each exposed metallic conduit run and bonded to it every 600 mm.

25. For a run of conduit partly or wholly embedded, PVC insulated stranded copper conductor wire, as ground conductor shall run through the conduit.

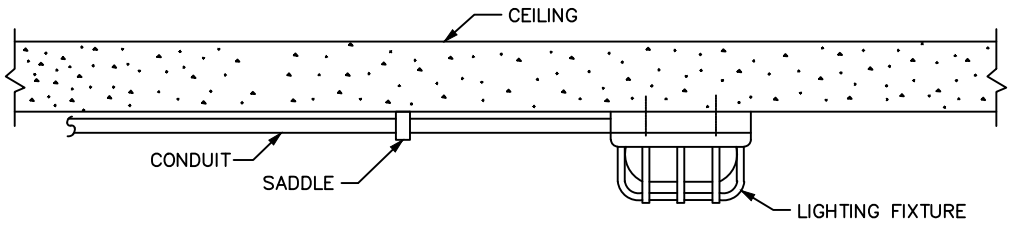
26. Typical details of lighting fixtures, other lighting system components and their mounting arrangement as shown herein are for general guidance only. The type no. of some make has been referred in the various drawings only to indicate desired appearance and construction features of the fixture. The contactor has to design the same fulfilling the requirement of the specification.

TENDER ONLY

					NOTES & DETAILS- ILLUMINATION	CONSULTANT: DEVELOPMENT CONSULTANTS PVT LTD, CONSULTING ENGINEERS
					ALUMINA UNLOADING AND TRANSPORTATION SYSTEM	JOB NO. 14L08 | SCALE : N.T.S
BB	KKB	BM	0	24.11.14	NATIONAL ALUMINIUM COMPANY LIMITED, SMELTER PLANT, ANGUL-759145	DWG. NO. 14L08-DWG-E-0800 SHT.-06 | REV. 0
APPVD.	DRAWN	CHKD.	REV.	DATE		

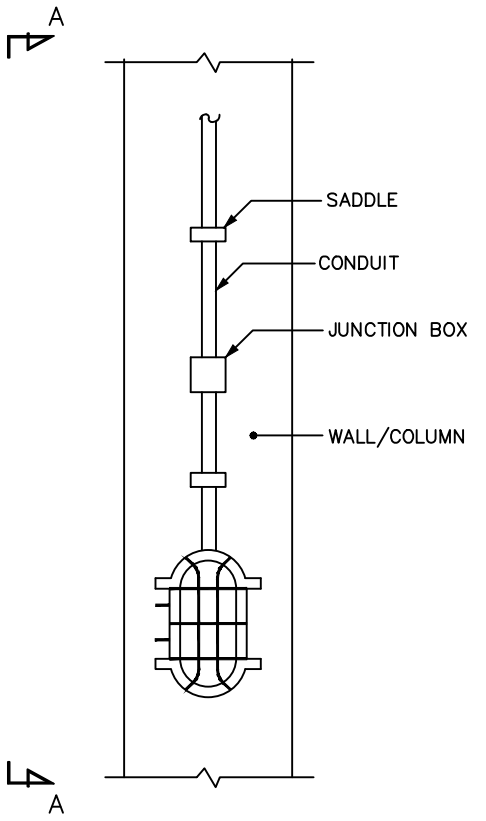
File Name 14L08-DWG-E-0800

A4_DD (9-96) [210x297]



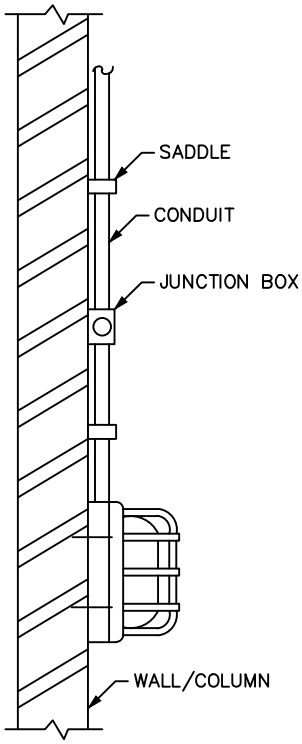
CEILING MOUNTING

TYPE– IA



WALL/COLUMN MOUNTING

TYPE– IA



VIEW – AA

TYPE– IA

NOTE:

1. BULKHEAD LUMINAIRE WITH 60W GLS
   [EQ. PHILIPS TYPE NXC 101/B 22 GR/EQV.]

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS– ILLUMINATION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT

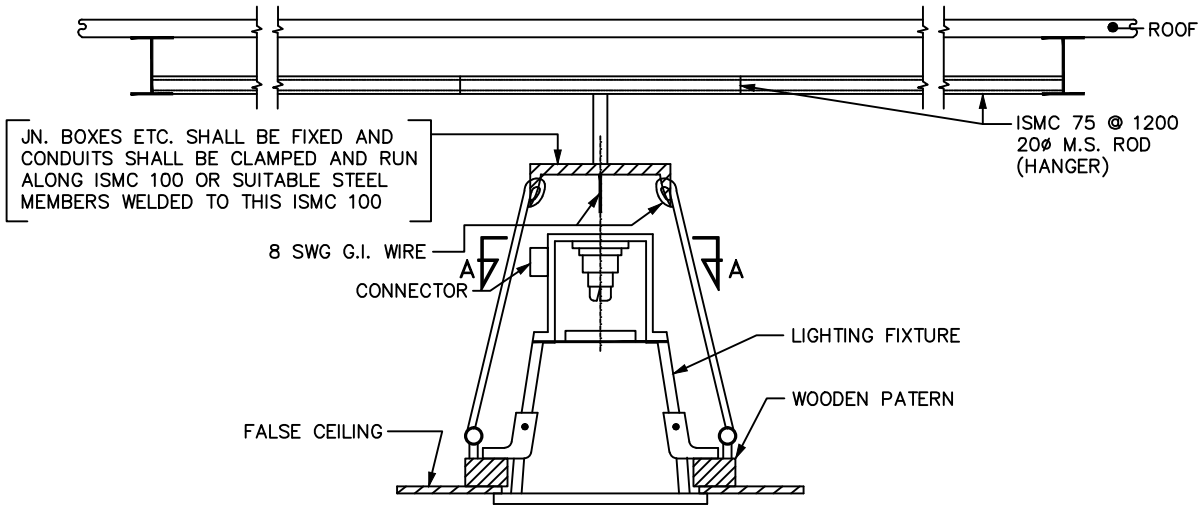
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

DWG. NO. 14L08–DWG–E–0800 SHT.-07 | REV. 0

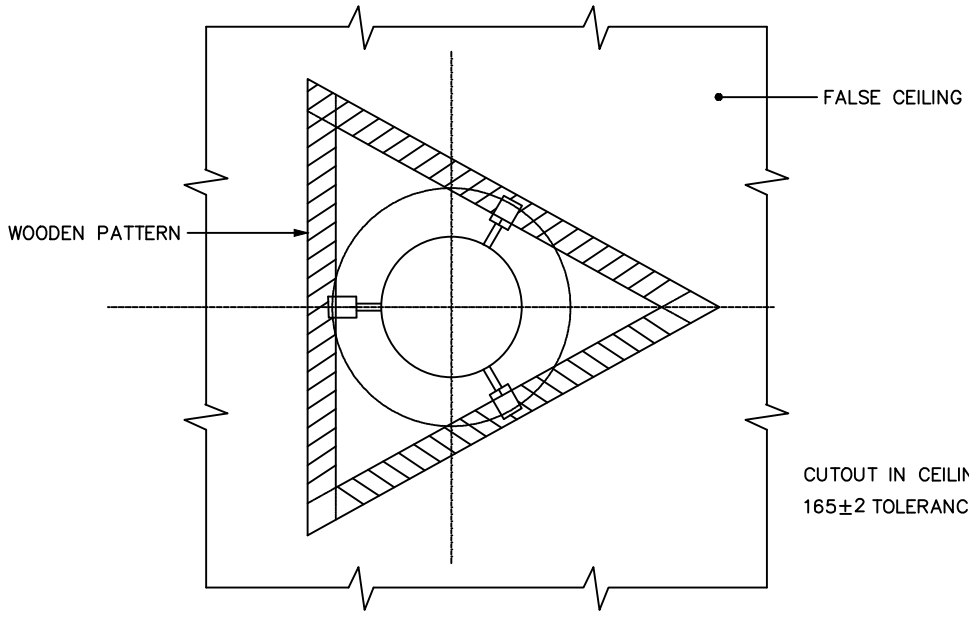
File Name 14L08–DWG–E–0800

A4_DD (9–96) [210x297]



FALSE CEILING MOUNTING

TYPE– CA/CB/CC/CD



VIEW–AA

RECESSED DOWNLIGHT WITH 100W GLS/11W CFL/13W OR 18W PL–C/EQV.
[EQ. PHILIPS TYPE FCS 100/FBH–145M/EQV.]

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS– ILLUMINATION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

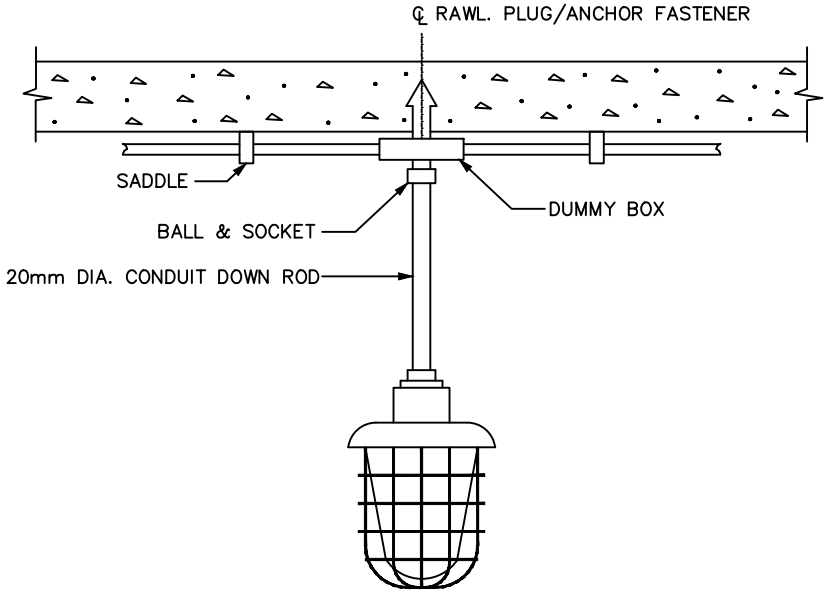
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JOB NO. 14L08 | SCALE : N.T.S

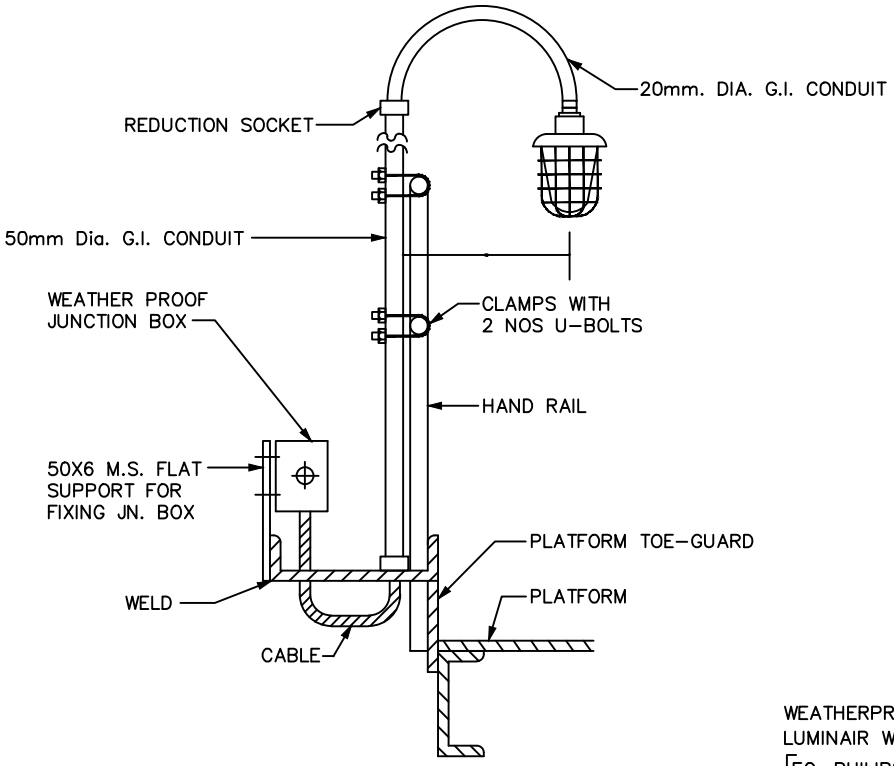
DWG. NO. 14L08–DWG–E–0800 SHT.-08 | REV. 0

File Name 14L08–DWG–E–0800

A4_DD (9–96) [210x297]



PENDANT/CEILING MOUNTING : TYPE–IA



WEATHERPROOF BULKHEAD
LUMINAIR WITH 1X60W GLS LAMP.
[EQ. PHILIPS TYPE NXC101/EQV.]

PLATFORM MOUNTING : TYPE–IA

TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS– ILLUMINATION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

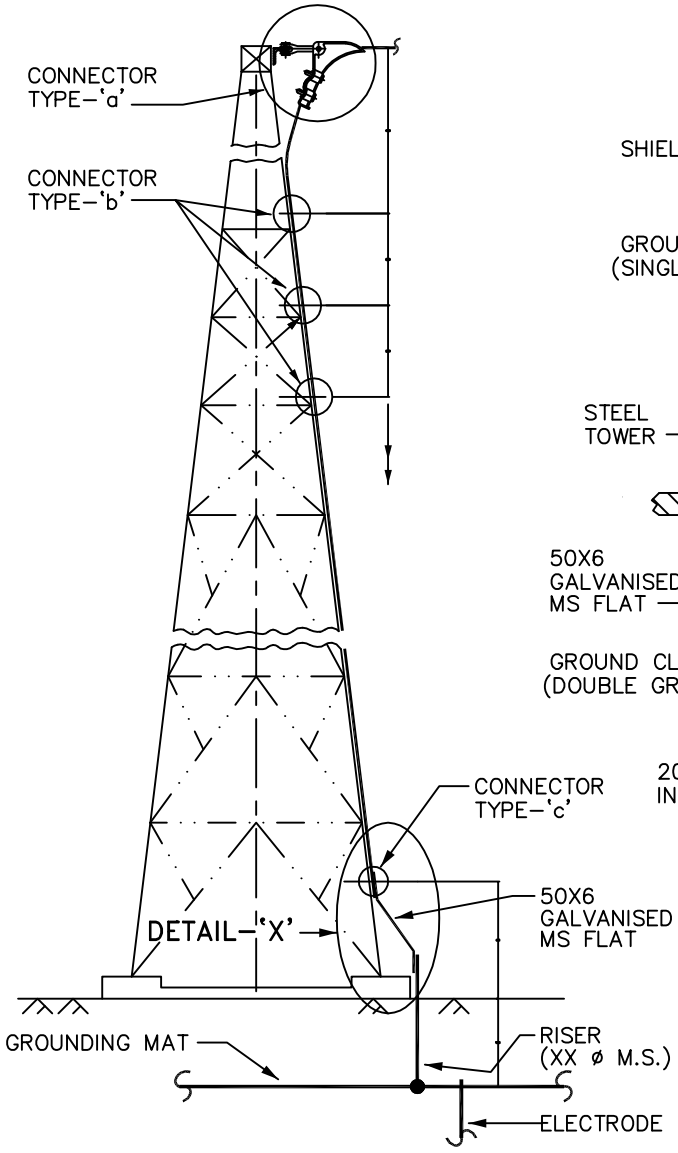
CONSULTANT
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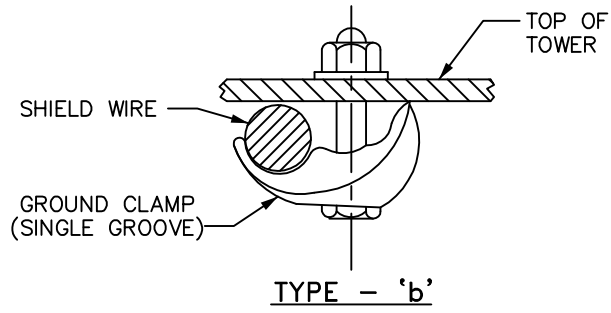
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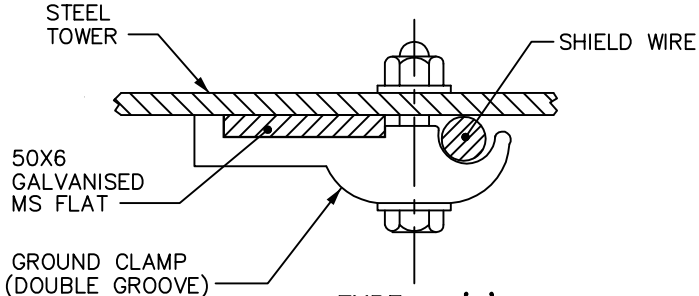
File Name 14L08–DWG–E–0800

A4_DD (9–96) [210x297]

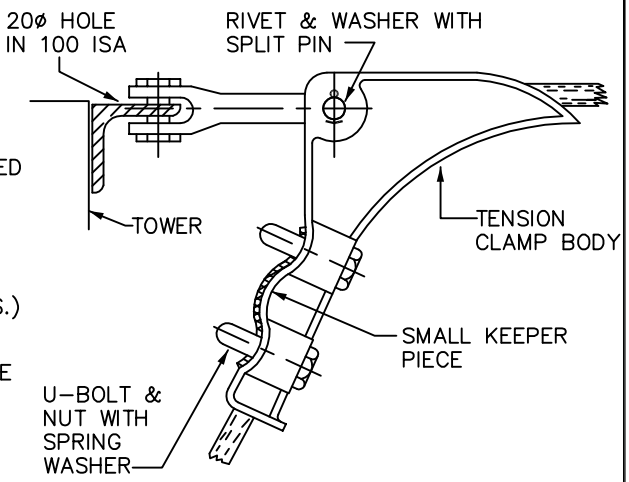


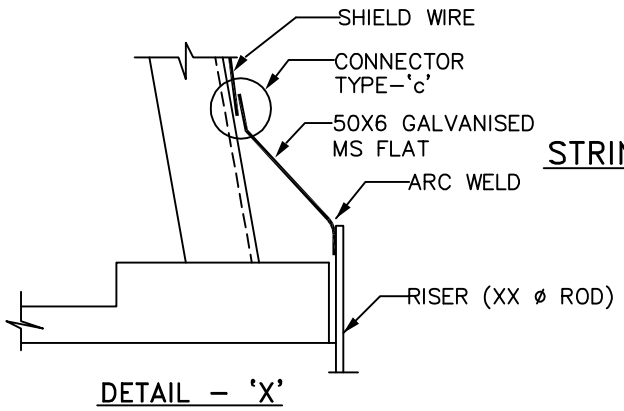


TYPE – 'b'



TYPE – 'c'





DETAIL – 'X'

TYPE–'a'

STRINGING ARRANGEMENT & GROUNDING OF G.I. SHIELD WIRE

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS
LIGHTNING PROTECTION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : NTS

DWG. NO. 14L08–DWG–E–1001 | REV. 0

SHT.–10 OF 13

File Name 14L08–DWG–E–1001

A4_DD (9–96) [210x297]

6.0 LIGHTING PROTECTION OF OUTDOOR SUBSTATION/ SWITCHYARD AND OTHER AREAS.

6.1 Lightning protection of outdoor switchyards/substations shall be done by lightning masts on top of steel towers. shield wires may also be used wherever required. These shall be strung across the top of the steel towers and/or building/plant structure.

6.2 The shield wire, which shall be brought down to the bottom of the steel towers, shall be connected to the earthing conductor (50 x 6 mm galvanished MS flat), which in turn, shall be connected to the riser from the main grounding mat/grid.

6.3 For lightning protection of conveyor gallery, a horizontal conductor (25 x3 mm galvanised MS flat) running along the entire length of the conveyor gallery shall be provided on top of the gallery roof. This conductor be connected to a earth terminal at approximate intervals of 30M by two down conductors, each 25 x 3 mm galvanised MS flat.

7.0 The sizes and materials of earthing conductors used in lightning protection system are listed below :

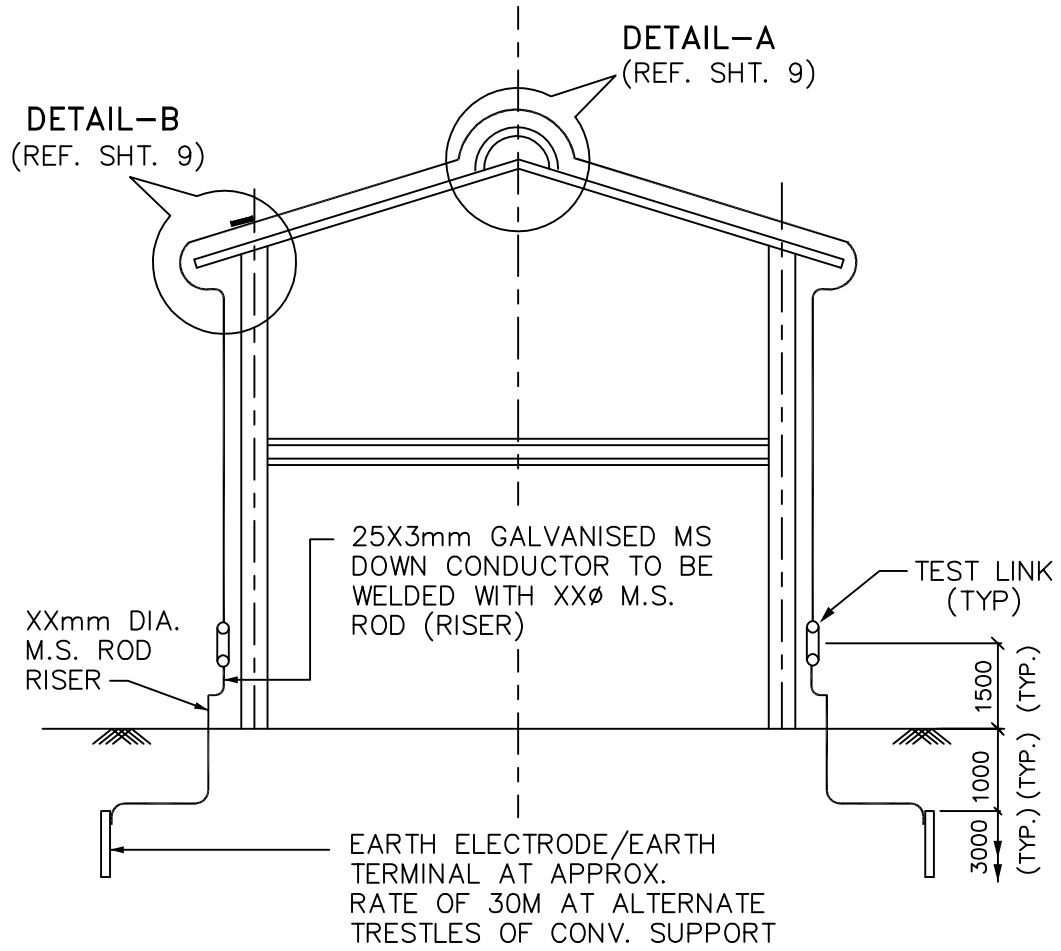
	DESCRIPTION		SIZE	MATERIAL
a)	Vertical Air Terminals		20 mm dia rod	Galvanished Mild steel
b)	Horizontal conductors	i)	50 x 6 mm Flat	Galvanished Mild steel
		ii)	25 x 3 mm Flat	Galvanished Mild steel
c)	Down Conductors	i)	50 x 6 mm Flat	Galvanished Mild steel
		ii)	25 x 3 mm Flat	Galvanished Mild steel
d)	Riser From Electrode/ Grounding Mat		xx mm dia Rod	Mild Steel
e)	Electrode for Lighting Protection		xx mm dia Rod 3000 mm long	Mild Steel

FOR TENDER ONLY

					NOTES & DETAILS LIGHTNING PROTECTION	CONSULTANT: DEVELOPMENT CONSULTANTS PVT LTD, CONSULTING ENGINEERS
					ALUMINA UNLOADING AND TRANSPORTATION SYSTEM	JOB NO. 14L08 / SCALE : NTS
B.B	KKB	B.M	0	24.11.14	NATIONAL ALUMINIUM COMPANY LIMITED, SMELTER PLANT, ANGUL-759145	DWG. NO. 14L08-DWG-E-1001 / REV. 0
APPVD.	DRAWN	CHKD.	REV.	DATE		SHT.-11 OF 13

File Name 14L08-DWG-E-1001

A4_DD (9-96) [210x297]



SECTION

(TYPICAL ARRANGEMENT OF DOWN CONDUCTOR FOR CONV. GALLERY)

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS
LIGHTNING PROTECTION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

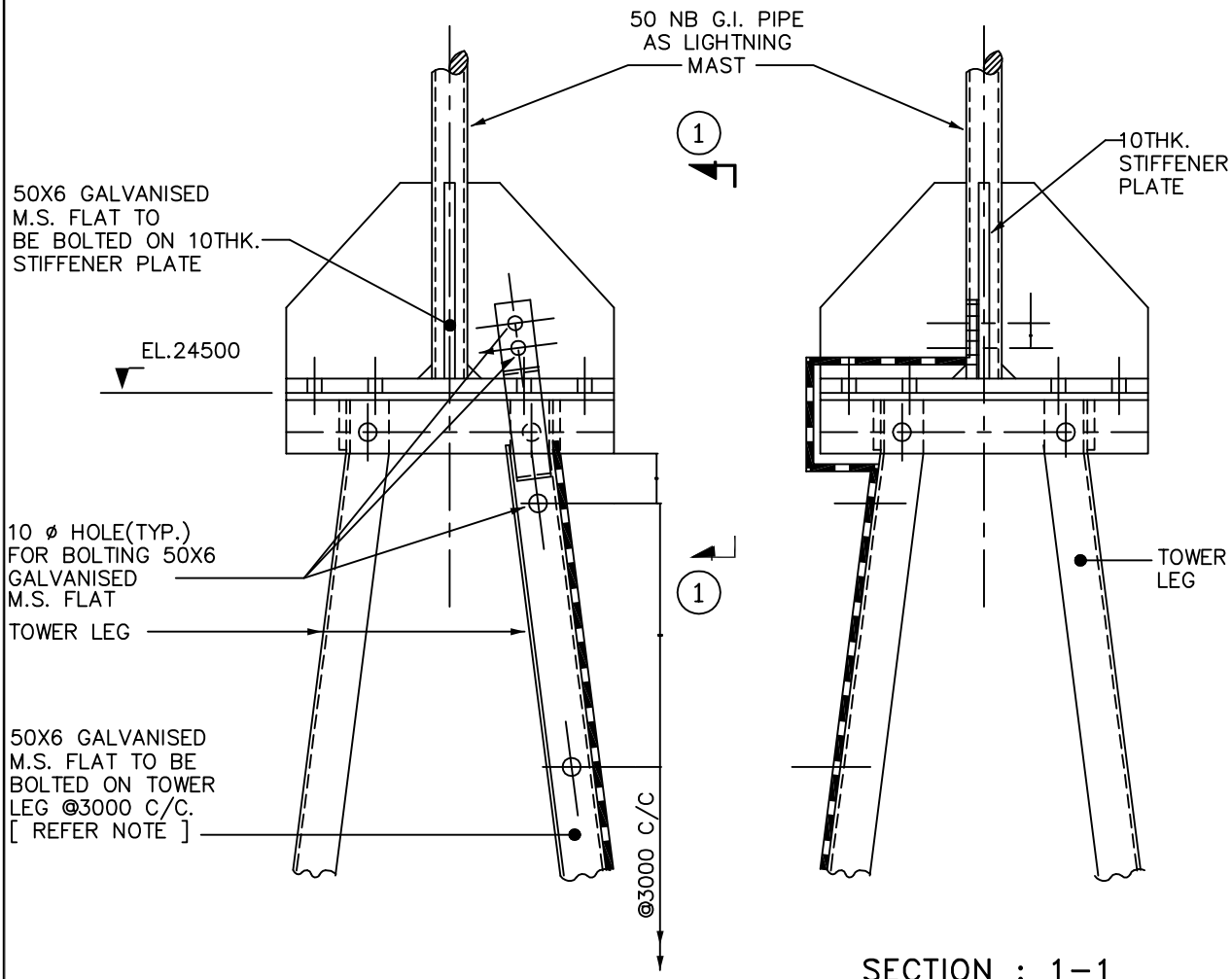
NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08	SCALE : NTS
DWG. NO. 14L08–DWG–E–1001 SHT.–12 OF 13	REV. 0

File Name 14L08–DWG–E–1001

A4_DD (9–96) [210x297]



SECTION : 1-1

GROUNDING OF SUB-STATION LIGHTNING MAST

NOTE: THESE FLATS SHALL SERVE AS GROUND CONDUCTOR DOWNCOMER AND SHALL BE CONNECTED TO SUBSTATION GROUND GRID

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS
LIGHTNING PROTECTION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

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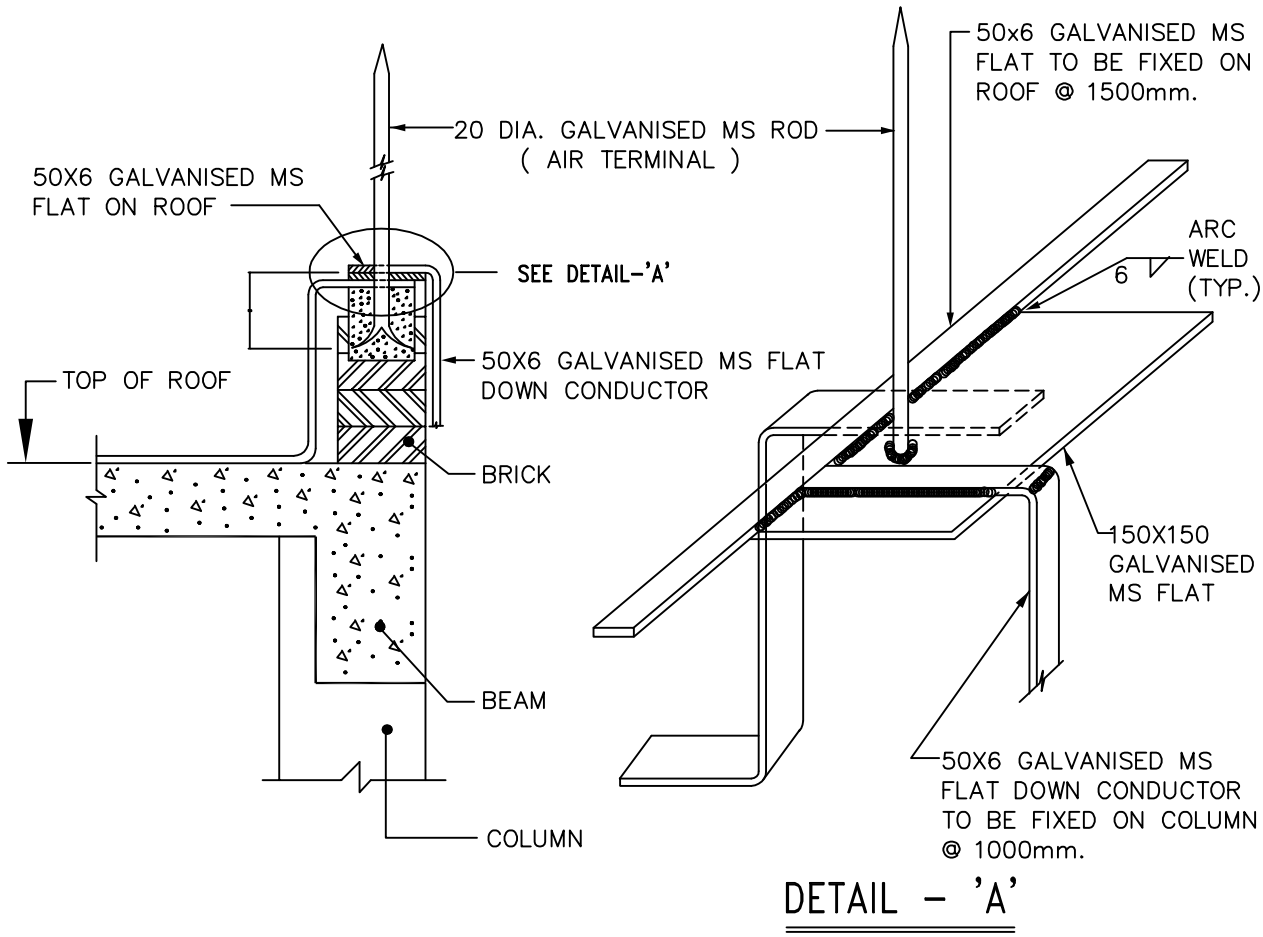
JOB NO. 14L08 | SCALE : NTS

DWG. NO. 14L08-DWG-E-1001 | REV. 0

SHT.-13 OF 13

File Name 14L08-DWG-E-1001

A4_DD (9-96) [210x297]



DETAIL - 'A'

FIXING DETAILS OF AIR TERMINAL ROD ON BUILDING ROOF

(FOR LIGHTNING PROTECTION)

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS
LIGHTNING PROTECTION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

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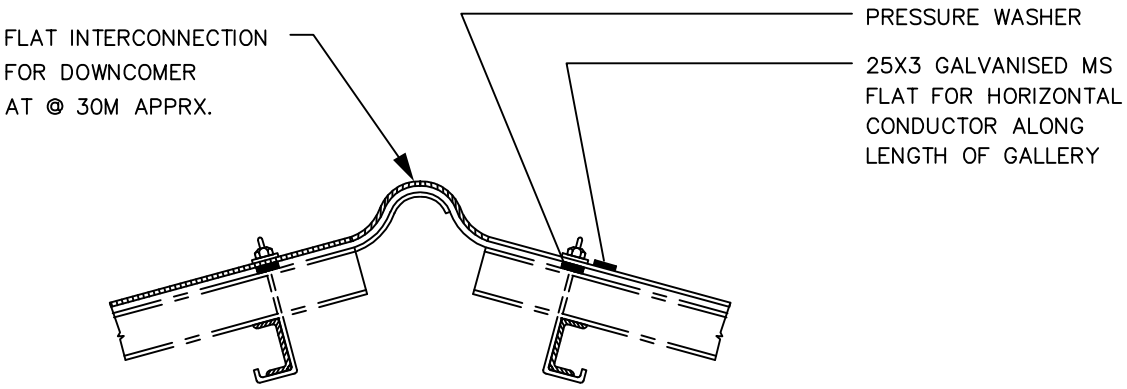
JOB NO. 14L08 | SCALE : NTS

DWG. NO. 14L08-DWG-E-1001 | REV. 0

SHT.-2 OF 13

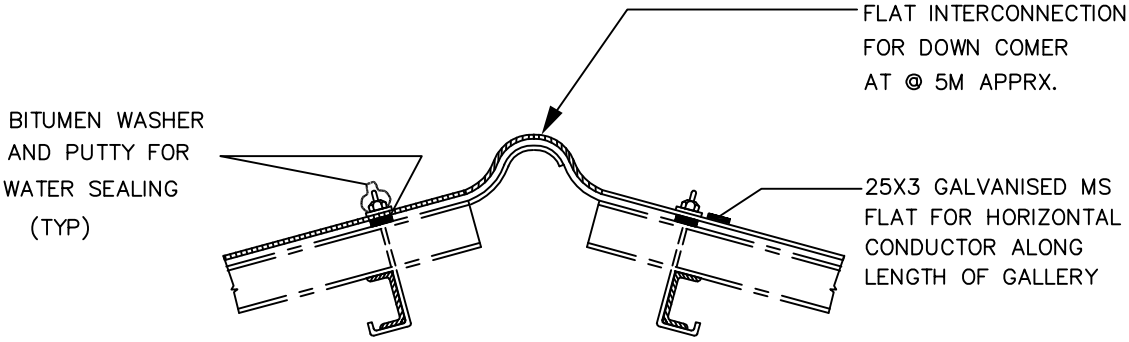
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A4_DD (9-96) [210x297]



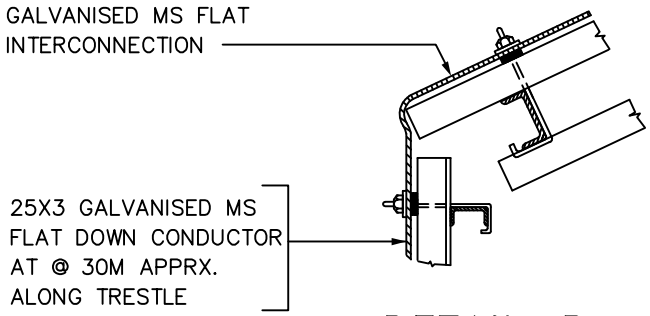
DETAIL–A

(FOR DOWNCOMER)



DETAIL–A

(WITHOUT DOWNCOMER)



DETAIL–B

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS
LIGHTNING PROTECTION

ALUMINA UNLOADING AND
TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

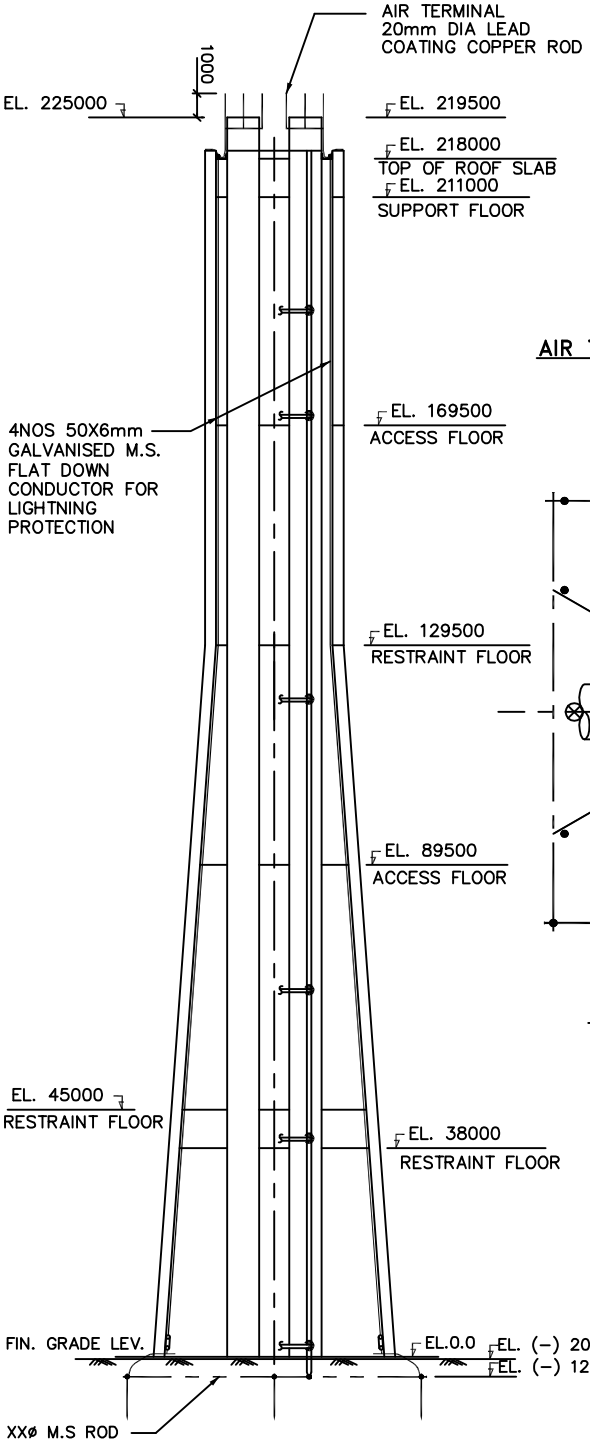
JOB NO. 14L08 | SCALE : NTS

DWG. NO. 14L08–DWG–E–1001 | REV.

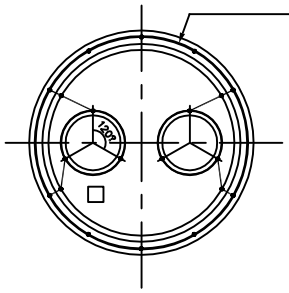
SHT.–3 OF 13 | 0

File Name 14L08–DWG–E–1001

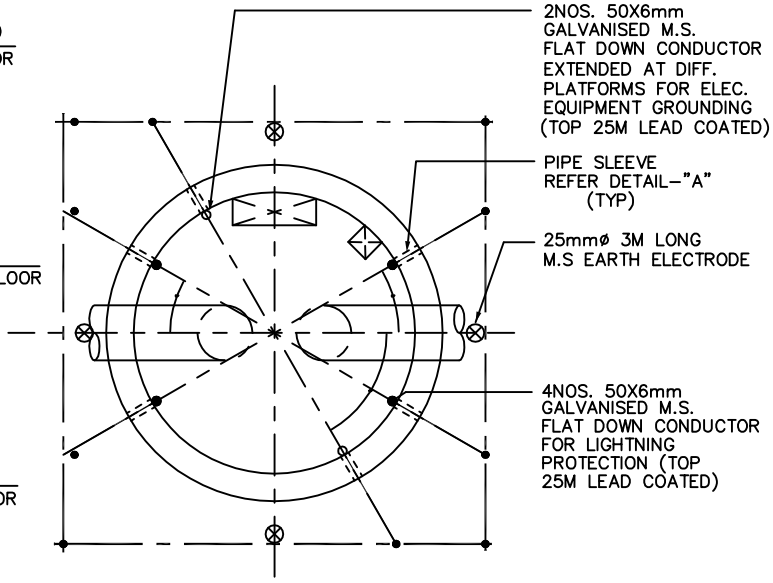
A4_DD (9–96) [210x297]



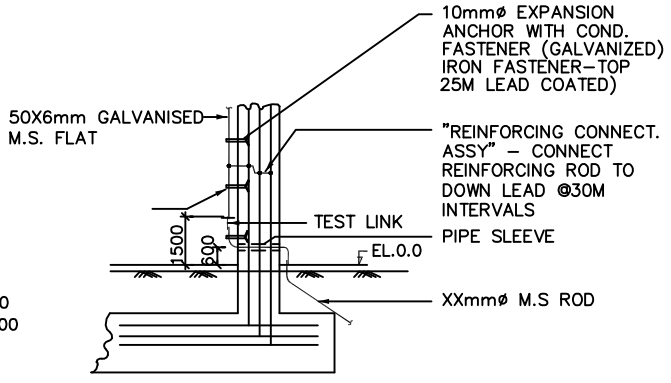
LIGHTNING PROTECTION
ARRANGEMENT OF RCC STACK



TOP OF STACK
AIR TERMINAL & DOWNCOMER LOCATION



PLAN AT EL.(±)0.0
LIGHTNING DOWN CONDUCTOR



DETAIL - "A"

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS
LIGHTNING PROTECTION

ALUMINA UNLOADING AND
TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : NTS

DWG. NO. 14L08-DWG-E-1001 | REV. 0
SHT.-4 OF 13

File Name 14L08-DWG-E-1001

A4_DD (9-96) [210x297]

1.0 AIR TERMINATIONS

1.1 Vertical air terminal rods shall be installed on the top of all structured/buildings to be protected from lightning strokes.

1.2 Vertical air terminal except those for chimney shall be 20 mm dia galvanised steel rods. The projected length of the rods including mounting structure, if any, shall be as required to protect the objects, from lightning stroke. Air terminal rods provided on top of chimney/ stack for lightning protection shall be 20 mm dia lead coated solid copper rods.

1.3 Air terminal rods shall be properly fixed on top of buildings/ structures to withstand wind pressure.In case the air terminal rods are embedded in the building roof, the portion embedded in the contrete shall not touch the reinforcement bars and shall be duely insulated from them.

1.4 All vertical air terminal rods shall be electrically connected by means of horizontal conductors (galvanised MS flats) of size 50 x 6 mm.

1.5 The shielding angle for one vertical air termination shall be 45 degrees. For more than one rod, shielding angle between the rods shall be taken as 60 degrees.

1.6 Horizontal air terminations (galvanised MS flats) shall be so laid out that no part of the roof is more than nine (9) metres away from the nearest Horizonal air terminals.

2.0 SHIELDING MASTS

2.1 The shielding mast for lightning protection shall be installed on top of the steel column cap plates of power house main building.

2.2 The shielding masts shall be made of galvanished steel pipe and the heights of the same shall be decided considering the zones to be protected.

2.3 Each shielding mast shall be connected to grounding grid of the station by a 50 x 6 mm. galvanised MS down conductor running along the building column. In addition, all power house building column joints shall be electrically bonded.

3.0 DOWN CONDUCTORS

3.1 The down conductors shall be 50 x 6 mm galvanished MS flats. However, The down conductor of conveyor gallery may be 25 x 3 mm galvanised MS flats.

One end of these flats shall be connected to the air terminal rods/ horizontal conductors on top of roof/structure and the other end to the nearest earth terminals.

3.2 Each down conductor shall have an independent earth termination. In no case conductors of the lightning protection system shall be connected with the conductors of the grounding system above ground level.

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS
LIGHTNING PROTECTION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

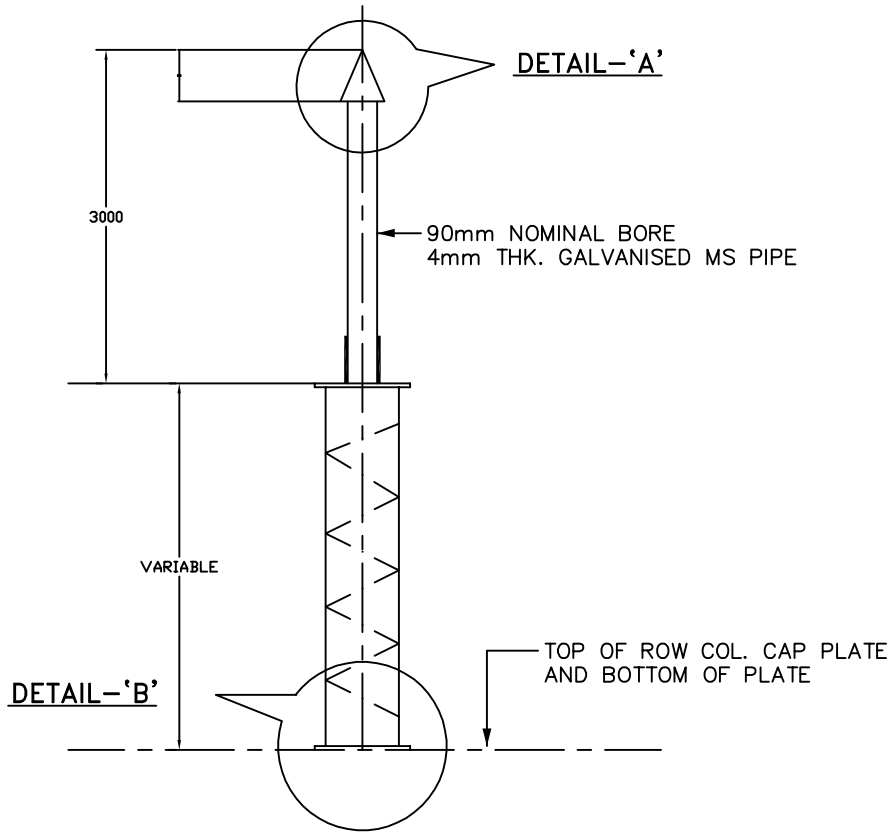
JOB NO. 14L08 | SCALE : NTS

DWG. NO. 14L08-DWG-E-1001 | REV. 0

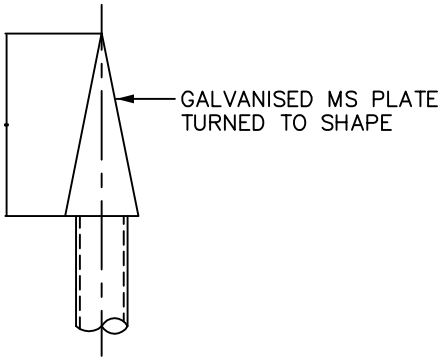
SHT.-5 OF 13

File Name 14L08-DWG-E-1001

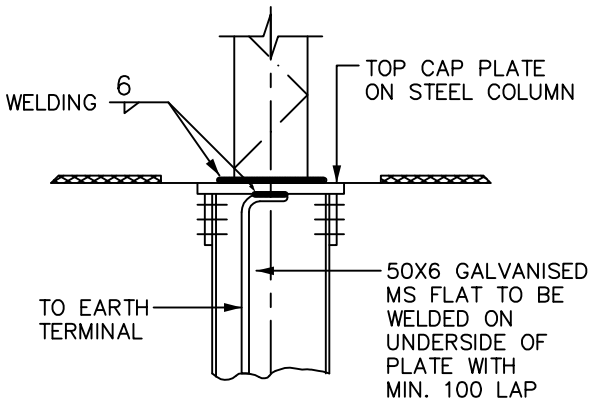
A4_DD (9-96) [210x297]



SHIELDING MAST



DETAIL – A



DETAIL –B

FIXING DETAILS OF SHIELDING MAST ON TOP OF STEEL COLUMNS OF POWER HOUSE BUILDING (FOR LIGHTNING PROTECTION)

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS
LIGHTNING PROTECTION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

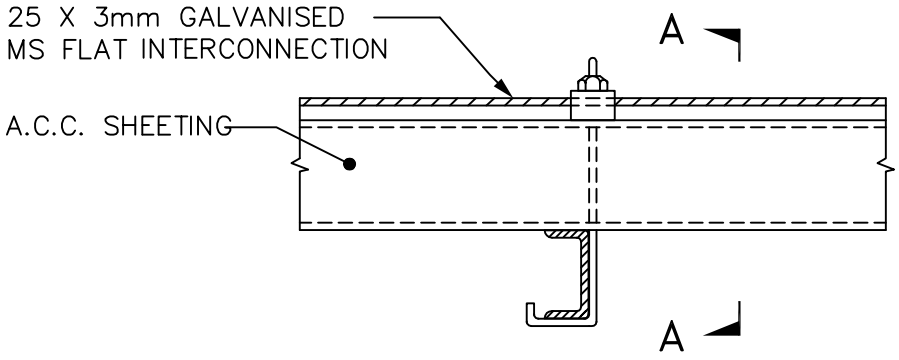
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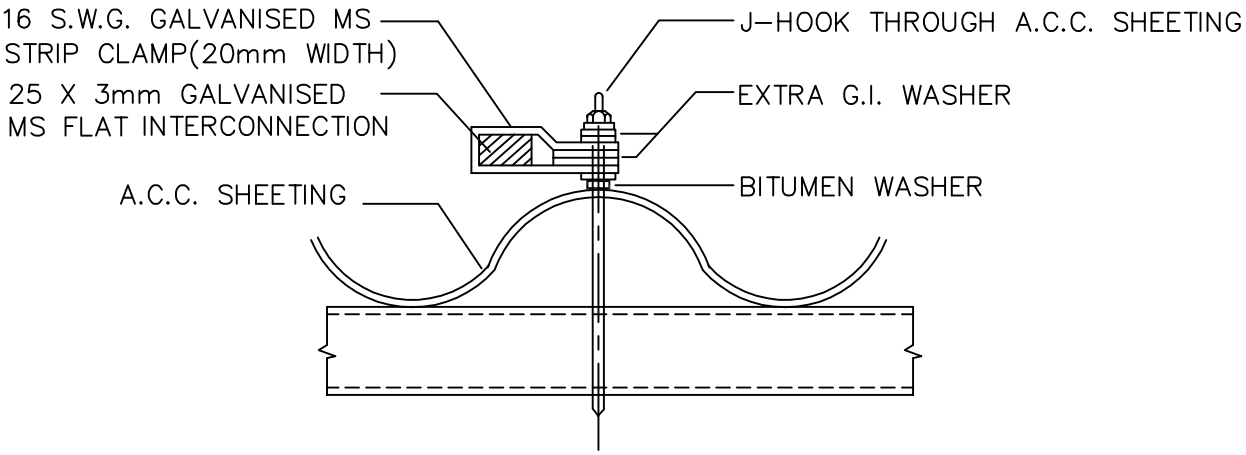
DWG. NO. 14L08–DWG–E–1001 | REV. 0

SHT.–6 OF 13

File Name 14L08–DWG–E–1001

A4_DD (9–96) [210x297]





SECTION– A–A

TYPICAL FIXING ARRANGEMENT OF GALVANISED MS INTERCONNECTION FLAT ON ASBESTOS CEMENT CONCRETE (A.C.C) SHEETING (CONVEYOR GALLERY)

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS
LIGHTNING PROTECTION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : NTS

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SHT.–7 OF 13

File Name 14L08–DWG–E–1001

A4_DD (9–96) [210x297]

3.3 The connetion between each down conductor and earth terminal shall be made via test link located at approximately 1500 mm above ground level.

3.4 The down conductors shall be laid straight and sharp bends shall be avoided as far as practicable. These shall be cleated on the outside of the building wall and or columns/structures at intervals of about 750 mm., unless indicated otherwise in the drawings.

3.5 Down conductors along the chimney shell shall be electrically connected with the reinforcement rods by suitable lugs welded (6 mm fillet) to both down conductor and reinforcement at the interval of 30 mm.

3.6 All exposed metallic parts of a building shall be bonded to the down conductors. Such parts shall include ladders, balconies, conduits etc.

4.0 EARTH TERMINALS.

4.1 Where ground mat is available, the risers specifically ear-marked for lightning protection shall be considered as Earth Terminal. In such case, one electrode shall be provide close to the each Earth Terminals.

4.2 Where ground mat is not available sparate earth pit as per IS-3043 or approved international standard specifically for lightning protection shall be provided as Earth Terminal.

5.0 JOINTING & CONNECTION

5.1 Number of joints in the lightning conductors shall be kept to a minimum.

5.2 All the joints shall be done by arc welding process. Overlapping of conductors at straight joints shall not be less than 150 mm. The contact surfaces shall be properly cleaned before jointing.

5.3 Those portions of galvanished steel flats, which have been welded at site, shall be coated with two (2) coats of cold galvanising anti-corrosive paint after welding.

5.4 After successful testing the bolted joints of test links shall be wrapped by bitumenons hessian tape followed by 3 mm thick coating of bitumen compound.

5.5 Air terminal rods and shielding masts shall be coated with weather resistant anti-corrosive paint (zinc chromate followed by two coats of aluminium paint).

5.6 Steel to copper connection shall be brazed type.

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS
LIGHTNING PROTECTION

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

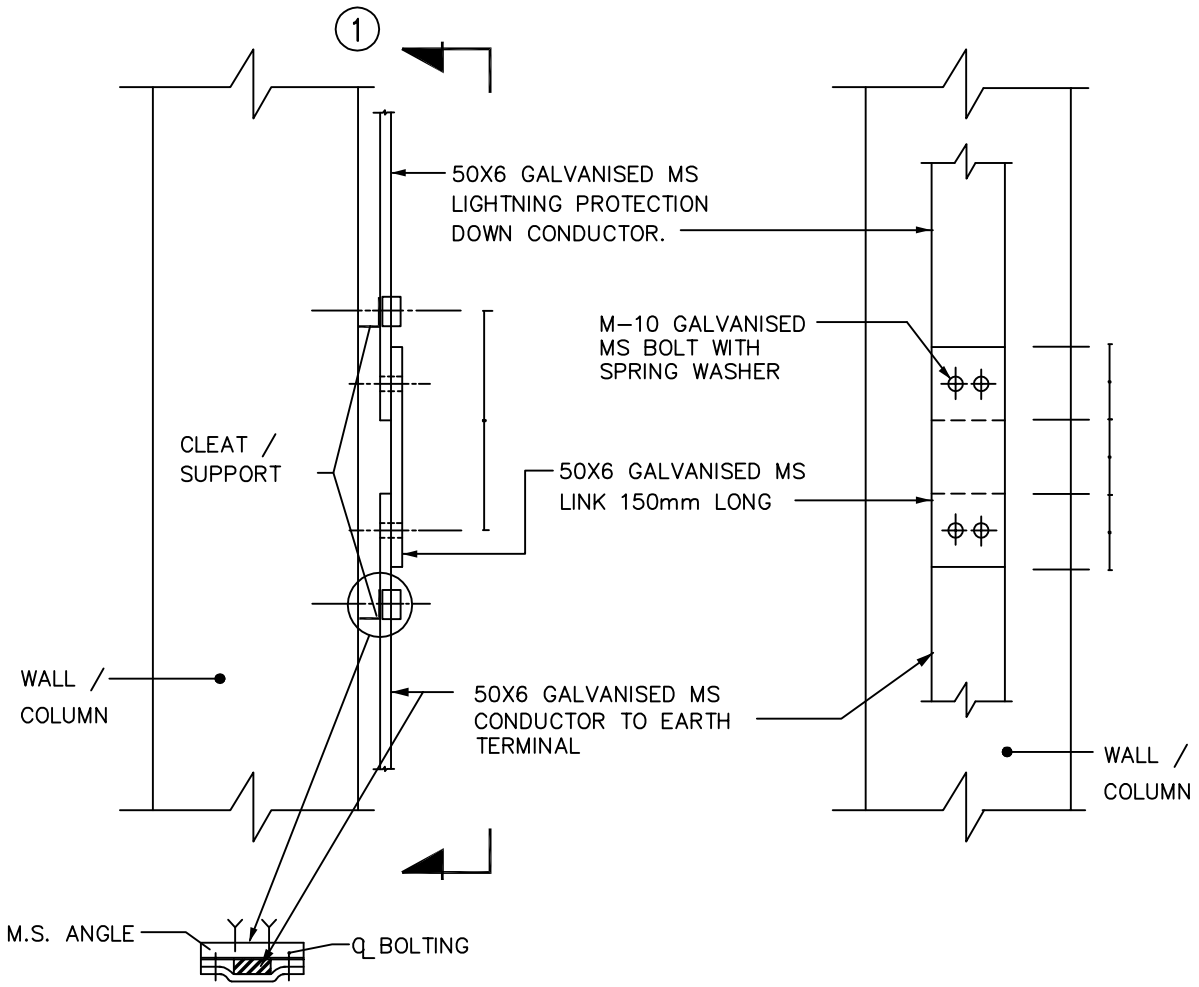
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DWG. NO. 14L08-DWG-E-1001 | REV. 0

SHT.-8 OF 13

File Name 14L08-DWG-E-1001

A4_DD (9-96) [210x297]



CLEATING ARRANGEMENT

SECTION - (1)

TEST LINK POINT / CLEATING ARRANGEMENT

NOTE :-

LINK POINT TO BE MOUNTED AT A HEIGHT
OF 1.5M ABOVE GROUND LEVEL

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS
LIGHTNING PROTECTION

ALUMINA UNLOADING AND
TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : NTS

DWG. NO. 14L08-DWG-E-1001 | REV. 0

SHT.-9 OF 13

File Name 14L08-DWG-E-1001

A4_DD (9-96) [210x297]

LIGHTNING PROTECTION NOTES AND DETAILS

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

NOTES & DETAILS
LIGHTNING PROTECTION

ALUMINA UNLOADING AND
TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
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JOB NO. 14L08 | SCALE : NTS

DWG. NO. 14L08-DWG-E-1001 | REV. 0

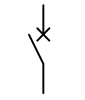
SHT.-1 OF 13

File Name 14L08-DWG-E-1001

A4_DD (9-96) [210x297]

DEVICE LEGEND :-


OFF–LOAD ISOLATOR


CIRCUIT BREAKER

FUSE

DRAWOUT CONNECTION


CURRENT TRANSFORMER


CORE BALANCE
CURRENT TRANSFORMER


VOLTAGE TRANSFORMER



DUAL CHANNEL CURRENT TRANSDUCER



DUAL CHANNEL VOLTAGE TRANSDUCER



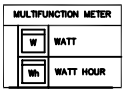
DUAL CHANNEL KILO–WATT TRANSDUCER



AMMETER



VOLTMETER



MULTIFUNCTION METER



AMMETER SELECTOR SWITCH

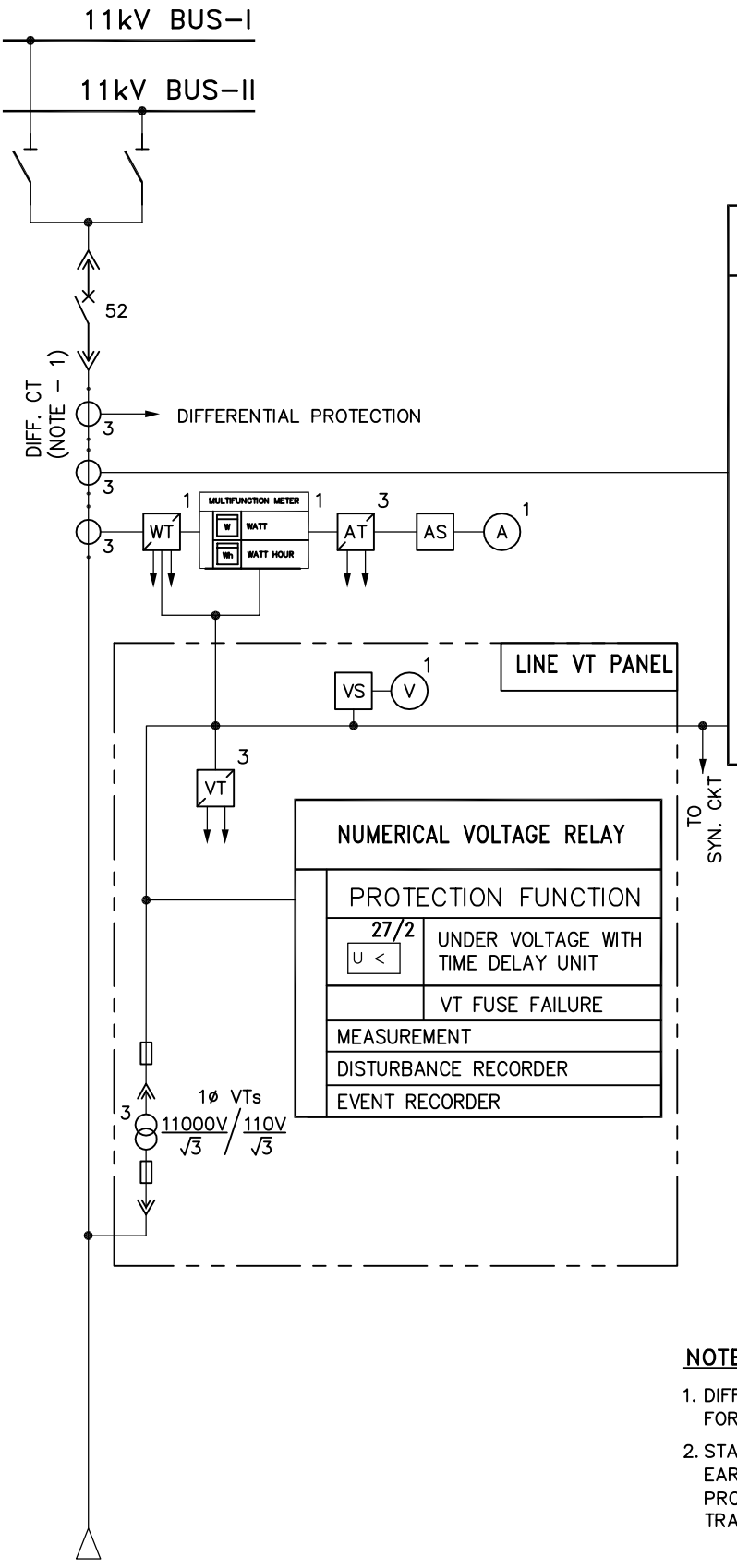


VOLTMETER SELECTOR SWITCH

14L08-DWG-E-105 Sh.1 of 7 24.11.14

A4_DD (9–96) [210x297]

					TYPICAL SINGLE LINE DIAGRAM ELECTRICAL LEGENDS	DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS
					ALUMINA UNLOADING AND TRANSPORTATION SYSTEM	JOB NO. 14L08 / SCALE : NONE
BB	BM	BM	0	24.11.14	NATIONAL ALUMINIUM COMPANY LIMITED SMELTER PLANT, ANGUL-759145	DWG. NO. 14L08–DWG–E–0105 SHT. 1 OF 7 / REV. 0
APPVD.	REVWD.	CHKD.	REV.	DATE		



NOTES:–

1. DIFFERENTIAL CTS SHALL BE PROVIDED FOR INCOMERS FROM TRANSFORMER ONLY.
2. STANDBY EARTH FAULT & RESTRICTED EARTH FAULT PROTECTION SHALL BE PROVIDED FOR INCOMER FROM TRANSFORMER ONLY.

TYPE–A INCOMER

BB	BM	BM	0	24.11.14
APPVD.	REVWD.	CHKD.	REV.	DATE

SINGLE LINE DIAGRAM OF 11kV I/C FEEDERS (TYP)

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS

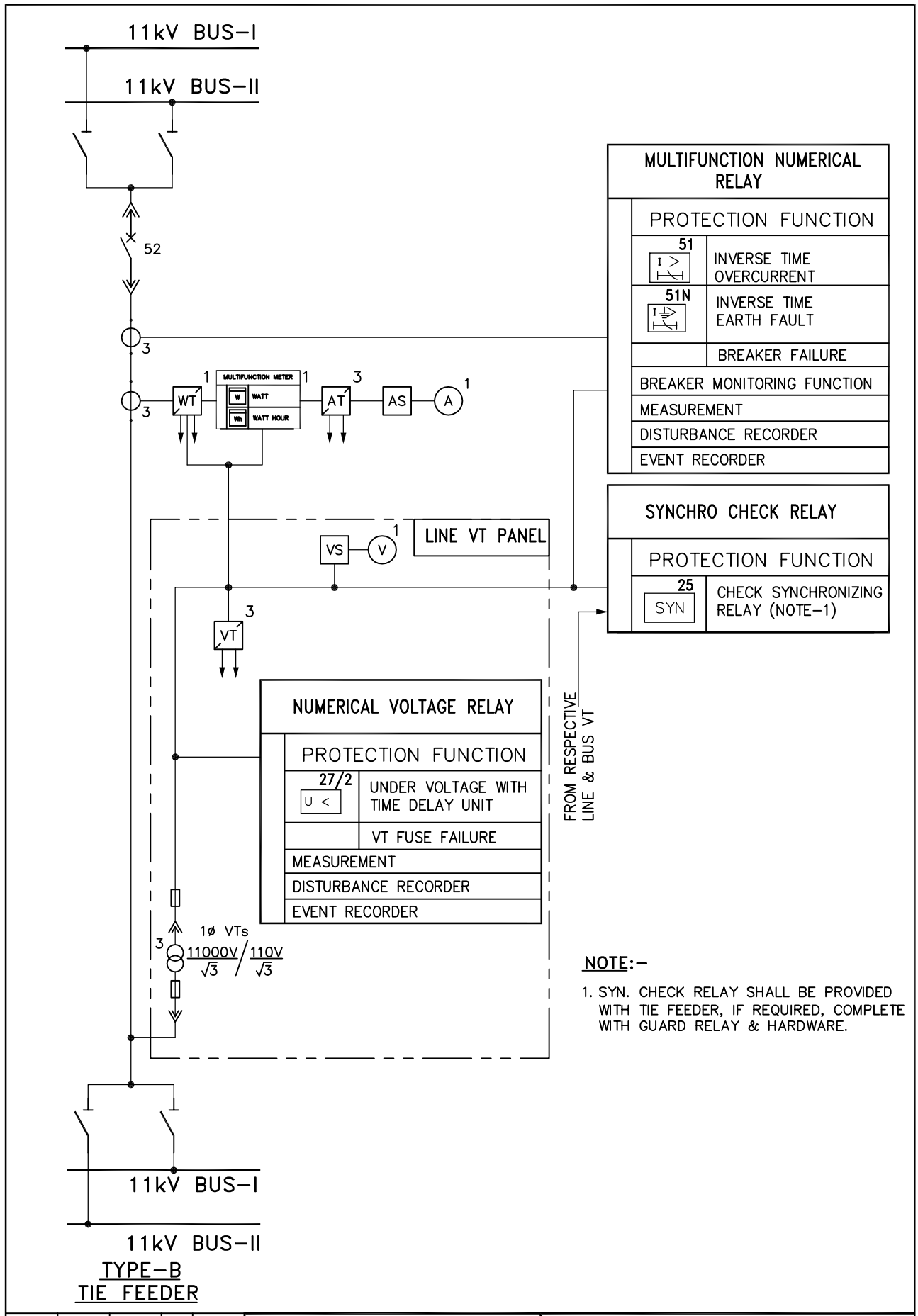
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DWG. NO. 14L08–DWG–E–0105 | REV. 0

SHT. 2 OF 7

14L08-DWG-E-105 Sh.2 of 7 24.11.14

A4_DD (9–96) [210x297]



BB	BM	BM	0	24.11.14
APPVD.	REVWD.	CHKD.	REV.	DATE

SINGLE LINE DIAGRAM OF 11kV TIE FEEDERS (TYP)

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS

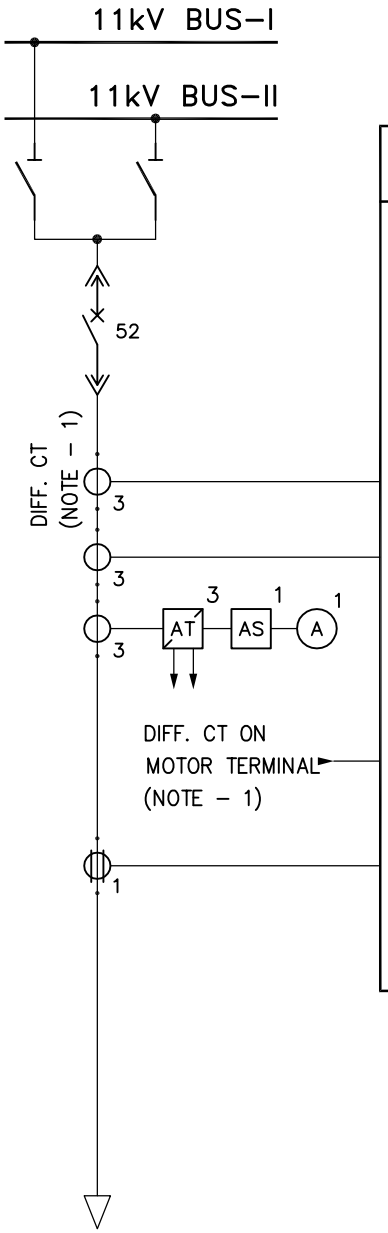
JOB NO. 14L08 | SCALE : NONE

DWG. NO. 14L08-DWG-E-0105 | REV. 0

SHT. 3 OF 7

14L08-DWG-E-105 Sh.3 of 7 24.11.14

A4_DD (9-96) [210x297]



MULTIFUNCTION NUMERICAL RELAY	
PROTECTION FUNCTION	
50 I>	SHORT CIRCUIT
49	THERMAL OVERLOAD
50G I≟>	DEFINITE TIME OVER CURRENT
46 I2>	CURRENT UNBALANCE/ SINGLE PHASING
50LR n≈0 I>	LOCKED ROTOR
87M Id	DIFFERENTIAL (REF. NOTE–1)
	BREAKER FAILURE
MEASUREMENT	
BREAKER MONITORING FUNCTION	
DISTURBANCE RECORDER	
EVENT RECORDER	

TYPE–C
MOTOR FEEDER

NOTE :–

1. DIFFERENTIAL PROTECTION SHALL BE PROVIDED FOR MOTOR RATED ABOVE 1000KW.

BB	BM	BM	0	24.11.14
APPVD.	REVWD.	CHKD.	REV.	DATE

SINGLE LINE DIAGRAM OF 11kV MOTOR FEEDERS (TYP)

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS

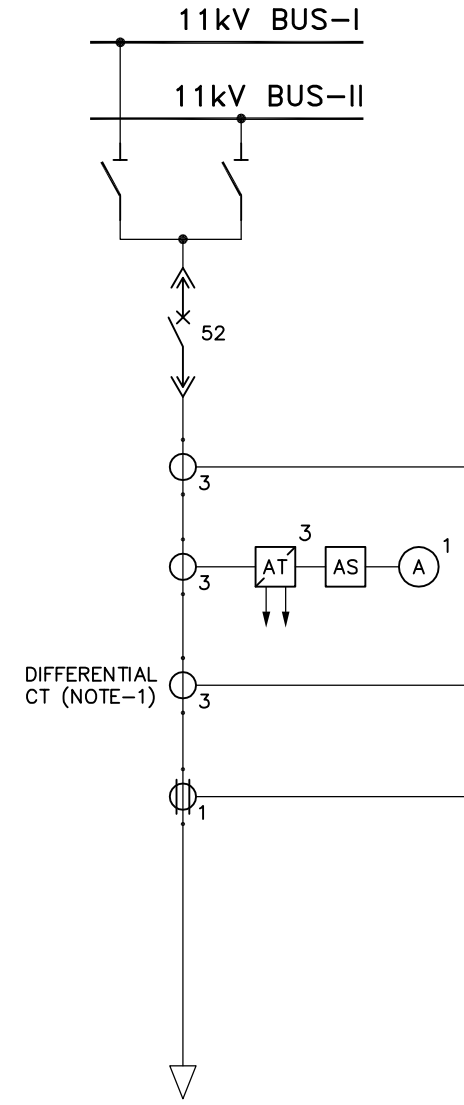
JOB NO. 14L08 | SCALE : NONE

DWG. NO. 14L08–DWG–E–0105 | REV. 0

SHT. 4 OF 7

14L08-DWG-E-105 Sh.4 of 7 24.11.14

A4_DD (9–96) [210x297]



MULTIFUNCTION NUMERICL RELAY	
PROTECTION FUNCTION	
50 I >	INSTANTANEOUS OVERCURRENT
51 I >	INVERSE TIME OVERCURRENT
50G I ⏚ >	DEFINITE TIME OVER CURRENT
87 Id	DIFFERENTIAL (NOTE–1)
	BREAKER FAILURE
BREAKER MONITORING FUNCTION	
MEASUREMENT	
DISTURBANCE RECORDER	
EVENT RECORDER	

ELECTRO–MAGNETIC/STATIC AUXILIARY RELAY		
PROTECTION FUNCTION		
63	BUCHHOLZ	ALARM
		TRIP
WTI t >	WINDING TEMP. HIGH	ALARM
		TRIP
	OIL TEMP. HIGH	ALARM
		TRIP
	PRESS. RELIEF DEV. OPERATED – ALARM	
	CONSERVATOR OIL LEVEL LOW – ALARM	

FROM AUX. TRANSFORMER

TYPE–D TRANSFORMER FEEDER

NOTE:–

1. DIFFERENTIAL PROTECTION SHALL BE PROVIDED FOR TRANSF. RATED 5MVA AND ABOVE.

BB	BM	BM	0	24.11.14
APPVD.	REVWD.	CHKD.	REV.	DATE

SINGLE LINE DIAGRAM OF 11kV TRANSFORMER FEEDERS (TYP)

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS

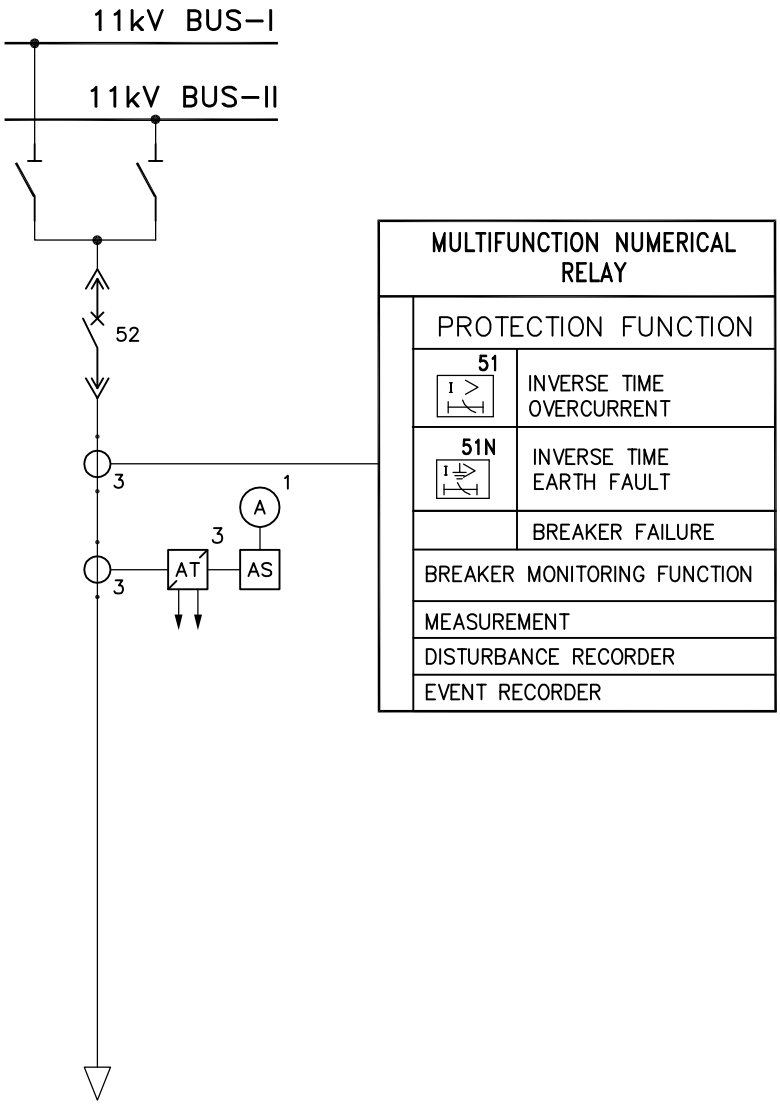
JOB NO. 14L08 | SCALE : NONE

DWG. NO. 14L08–DWG–E–0105 | REV. 0

SHT. 5 OF 7

14L08-DWG-E-105 Sh.5 of 7 24.11.14

A4_DD (9–96) [210x297]



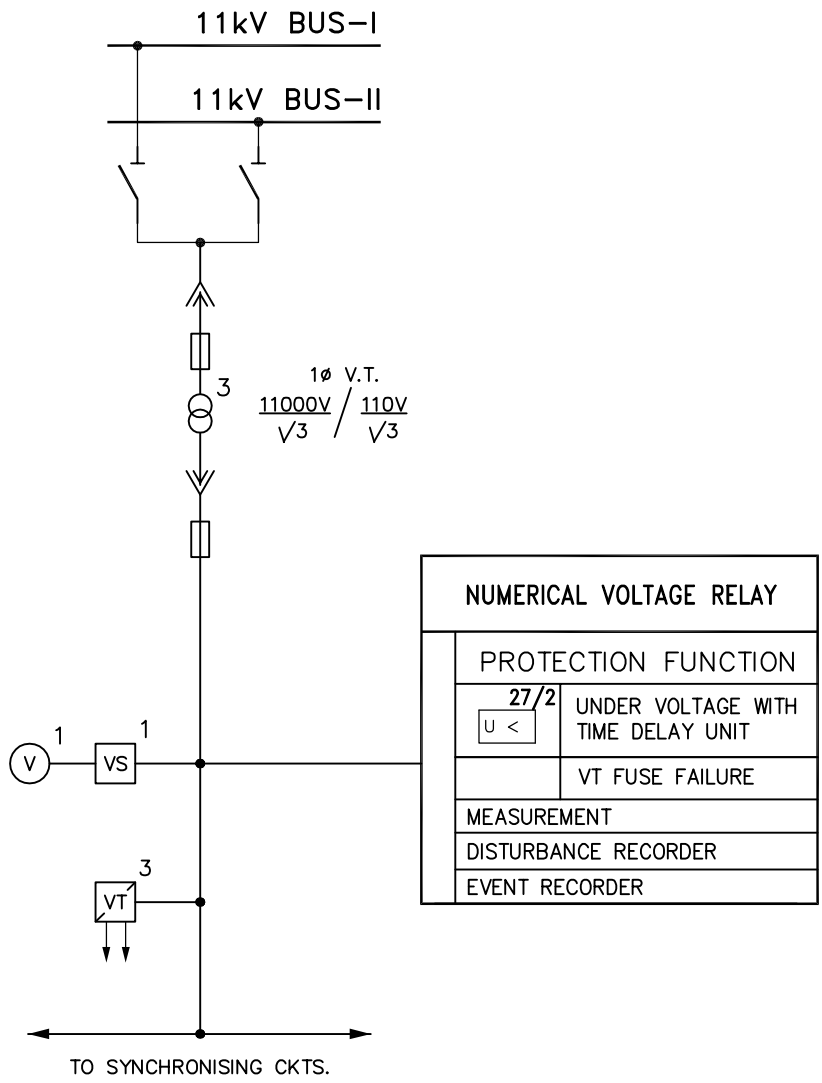
TYPE–E
OUTGOING FEEDER(O/G) / BUS COUPLER(B/C)

NOTE:–

1. METERING CT, TRANSDUCER, METER SELECTOR SWITCH & METER ARE NOT APPLICABLE FOR BUS COUPLER.
2. PARTIAL DIFFERENTIAL SCHEME SHALL BE PROVIDED WITH BUS COUPLER.

					SINGLE LINE DIAGRAM OF 11kV O/G & B/C FEEDERS (TYP)	DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS
					ALUMINA UNLOADING AND TRANSPORTATION SYSTEM	JOB NO. 14L08 / SCALE : NONE
BB	BM	BM	0	24.11.14	NATIONAL ALUMINIUM COMPANY LIMITED SMELTER PLANT, ANGUL-759145	DWG. NO. 14L08–DWG–E–0105 SHT. 6 OF 7 / REV. 0
APPVD.	REVWD.	CHKD.	REV.	DATE		

14L08-DWG-E-105 Sh.6 of 7 24.11.14
A4_DD (9–96) [210x297]



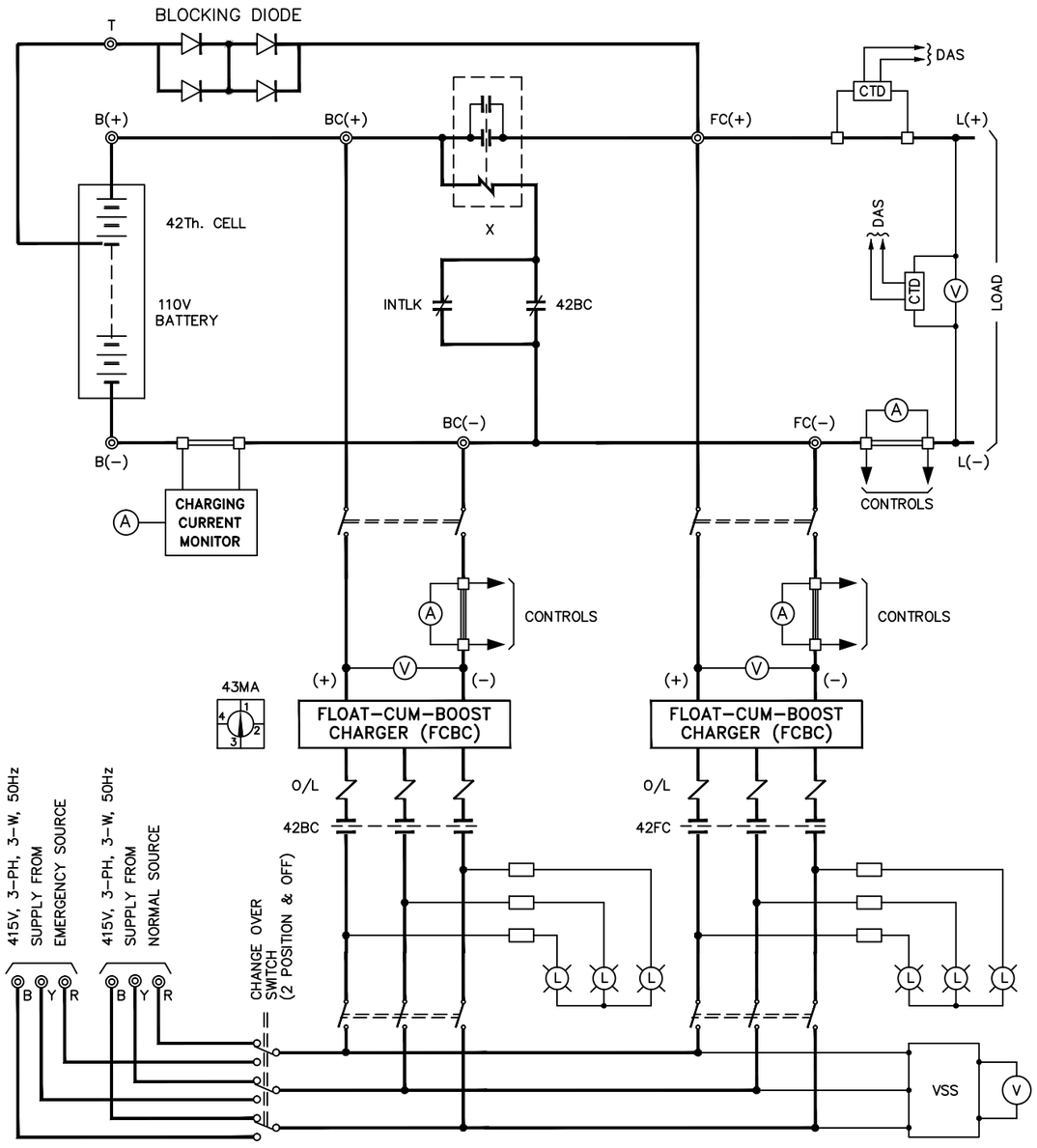
TYPE–F

BUS VT PANEL

14L08-DWG-E-105 Sh.7 of 7 24.11.14

A4_DD (9-96) [210x297]

					SINGLE LINE DIAGRAM OF 11kV BUS VT FEEDERS (TYP)	DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS
					ALUMINA UNLOADING AND TRANSPORTATION SYSTEM	JOB NO. 14L08 / SCALE : NONE
BB	BM	BM	0	24.11.14	NATIONAL ALUMINIUM COMPANY LIMITED SMELTER PLANT, ANGUL-759145	DWG. NO. 14L08–DWG–E–0105 SHT. 7 OF 7 / REV. 0
APPVD.	REVWD.	CHKD.	REV.	DATE		



OPERATION :−

1 . FLOAT CHARGER

a. OFF. FCBC MODE SELECTION SWITCH (43MA) IN AUTO FLOAT / CHARGE POSITION.

b. UNDER NORMAL OPERATION , FC WILL BE SUPPLYING LOAD CURRENT AS WELL AS THE FLOAT CHARGING CURRENT OF THE BATTERY.

c. IF FOR ANY REASON FC FAILS , FCBC WILL CUT IN AUTOMATICALLY AT FLOAT VOLTAGE TO TAKE OVER THE FUNCTIONS OF FC.

d. THERE IS ALSO PROVISION OF FLOAT CHARGING BY FCBC THROUGH MANUAL SELECTION BY MOVING 43MA TO FLOAT CHARGE POSITION.

2 . EQUALISING CHARGE

a. STATION SUPPLY HEALTHY. FC IS ON AND FCBC IS OFF. 43MA IN AUTO FLOAT /CHARGE POSITION.

b. FLOAT CHARGING CURRENT OF THE BATTERY WILL BE CONTINUOUSLY MONITORED TO ASCERTAIN THE BATTERY CONDITION.

c. IF THE FLOAT CHARGING CURRENT EXCEEDS A PRESET VALUE , FCBC WILL BE AUTOMA−TICALLY SWITCHED ON FOR CHARGING THE BATTERY AT A SLIGHTLY HIGHER RATE (EQUALISING CHARGE)

d. AFTER THE BATTERY IS CHARGED , FCBC WILL BE AUTOMATICALLY SWITCHED OFF AND FC WILL AGAIN TAKE OVER THE FUNCTION OF FLOAT CHARGING THE BATTERY.

e. THE LOAD CURRENT WILL BE MAINTAINED BY FC THROUGHOUT THE ENTIRE SEQUENCE.

f. THERE IS ALSO PROVISION FOR EQUALISING CHARGE THROUGH MANUAL SELECTION BY MOVING 43MA TO EQUALISING CHARGE POSITION.

3 . BOOST CHARGE

a. STATION SUPPLY HEALTHY. FC IS ON. FCBC IS ALSO ON. 43MA IN BOOST CHARGE POSITION.

b. FCBC BOOST CHARGES THE BATTERY AT HIGHER RATE.

c. FC MAINTAINS THE LOAD CURRENT. IF IT FAILS THE SUPPLY WILL BE MAINTAINED THROUGH BLOCKING DIODE WITHOUT ANY INTERRUPTION.

4 . EMERGENCY

a. STATION SUPPLY OFF. FC & FCBC GO OUT OF SERVICE.

b. THE BATTERY TAKES OVER & SUPPLIES THE EMERGENCY LOAD WITHOUT ANY INTERRUPTION.

LEGEND :−

	DISCONNECTING SWITCH
	HRC CARTRIDGE FUSE
	CONTACT
	COIL
V / A	VOLTMETER / AMMETER
VSS	VOLTMETER SELECTOR SWITCH (RY−YB−BR−OFF)
O/L	OVER LOAD RELAY (RATED COIL VOLTAGE − 415V)
X	D.C. CONTACTOR
42	A.C. CONTACTOR (RATED COIL VOLTAGE − 415V)
L	NEON LAMP
	MODE SELECTOR SWITCH. (43MA)
	1.. AUTO FLOAT / CHARGE
	2.. FLOAT(MANUAL)
	3.. EQUALISING CHARGE (MANUAL)
	4.. BOOST CHARGE (MANUAL)
CTD / VTD	CURRENT/VOLTAGE TRANSDUCER WITH DUAL OUTPUT

FOR TENDER PURPOSE ONLY

REVIEWED											
			BB	BM	BM	KKB	FOR TENDER PURPOSE ONLY		0	24.11.14
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

BATTERY CHARGER SCHEME

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LTD. SMELTER PLANT, ANGUL−759145

DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : NONE

DWG.NO. 14L08−DWG−E−1206 | REV. 0

14L08-DWG-E-1206

26.09.14

A3 (9−96) [420x297]

CONTROL SUPPLY | SP.CHARGE MOTOR | CLOSE CKT. | INDICATION | TRIP SUPERVISION | TRIP CKT.

110V DC SUPPLY (+) (−)

FU-TR
FU-CL
FU-SPCH.
PROTECTIVE DEVICE
43 LOCAL
43 REMOTE
33 SERV
TRIP
NEUTRAL
CLOSE
33 SERV.
52X I/C-1
52X B/C
27D/F BUS DEAD
27D/F
MANUAL CLOSING FROM PLC
AUTO CLOSING FROM PLC
PLC
CS
33 TEST
LINE
27A/B HEALTHY
27A/B & PT FUSE FAILURE
BUS NOT EARTHED
86 I/C
86 B/C
74X
LS SP.CH
M
94
52 a
52 b
52CC
30A
30B
OP
RE
G A B W R
LS SP.CH.
74
74B
74A
2
SYN. FAIL
LINE U/V
UP STREAM BREAKER TRIP
33 TEST
43 LOCAL
51
86
51N
52TC
52X I/C-2

43 REMOTE | 43 LOCAL | 33 S | 30A | 30B | 52X | 74X

PLC | PLC | SPARE | PLC | SPARE | PLC | SPARE | PLC | SPARE | PLC | SPARE

NOTES:−

1. SUITABLE INTERLOCK TO BE BUILT WITHIN PLC TO PREVENT SUSTAINED PARALLEL OPERATION OF I/C & B/C.

TENDER ONLY

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LTD.
SMELTER PLANT, ANGUL-759145

CONSULTANT:−
DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS
KOLKATA. MUMBAI. CHENNA.I DELHI.

TITLE:−
TYPICAL CONTROL SCHEMATIC
415V MCC INCOMER

JOB NO. 14L08 | SCALE : N.T.S
DWG. NO.− 14L08-DWG-E-1301 | REV. 0

REVIEWED										
			B.B	B.M	B.M	KKB	INITIAL ISSUE	FOR TENDERING	0	24.11.14
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

File Name. 14L08-DWG-E-1301

A3 (9-96) [420x297]

CONTROL SUPPLY | SP.CHARGE MOTOR | CLOSE CKT. | INDICATION | TRIP SUPERVISION | TRIP CKT.

110V DC SUPPLY (+) (−)

FU–TR
FU–CL
FU–SPCH.
PROTECTIVE DEVICE
43 LOCAL
43 REMOTE
33 SERV
TRIP
NEUTRAL
CLOSE
33 SERV.
52X I/C–1
52X I/C–2
27D/F BUS DEAD
27D/F
MANUAL CLOSING FROM PLC
AUTO CLOSING FROM PLC
PLC
CS
33 TEST
LINE
27A/B HEALTHY
27A/B & PT FUSE FAILURE
BUS NOT EARTHED
86 I/C–1
86 I/C–2
74X
LS SP.CH
M
94
52 a
52 b
LS SP.CH.
52CC
30A
30B
OP
RE
G A B W R
LS SP.CH.
33 SERV
74X
30B
74
74B
74A
74A
74B
PLC
CS TRIP
33 SERV
SYN. FAIL
LINE U/V
UP STREAM BREAKER TRIP
TRIP
NEUTRAL
CLOSE
33 TEST
43 LOCAL
51
86
51N
2
52 b
52 a
74X
52TC
86
PLC
52X B/C
52X I/C–1
52X I/C–2
2

43 REMOTE | 43 LOCAL | 33 S | 30A | 30B | 52X | 74X

PLC | PLC | SPARE | PLC | SPARE | PLC | SPARE | PLC | SPARE | PLC | SPARE

NOTES:–

1. SUITABLE INTERLOCK TO BE BUILT WITHIN PLC TO PREVENT SUSTAINED PARALLEL OPERATION OF I/C & B/C.

TENDER ONLY

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LTD.
SMELTER PLANT, ANGUL–759145

CONSULTANT:–
DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS
KOLKATA. MUMBAI. CHENNA.I DELHI.

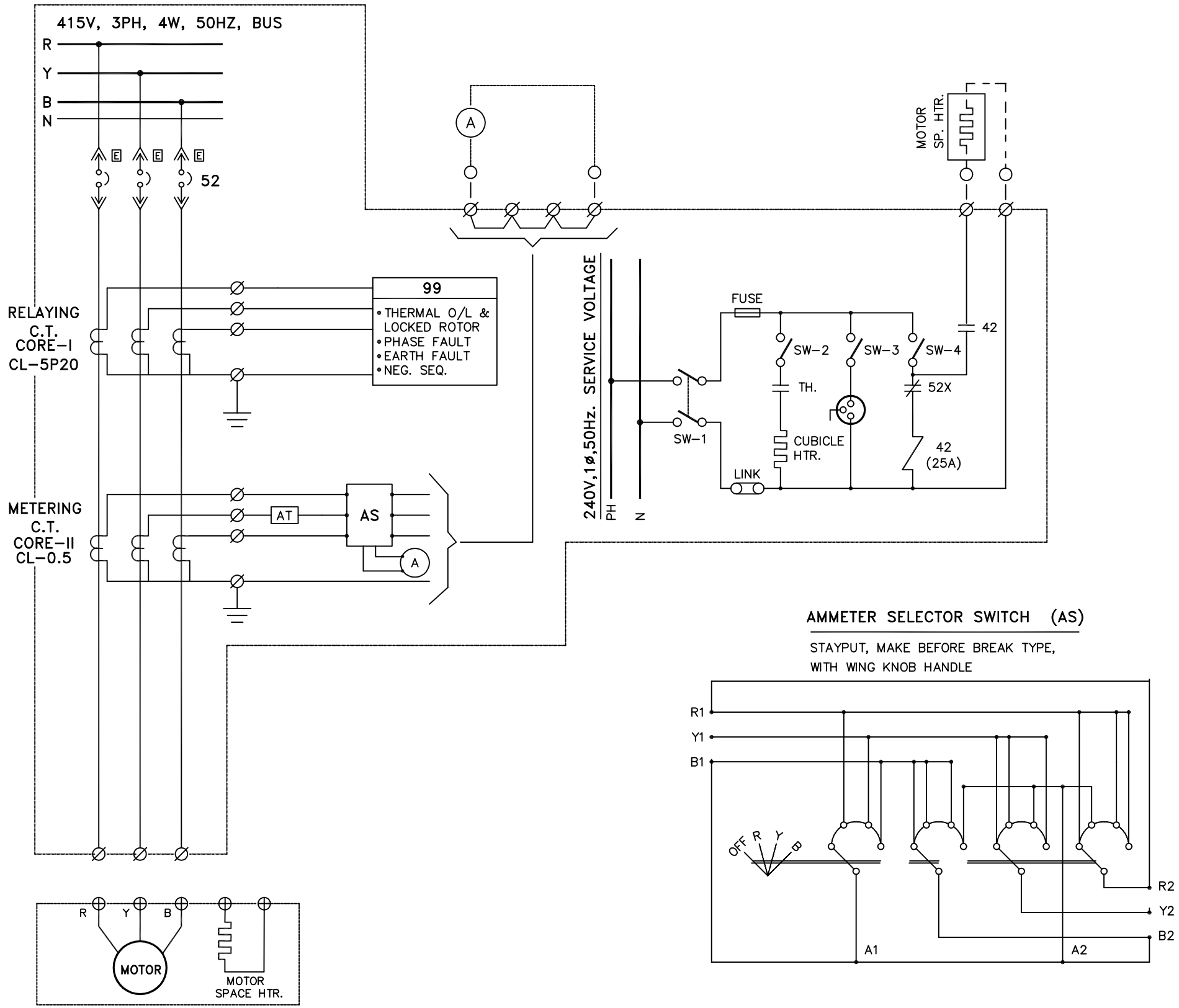
TITLE:–
TYPICAL CONTROL SCHEMATIC
415V MCC B/C

JOB NO. 14L08 | SCALE : N.T.S
DWG. NO.– 14L08–DWG–E–1302 | REV. 0

REVIEWED										
			B.B	B.M	B.M	KKB	INITIAL ISSUE	FOR TENDERING	0	24.11.14
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

File Name. 14L08–DWG–E–1302

A3 (9–96) [420x297]



AMMETER SELECTOR SWITCH (AS)

STAYPUT, MAKE BEFORE BREAK TYPE,
WITH WING KNOB HANDLE

N O T E S :–

1. ALL DEVICES, CONNECTIONS & TERMINALS SHOWN WITHIN AREA SHADED THUS [ ] SHALL BE LOCATED ON PCC/PMCC
2. ALL DEVICES/TERMINALS SHOWN WITHIN AREA SHADED THUS [ ] AND MARKED THUS ●SHALL BE LOCATED ON REMOTE.
3. THIS SCHEME HAS BEEN DRAWN WITH BREAKER "OFF" IN "SERVICE" POSITION,SELECTOR SWITCH(43) IN "NORMAL" POSITION AND NO POWER SUPPLY CONDITION.
4. FOR LEGENDS REFER DWG. NO. 14L08–DWG–E–0105
5. K1 AND K2 ARE INTERPOSING RELAYS.
6. 99 IS NUMERICAL MOTOR PROTECTION RELAY.
7. THIS SCHEME IS FOR GENERAL GUIDANCE OF THE TENDERERS ONLY. TENDERERS SHALL DEVELOP DETAIL SCHEMES FOR EACH MOTOR FEEDER.

TENDER ONLY

REVIEWED										
			B.B	B.M	B.M	KKB	INITIAL ISSUE	FOR TENDERING	0	24.11.14
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

TITLE: –
CONTROL SCHEMATIC (TYP)
BREAKER OPERATED 415V. MOTOR FEEDER

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LTD.
SMELTER PLANT, ANGUL–759145

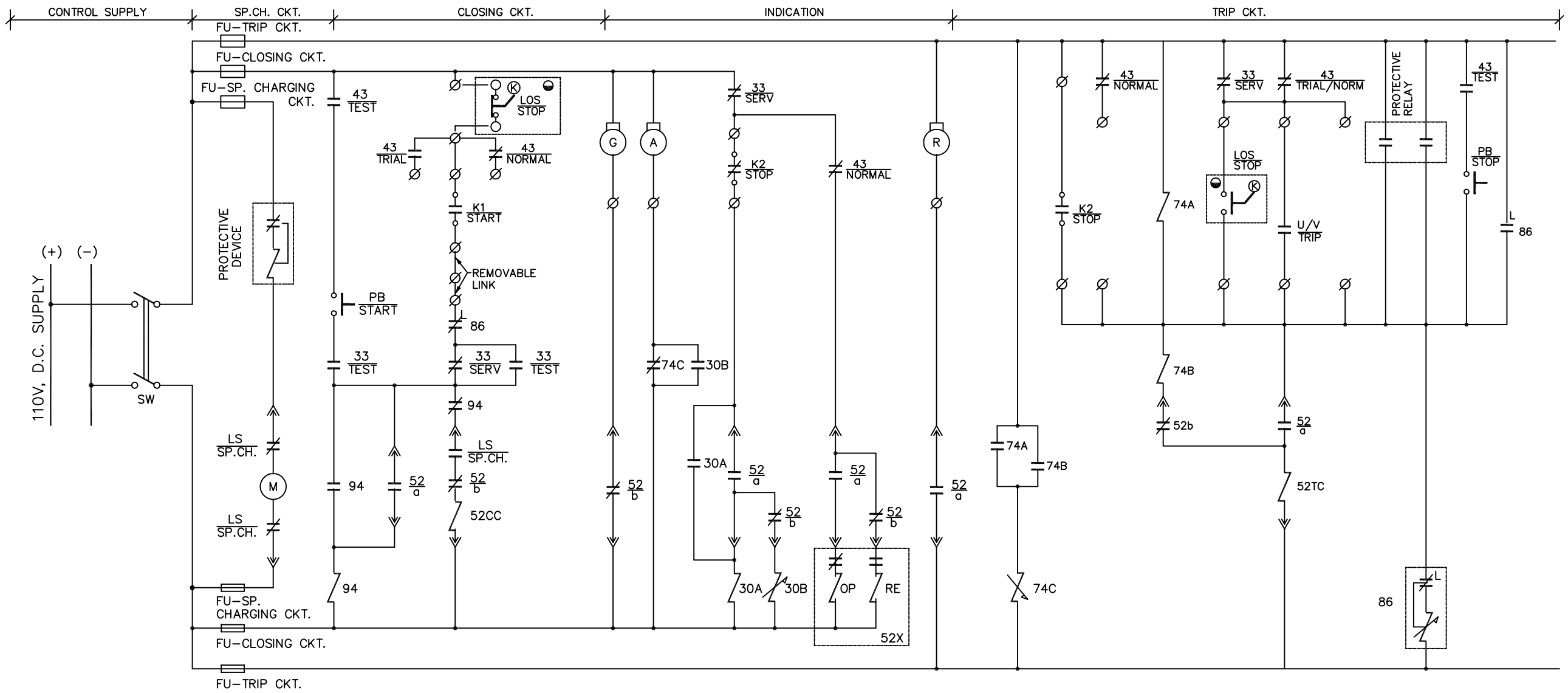
CONSULTANT: –
DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS
KOLKATA. MUMBAI. CHENNA.I DELHI.

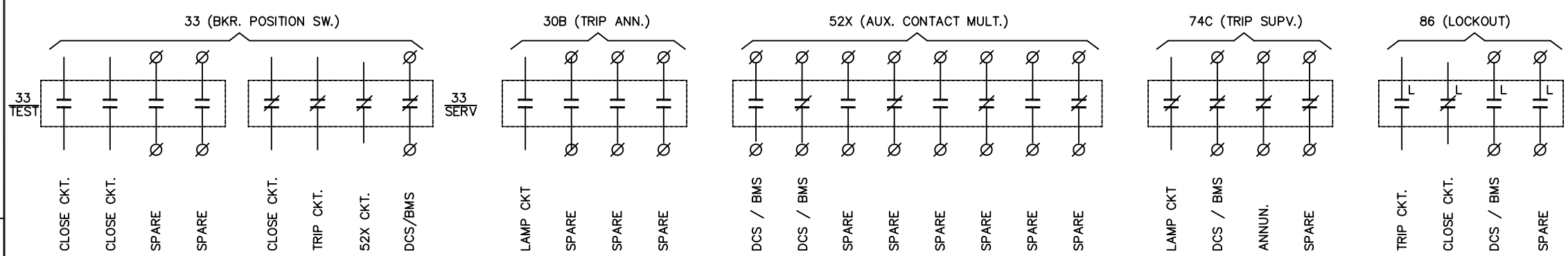
JOB NO. 14L08 | SCALE : N.T.S

DWG. NO.– 14L08–DWG–E–1303 (1 OF 3) | REV. 0

File Name. 14L08–DWG–E–1303 (sht. 1 of 3)

A3 (9–96) [420x297]





TENDER ONLY

NOTES :

1.. FOR NOTES REFER SHT. 1 OF THIS DWG.

2.. FOR CONTACT DEVELOPMENT OF SELECTOR SWITCH–43 REFER SHT.3 OF THIS DWG.

3.. K1 & K2 RELAYS IN SWGR PANEL.

REVIEWED										
			B.B	B.M	B.M	KKB	INITIAL ISSUE	FOR TENDERING	0	24.11.14
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

TITLE: –

CONTROL SCHEMATIC (TYP)
BREAKER OPERATED 415V. MOTOR FEEDER

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LTD.
SMELTER PLANT, ANGUL–759145

CONSULTANT: –
DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS
KOLKATA. MUMBAI. CHENNA.I DELHI.

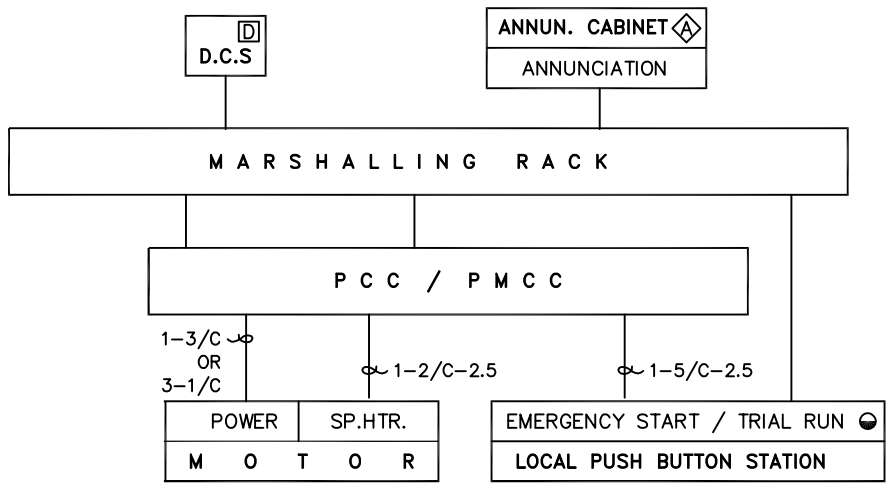
JOB NO. 14L08 | SCALE : N.T.S

DWG. NO.– 14L08–DWG–E–1303 (2 OF 3) | REV. 0

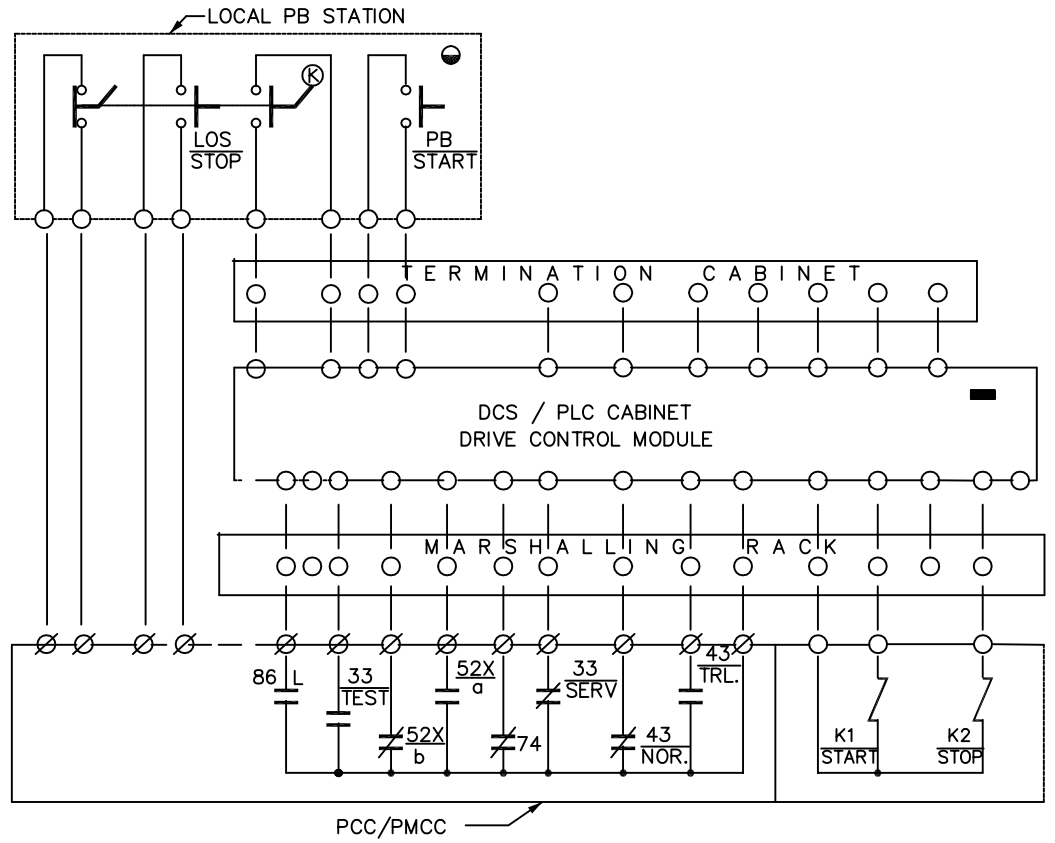
File Name. 14L08–DWG–E–1303 (sht. 2 of 3)

A3 (9–96) [420x297]

CABLE DIAGRAM

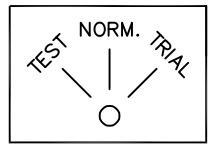


RCP–DCS/PLC–PCC/PMCC INTERFACE



SELECTOR SWITCH (43)

TYPE: STAYPUT WITH PISTOL GRIP HANDLE AND KEY INTERLOCK
(BREAKER OPERATED 415V MOTOR FEEDER – DCS/PLC CONTROLLED)



CONTACT NO.		POSITION TEST	POSITION NORMAL	POSITION TRIAL	PURPOSE
⊸⊣⊢⊸	1	X			BKR. CLOSE CKT.
⊸⊣⊢⊸	2		X		BKR. CLOSE CKT.
⊸⊣⊢⊸	3			X	BKR. CLOSE CKT.
⊸⊣⊢⊸	4	X			BKR. TRIP CKT.
⊸⊣⊢⊸	5		X		BKR. TRIP CKT.
⊸⊣⊢⊸	6		X	X	BKR. TRIP CKT.
⊸⊣⊢⊸	7		X		DCS / BMS
⊸⊣⊢⊸	8			X	DCS / BMS
⊸⊣⊢⊸	9		X		52X CKT.
⊸⊣⊢⊸	10		X		SPARE

NOTE : FOR NOTES, REFER SHT. 1 OF THIS DWG.

TENDER ONLY

REVIEWED										
			B.B	B.M	B.M	KKB	INITIAL ISSUE	FOR TENDERING	0	24.11.14
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

TITLE: –

CONTROL SCHEMATIC (TYP)
BREAKER OPERATED 415V. MOTOR FEEDER

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LTD.
SMELTER PLANT, ANGUL–759145

CONSULTANT: –
DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS
KOLKATA. MUMBAI. CHENNA.I DELHI.

JOB NO. 14L08 | SCALE : N.T.S

DWG. NO.– 14L08–DWG–E–1303 (3 OF 3) | REV. 0

File Name. 14L08-DWG-E-1303 (sht. 3 of 3)

A3 (9–96) [420x297]

A3 (9–96) [420x297]

File Name. 14L08-DWG-E-1304 (snt. 1 of 2)

REVIEWED	APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE
	B.B	B.M	B.M	KKB	INITIAL ISSUE	FOR TENDERING	0	24.11.14

TITLE:– CONTROL SCHEMATIC (TYP)
CONTACTOR OPERATED 415V. UNI–DIRECTIONAL MOTOR FDR. : DCS/PLC CONTROLLED

CONSULTANT:– DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS
KOLKATA. MUMBAI. CHENNAI. DELHI.

JOB NO. 14L08 | SCALE : N.T.S | DWG. NO.– 14L08–DWG–E–1304 (1 OF 2) | REV. 0

NATIONAL ALUMINIUM COMPANY LTD.
SMELTER PLANT, ANGUL–759145

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

TENDER ONLY

SELECTOR SWITCH – 43

ACTUATOR WITH KEY INTERLOCK
MAINTAINED CONTACT, STAY–PUT TYPE

FRONT VIEW: NORMAL, TRIAL, MCC

CONTACT NO	POSITION NORM.	POSITION TRIAL	POSITION MCC	PURPOSE
1		X		42 CKT
2	X			42 CKT
3		X		DCS
4	X			DCS
5		X		SPARE
6	X			DCS
7			X	DCS
8			X	R CKT

NOTES:–

1. ALL EQUIPMENT, DEVICES AND CONNECTIONS SHOWN WITHIN AREA SHADED THUS ▭ SHALL BE PROVIDED AT MCC/PMCC
2. Ko AND K1 ARE INTERPOSING RELAYS.
3. THIS SCHEME IS INDICATE AND MEANT FOR GENERAL GUIDANCE OF THE TENDERERS ONLY. TENDERER SHALL DEVELOP DETAIL SCHEMES FOR EACH MOTOR FEEDER.

LEGEND:–

- ⩓ CONTACT CLOSED IN SERVICE POSITION
- ⩓ CONTACT CLOSED IN TEST POSITION
- ⩓ CONTACT CLOSED IN SERVICE & TEST POSITION
- TERMINAL AT MCC
- TERMINAL OF REMOTE EQUIPMENT
- TS TORQUE SWITCH
- LS LIMIT SWITCH
- C.F CONTROL FUSE
- R.C.P REMOTE CONTROL PANEL / DESK
- M.R. MARSHALLING RACK
- ⊗ STAY PUT TYPE
- —— REMOVABLE LINK

42X: 42X CKT. MOTOR HTG.CKT. SPARE 2 TIMER CKT. | 42(AUX.CONTACTS): SEAL IN CKT. OF 42, 'G' LAMP CKT., 'R' LAMP CKT., DCS DRIVE STATUS, SEAL IN CKT. OF 42, SPARE, DCS DRIVE STATUS, DCS DRIVE STATUS

FOR ESSENTIAL MOTOR: 42Y1 CKT. SPARE, I62 TIMER ICKT. SPARE, SPARE

R: TEST CIRCUIT, SEAL IN CKT. OF 42, SPARE, SEAL IN CKT. OF 42

74(SUPV.RELAY): DCS/MCC DISTURBANCE TRIP, DCS/ELE TRIP, SPARE, SPARE

FOR ESSENTIAL MOTOR: 42Y1: SEAL IN CKT. OF 42Y1, HOLDING CKT. OF 42, HOLDING CKT. OF 42 — OFF DELAY TIMER 62

42Y2: WINDING HEATING CIRCUIT, WINDING HEATING CIRCUIT, WINDING HEATING CIRCUIT, SPARE 42Y2 CIRCUIT — ON DELAY TIMER 2

WINDING HEATING CKT.OF HIGH INERTIA MOTORS <30KW

240V,1–Ph,50Hz CONTROL BUS (Ph, N); LK; CF; 43 MCC; R; 74; 42; 42X; A; SW; 42Y1/62/R; 42X/42Y1; 43 NORMAL; K1 START; K2 STOP; LPB STOP; 49; PROTN. TRIP; PB TEST; R; LPB START; SAFTY START PERMISSIVE; 43 TRIAL; 42X/42Y1; 42X/42Y1/62/R

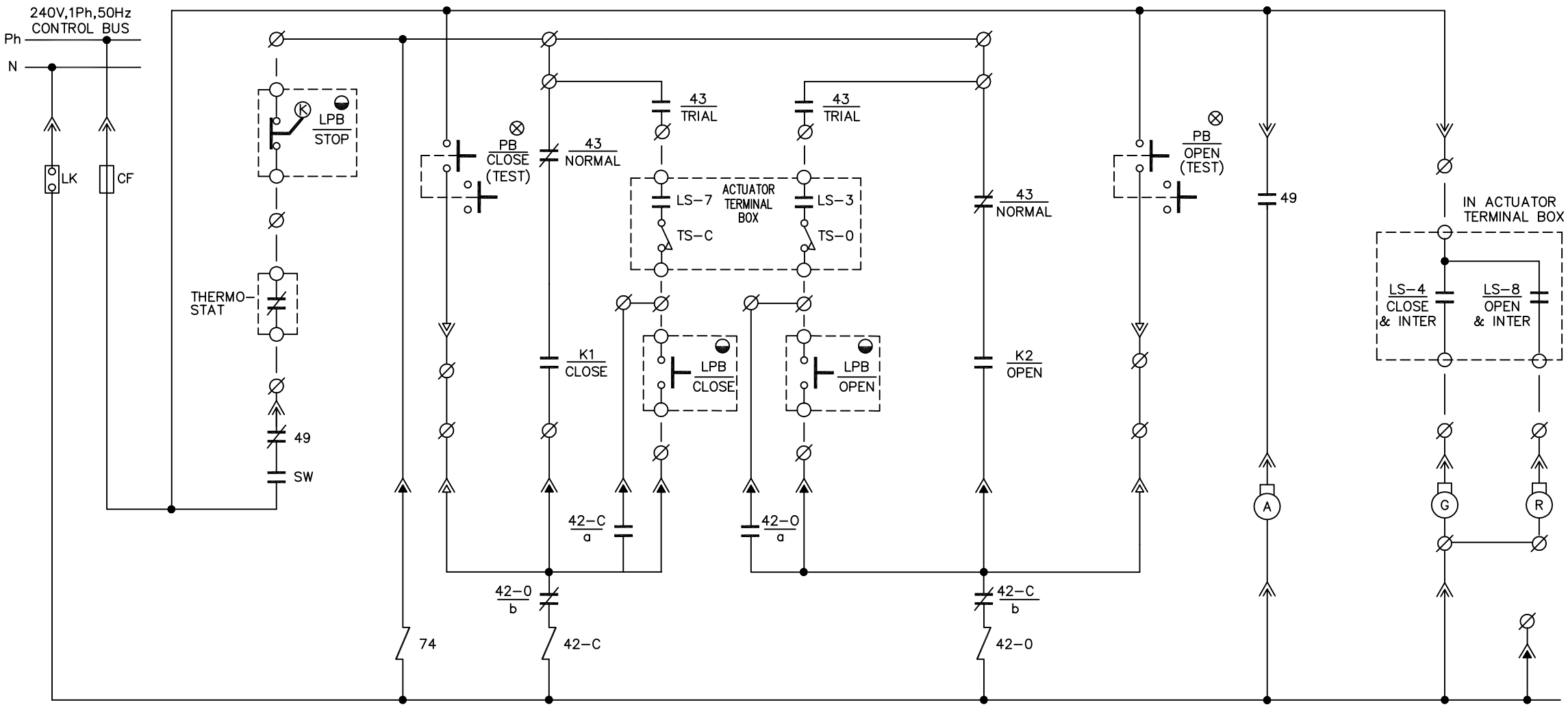
AUTO ACCELERATION FOR ESSENTIAL MOTORS

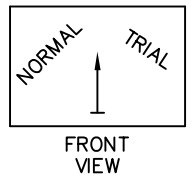
OFF DELAY TIMER 62 — 42X/42Y1

ON DELAY TIMER 2 — 42Y2/2

TIME DELAY CKT. FOR WINDING HEATING CONTROL (FOR INERTIA DRIVES)

42X/42; 42X/b; 2; G; R



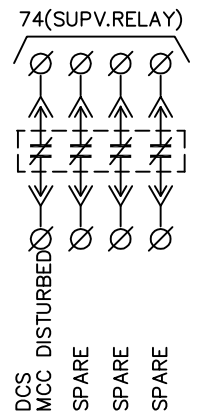


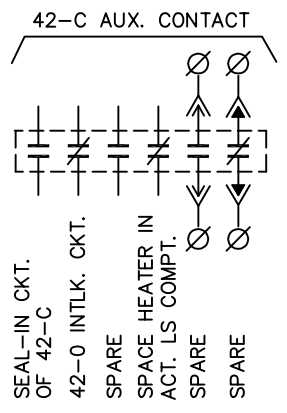
SELECTOR SWITCH – 43
ACTUATOR WITH KEY INTERLOCK
MAINTAINED CONTACT, STAY–PUT TYPE

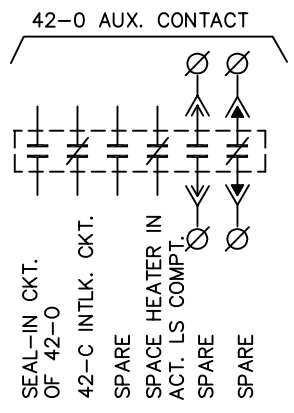
CONTACT NO.		POSITION NORM.	POSITION TRIAL	PURPOSE
⊶⊣⊢⊶	1		X	42–C CKT
⊶⊣⊢⊶	2	X		42–C CKT
⊶⊣⊢⊶	3		X	42–O CKT
⊶⊣⊢⊶	4	X		42–O CKT
⊶⊣⊢⊶	5		X	DCS
⊶⊣⊢⊶	6	X		SPARE

LIMIT SWITCH
SOLID BAR INDICATES CONTACT CLOSED

LIMIT SW. CONTACT NO.	VALVE POSITION OPEN	INTER	CLOSED	PURPOSE
⊶⊣⊢⊶ LS–1	———			SPARE
⊶⊣⊢⊶ LS–2	———			SPARE
⊶⊣⊢⊶ LS–3		———	———	42–O CKT
⊶⊣⊢⊶ LS–4		———	———	IND. CKT
⊶⊣⊢⊶ LS–5			———	SPARE
⊶⊣⊢⊶ LS–6			———	SPARE
⊶⊣⊢⊶ LS–7	———	———		42–C CKT
⊶⊣⊢⊶ LS–8	———	———		IND.CKT
LS–9 TO LS–16	SPARE			SPARE







NOTE:–

1. FOR NOTES AND LEGEND REF. TO SHT–1 OF THIS DRAWING.
2. CLOSE & OPEN LIMIT SWITCH SHALL BE MULTIPLIED AT MCC PANEL FOR FEED BACK TO DCS TO AVOID MIXING OF 240V AC CONTROL & 24V DC DCS CONTROL VOLTAGE.

TENDER ONLY

REVIEWED										
			B.B	B.M	B.M	KKB	INITIAL ISSUE	FOR TENDERING	0	24.11.14
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

TITLE: –
CONTROL SCHEMATIC (TYP)
CONTACTOR OPERATED 415V. BI–DIRECTIONAL
MOTOR FDR. : DCS/PLC CONTROLLED

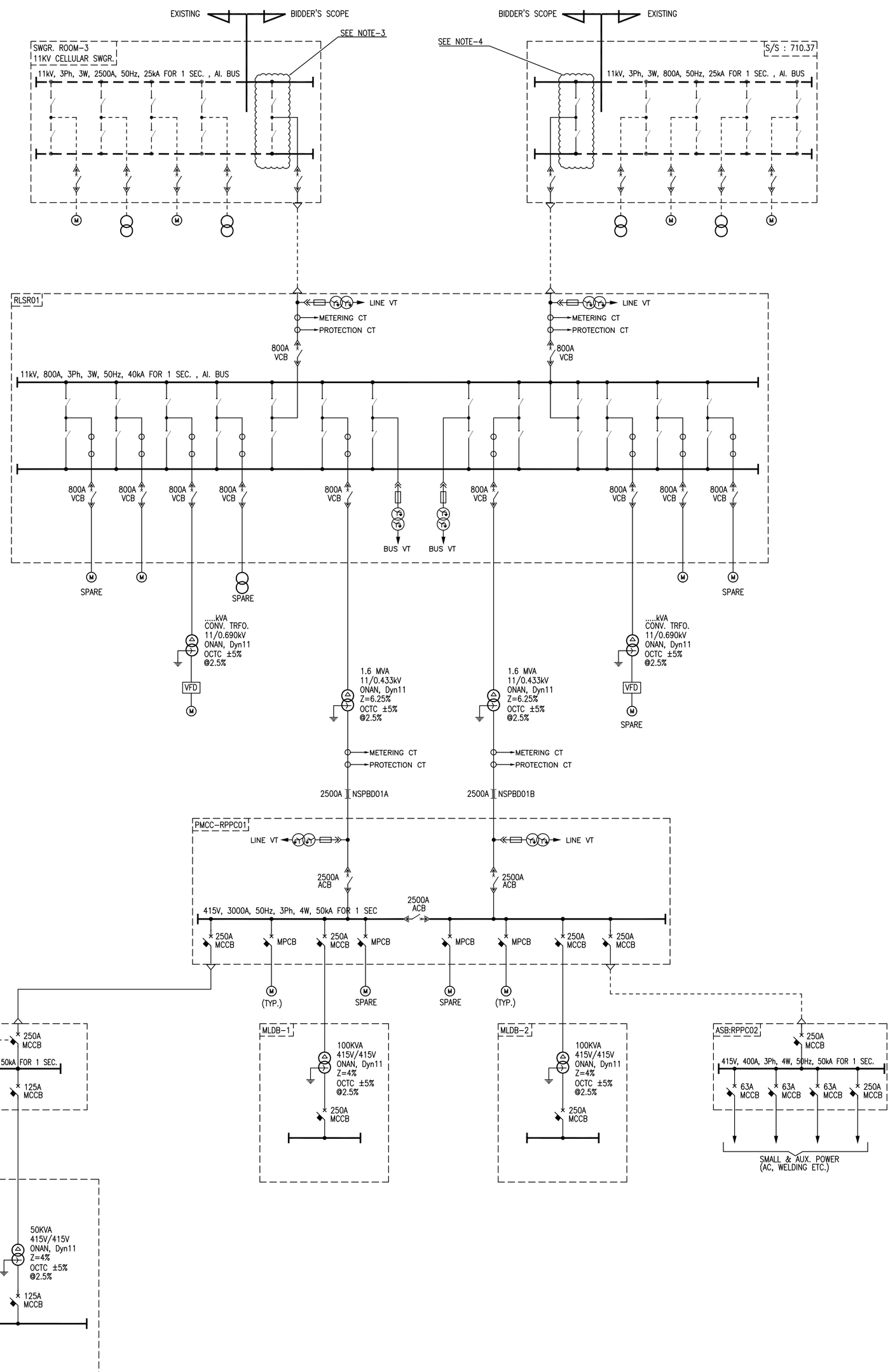
ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LTD.
SMELTER PLANT, ANGUL–759145

CONSULTANT: –
DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS
KOLKATA. MUMBAI. CHENNA.I DELHI.

JOB NO. 14L08 | SCALE : N.T.S
DWG. NO.– 14L08–DWG–E–1304 (2 OF 2) | REV. 0

File Name. 14L08–DWG–E–1304 (sht. 2 of 2)
A3 (9–96) [420x297]



LEGENDS:

- ISOLATOR
- CIRCUIT BREAKER (VCB, ACB,)
- TWO WINDING TRANSFORMER
- M — MOTOR
- DRAWOUT
- NON SEGREGATED PHASE BUS DUCT
- MCCB/MPCB
- CABLE CONNECTION
- VT
- FUSE
- CT
- K1/2 — INTERLOCK

MLDB	MAIN LIGHTING DISTRIBUTION BOARD.
ELDB	EMERGENCY LIGHTING DISTRIBUTION BOARD.
PMCC	POWER & MOTOR CONTROL CENTRE.
ASB	AUX. SWITCH BOARD.

NOTES:

1. THE POWER DISTRIBUTION SCHEME SHOWN IN THE DRAWING IS INDICATIVE ONLY AND FOR GENERAL UNDERSTANDING OF THE WORK UNDER THE TENDERER'S SCOPE. ITEMS THAT ARE NOT SPECIFICALLY MENTIONED/SPECIFIED BUT ARE REQUIRED TO MAKE THE SYSTEM COMPLETE, SAFE IN ALL RESPECT SHALL BE DEEMED TO BE INCLUDED IN THE SCOPE OF THE TENDERER.
2. RATING AND QUANTITY OF DIFFERENT EQUIPMENTS (e.g. TRANSFORMER RATING & IMPEDANCE, RATING OF SWITCHBOARD, DISTRIBUTION OF LIGHTING & SMALL POWER, UPS & DC SYSTEM etc.) SHOWN IN THE DRAWING ARE INDICATIVE & MINIMUM . EXACT RATING AND QUANTITY SHALL BE DECIDED BY CONTRACTOR DURING DETAIL ENGINEERING WITH BACK UP CALCULATION & AS PER INPUT FROM OWNER AS APPLICABLE.
3. IN 11KV CELLULAR SWITCHGEAR, SPACE AVAILABLE FOR FUTURE FEEDER 3C10 SHALL BE USED FOR PROPOSED AUGMENTATION. TWO NOS. ISOLATORS ARE INSTALLED IN FEEDER 3C10. BUS WORK IS ALSO EXISTING UPTO THE ISOLATORS. NECESSARY BUS WORK AFTER THE ISOLATORS, BREAKER, CT ETC. SHALL BE PROVIDED BY LSTK CONTRACTOR.
4. 11KV SWITCHGEAR AT SUBSTATION-37 SHALL BE EXTENDED BY ADDING ONE NO. VCB FEEDER. EXTENSION OF 11KV FEEDER ALONG WITH THE BUS WORK AND INTERFACING WITH THE EXISTING SYSTEM SHALL BE INCLUDED IN BIDDER SCOPE.
5. BIDDER SHALL VERIFY THE EXISTING SYSTEM DATA FROM SITE.
6. AUTO CHANGEOVER SHALL BE PROVIDED AT EMERGENCY MCC, RPPC03 SO THAT IN CASE OF OUTAGE OF NORMAL AC POWER THE EMERGENCY SUPPLY SHALL AUTOMATICALLY TAKES OVER THE EMERGENCY LOADS.
7. RATING OF CONVERTER TRANSFORMER SHALL BE DECIDED BY EPC CONTRACTOR BASED ON THE REQUIREMENT AND SHALL BE JUSTIFIED BY BACK UP CALCULATION.

TENDER PURPOSE ONLY

REV.NO	DATE	DESCRIPTION /REVISION NOTES	DRAWN	CHECKED	VERIFIED	APPROVED
5	15.06.15	REVISED AS PER OWNER'S COMMENTS	NH	NB	BM	BB
4	18.02.15	REVISED AS PER OWNER'S COMMENTS	NH	NB	BM	BB
3	02.12.14	REVISED AS PER OWNER'S COMMENTS	NH	BM	BM	BB
2	14.11.14	REVISED AS PER OWNER'S COMMENTS	NH	BM	BM	BB
1	10.11.14	REVISED AS PER OWNER'S COMMENTS	NH	BM	BM	BB
0	26.09.14	PRELIMINARY	KKBose	BM	BM	BB

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS
KOLKATA MUMBAI CHENNAI NEW DELHI

RELEASE STATUS		DATE	SIGNATURE
PRELIMINARY			
✓ FOR TENDER ONLY		15.06.15	
FOR CONSTRUCTION			
REVIEWED	ARCHITECTURAL		
	CIVIL & STRUCTURAL		
	ELECTRICAL		
	INSTRUMENTATION		
	MECHANICAL		

PROJECT : ALUMINA UNLOADING AND TRANSPORTATION

DRAWING TITLE : KEY SINGLE LINE DIAGRAM

DWG. NO. 14L08-DWG-E-0101 REV. 5

JOB NO: 14L08 | **SCALE: NTS** | **PROJECTION:**

RELAY LEGEND

DEVICE NO.	DESCRIPTION	RATING	ADJUSTABLE RANGE
51	INVERSE TIME OVER CURRENT RELAY FOR PHASE FAULT (1–POLE)	5A/1A 1.3 SEC. Ver.	50–200%
51N	INVERSE TIME OVER CURRENT RELAY FOR EARTH FAULT (1–POLE)	5A/1A 1.3 SEC. Ver.	10–40%
2L,2U,2T	TIME DELAY RELAY	110V DC	–
99	MOTOR PROTECTION RELAY • THERMAL O/L. & LOCKED ROTOR • SHORT CKT. & E/F • UNBALANCE CURRENT • UNDERCURRENT	5A/1A	70–130% & 150–600% 600–1200% 300–600% 10–40%
86	LOCKOUT RELAY (HAND RESET)	110V. DC.	–
27L	INSTANTANEOUS UNDER VOLTAGE RELAY, 1–POLE.	110V. AC.	40–80%
27U,27T	INSTANTANEOUS UNDER VOLTAGE RELAY, 1–POLE.	110V. AC.	20–80%
74	SUPERVISION RELAY	110V DC	–
94	ANTI PUMPING RELAY	110V DC	–
50/51	INVERSE TIME OVER CURRENT RELAY WITH HIGH SET INSTANTENEOUS UNIT	5A/1A	50–200% 500–2000%
50N	INSTANTENIOUS EARTH FAULT RELAY	5A/1A	10–40%

CT RATING TABLE

APPLICATION	RATIO (A/A)	VA BURDEN	ACCURACY CLASS/ALF	ISF <
INCOMER • OVERCURRENT PROTECTION, EARTH FAULT PROTECTION	REFER TYPICAL FEEDER DETAILS	15	5P20	–
• METERING		20	1.0	5.0
MOTOR FEEDER • PROTECTION • METERING		15 15	5P20 1.0	– 5.0
POWER FEEDER • METERING		15	1.0	5.0

FOR TENDER PURPOSE ONLY

14L08_E0106 Sh.1 of 10 24.11.14

A4_DD (9–96) [210x297]

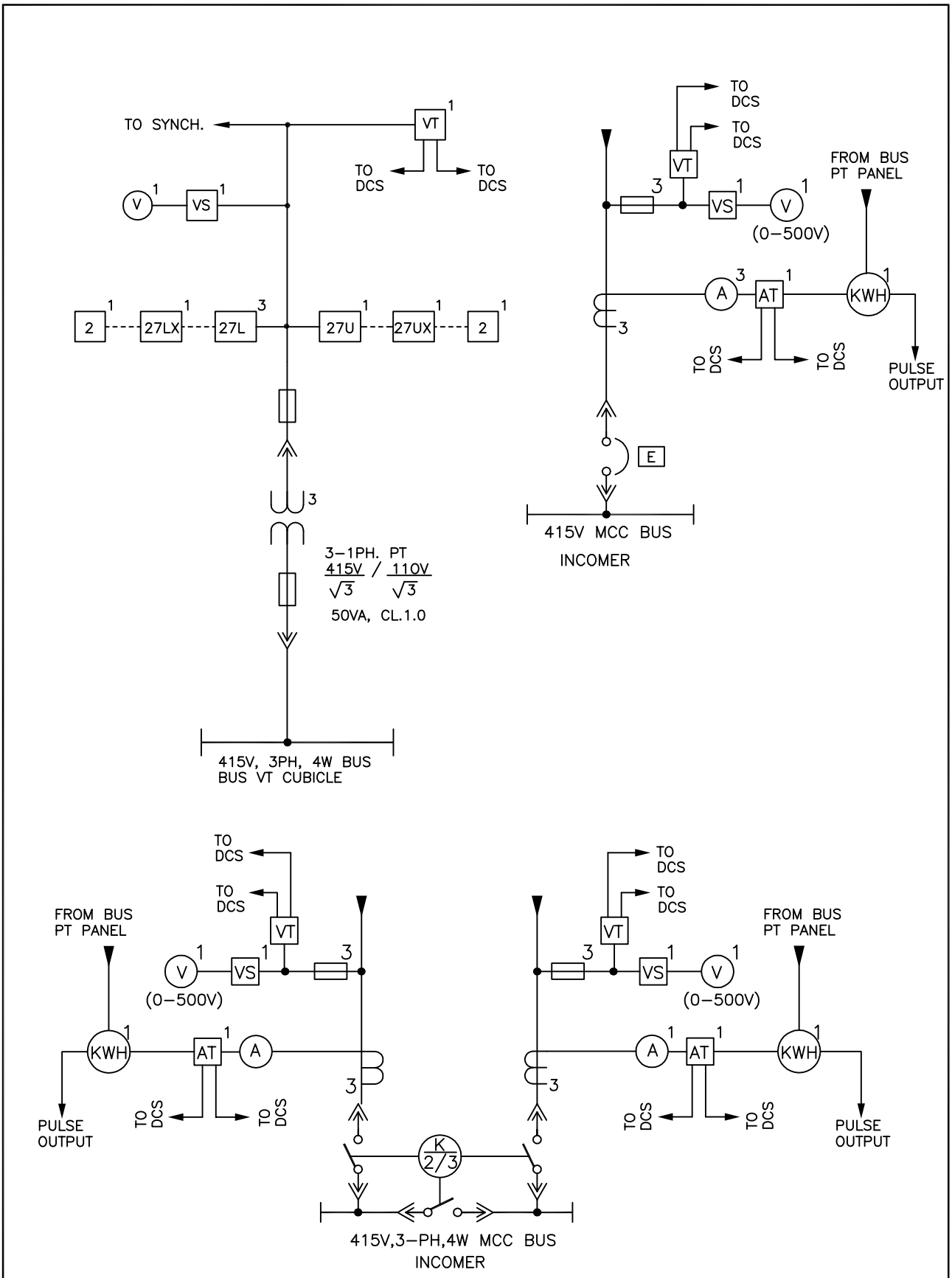
					SINGLE LINE DIAGRAM 415V PCC/PMCC/MCC FEEDERS (TYP)
					ALUMINA UNLOADING AND TRANSPORTATION SYSTEM
BB	BM	BM	0	24.11.14	NATIONAL ALUMINIUM COMPANY LIMITED SMELTER PLANT, ANGUL-759145
APPVD.	REVWD.	CHKD.	REV.	DATE	

DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : NONE

DWG. NO. 14L08–DWG–E–0106 | REV. 0

SHT. 01 OF 10



BB	BM	BM	0	24.11.14
APPVD.	REVWD.	CHKD.	REV.	DATE

SINGLE LINE DIAGRAM
415V PCC/PMCC/MCC FEEDERS (TYP)

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : NONE

DWG. NO. 14L08-DWG-E-0106 | REV. 0

SHT. 10 OF 10

14L08_E0106 Sh.10 of 10 24.11.14

A4_DD (9-96) [210x297]

DEVICE LEGEND

FUSE


CURRENT TRANSFORMER


POTENTIAL TRANSFORMER



AIR CIRCUIT BREAKER (ELECTRICALLY OPERATED) WITH SHUNT TRIP COIL

THERMAL OVERLOAD RELAY (49)


CONTACTOR / RELAY COIL (42)


LOAD BREAK ISOLATOR


NORMALLY OPEN CONTACT


NORMALLY CLOSED CONTACT



RELAY/TIMER



WATTHOUR METER



AMMETER



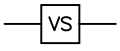
VOLTMETER



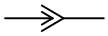
FREQUENCY METER



AMMETER SELECTOR SWITCH



VOLTMETER SELECTOR SWITCH


DRAWOUT CONNECTION



CURRENT TRANSDUCER



VOLTAGE TRANSDUCER



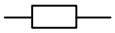
WATT TRANSDUCER

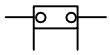

LINK


SWITCH FUSE


BUS DUCT (NON PHASE SEGREGATED)

CABLE CONNECTION


RESISTER

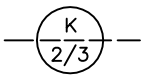

DC SHUNT


START PUSH BUTTON


STOP PUSH BUTTON


INDICATING LAMP (R–Y–B)


SOLINOID VALVE



CASTLE KEY INTERLOCK

TSS — TRIP SELECTOR SWITCH

SSS — SYNCHRONISING SELECTOR ICON

NOTES

1....FOR RELAY LEGEND REFER SHEET–1

2....IN SINGLE LINE DIAGRAM, THE NUMBER AGAINST C.T., V.T., METERS, RELAYS ETC. INDICATES THE QUANTITY TO BE SUPPLIED.

3....ALL 415V POWER CABLES SHALL BE HR PVC INSULATED OR XLPE, PVC INNER SHEATHED, ARMOURED, FRLS, PVC OVERALL SHEATHED WITH STRANDED ALUMINIUM CONDUCTOR.

4....ACCURACY CLASS OF THE CURRENT TRANSFORMERS SHALL BE :

a) CLASS PS/5P20 FOR RELAYING

b) CLASS 1.0, ISF<5 FOR METERING

5....DEVICES INDICATED IN TYPICAL FEEDER DETAILS ARE ONLY MINIMUM. TENDERER SHALL ENSURE THAT ALL DEVICES / EQUIPMENT NECESSARY TO FULFILL THE REQUIREMENT OF SPECIFICATION ARE INCLUDED IN THE SCOPE OF SUPPLY.

6....FOR EU/FU TYPE MOTOR FEEDER MCCB WITH E/F PROTECTION IS USED.

FOR TENDER PURPOSE ONLY

14L08_E0106 Sh.2 of 10 24.11.14

A4_DD (9–96) [210x297]

BB	BM	BM	0	24.11.14
APPVD.	REVWD.	CHKD.	REV.	DATE

SINGLE LINE DIAGRAM
415V PCC/PMCC/MCC FEEDERS (TYP)

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : NONE

DWG. NO. 14L08–DWG–E–0106 | REV. 0

SHT. 02 OF 10

LEGEND



CONTACT CLOSED IN SERVICE POSITION



CONTACT CLOSED IN SERVICE &
TEST POSITION



CONTACT CLOSED IN TEST POSITION



WIRING TERMINAL FOR EQUIPMENT



WIRING TERMINAL OF REMOTE EQUIPMENT

REMOVABLE LINK



STAY PUT TYPE



TERMINAL OF MOTOR/LOCAL
PUSH BUTTON STATION

M.R. MARSHALLING RACK

R.C.P. REMOTE CONTROL PANEL/DESK

C.F. CONTROL FUSE

L.S. LIMIT SWITCH

T.S. TORQUE SWITCH



LOCAL CLOSED NEAR EQUIPMENT

FOR TENDER PURPOSE ONLY

BB	BM	BM	0	24.11.14
APPVD.	REVWD.	CHKD.	REV.	DATE

SINGLE LINE DIAGRAM
415V PCC/PMCC/MCC FEEDERS (TYP)

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS

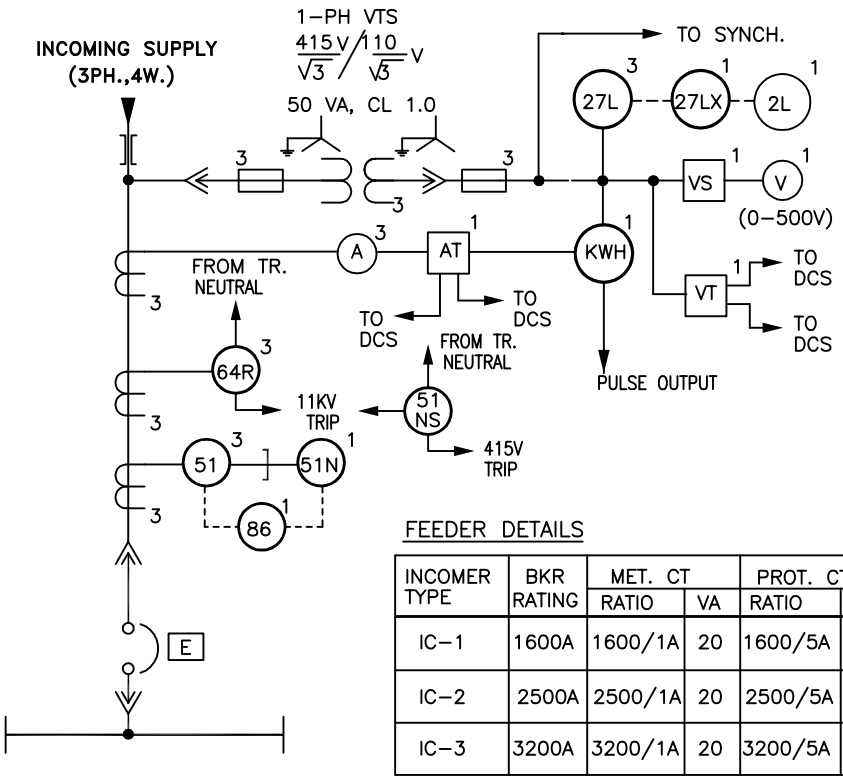
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DWG. NO. 14L08-DWG-E-0106 | REV. 0

SHT. 03 OF 10

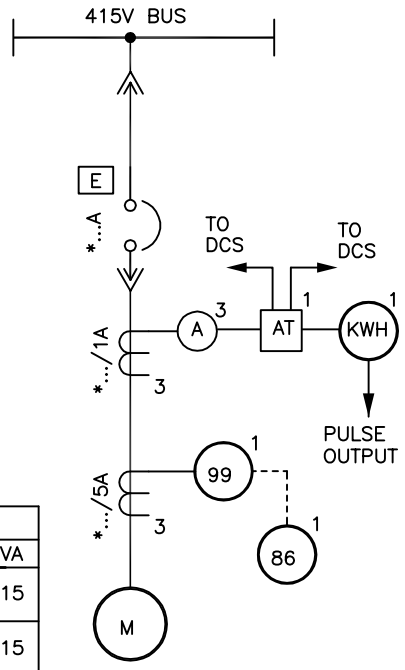
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A4_DD (9-96) [210x297]

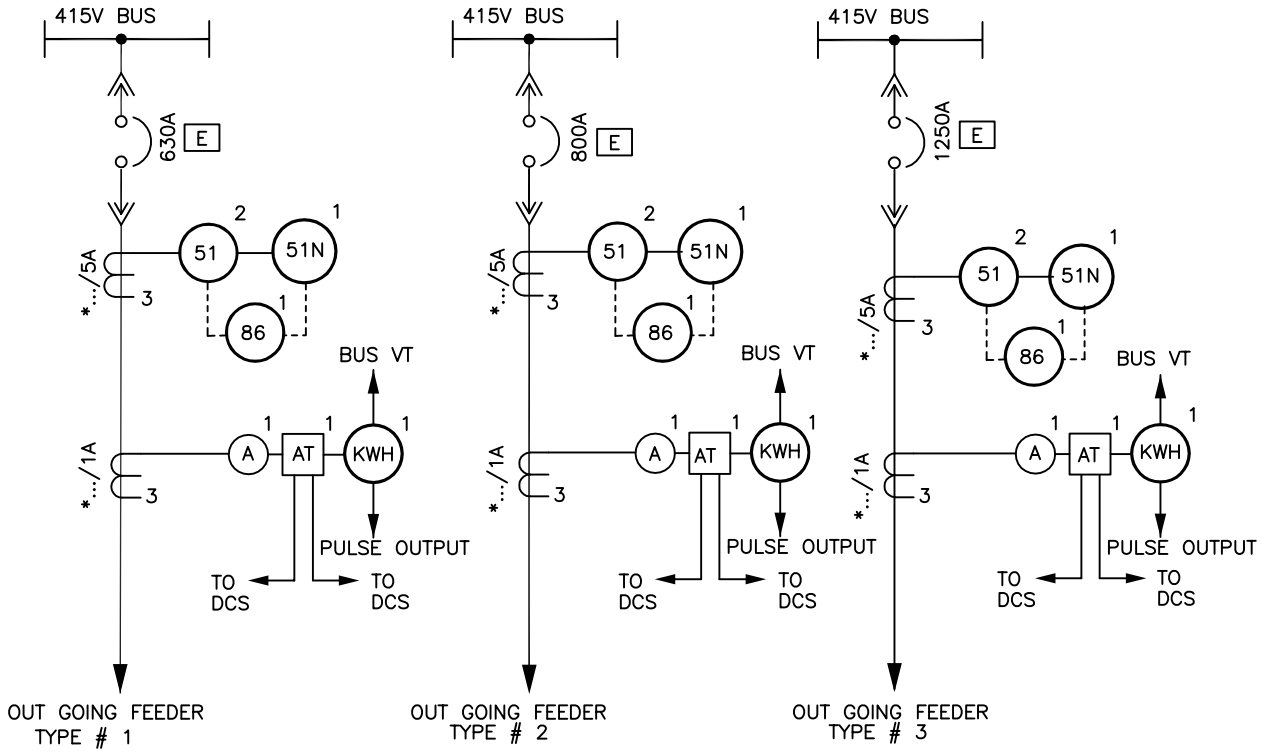


FEEDER DETAILS

INCOMER TYPE	BKR RATING	MET. CT		PROT. CT	
		RATIO	VA	RATIO	VA
IC-1	1600A	1600/1A	20	1600/5A	15
IC-2	2500A	2500/1A	20	2500/5A	15
IC-3	3200A	3200/1A	20	3200/5A	15



MOTOR FEEDER (TYP)



FOR TENDER PURPOSE ONLY

NOTE: RATING SHALL BE PROVIDED AS REQUIRED.

BB	BM	BM	1	19.06.15
BB	BM	BM	0	24.11.14
APPVD.	REVWD.	CHKD.	REV.	DATE

SINGLE LINE DIAGRAM
415V PCC/PMCC/MCC FEEDERS (TYP)

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS

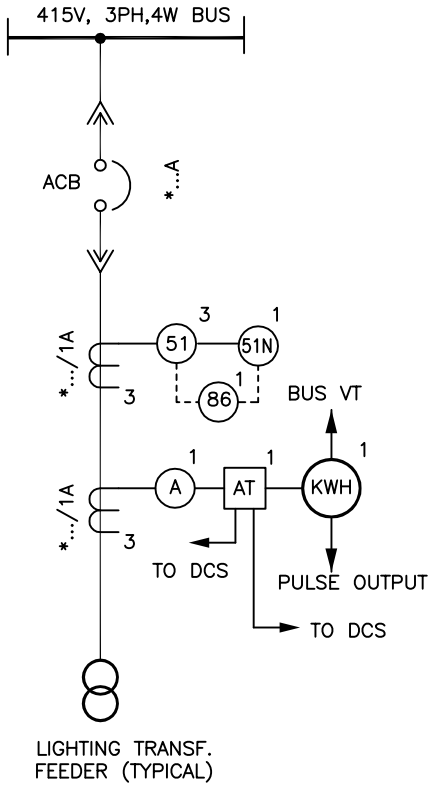
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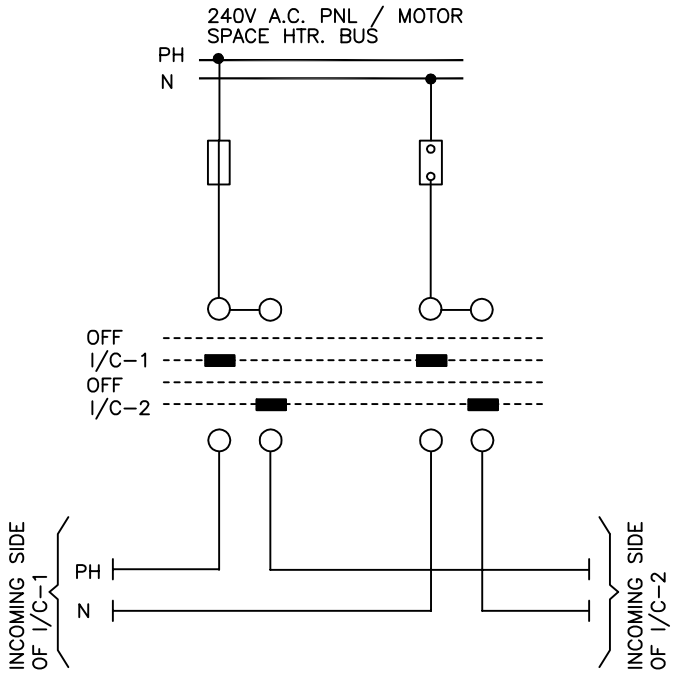
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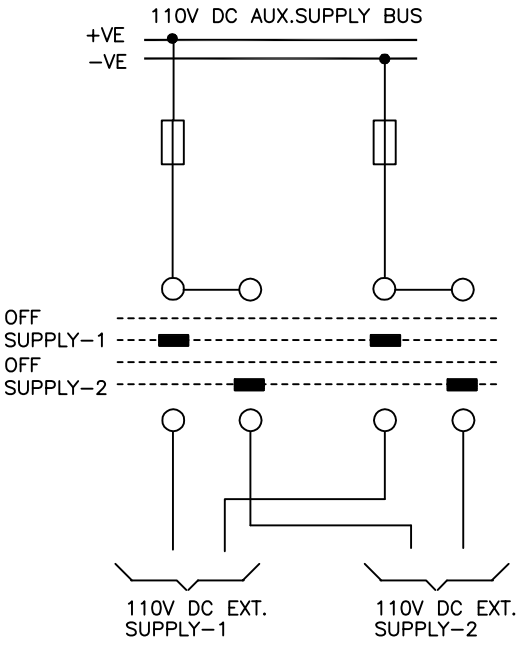
SHT. 04 OF 10

14L08_E0106 Sh.4 of 10 19.06.15

A4_DD (9-96) [210x297]







* NOTE: RATING SHALL BE PROVIDED AS REQUIRED.

FOR TENDER PURPOSE ONLY

BB	BM	BM	1	19.06.15
BB	BM	BM	0	24.11.14
APPVD.	REVWD.	CHKD.	REV.	DATE

SINGLE LINE DIAGRAM
415V PCC/PMCC/MCC FEEDERS (TYP)

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS

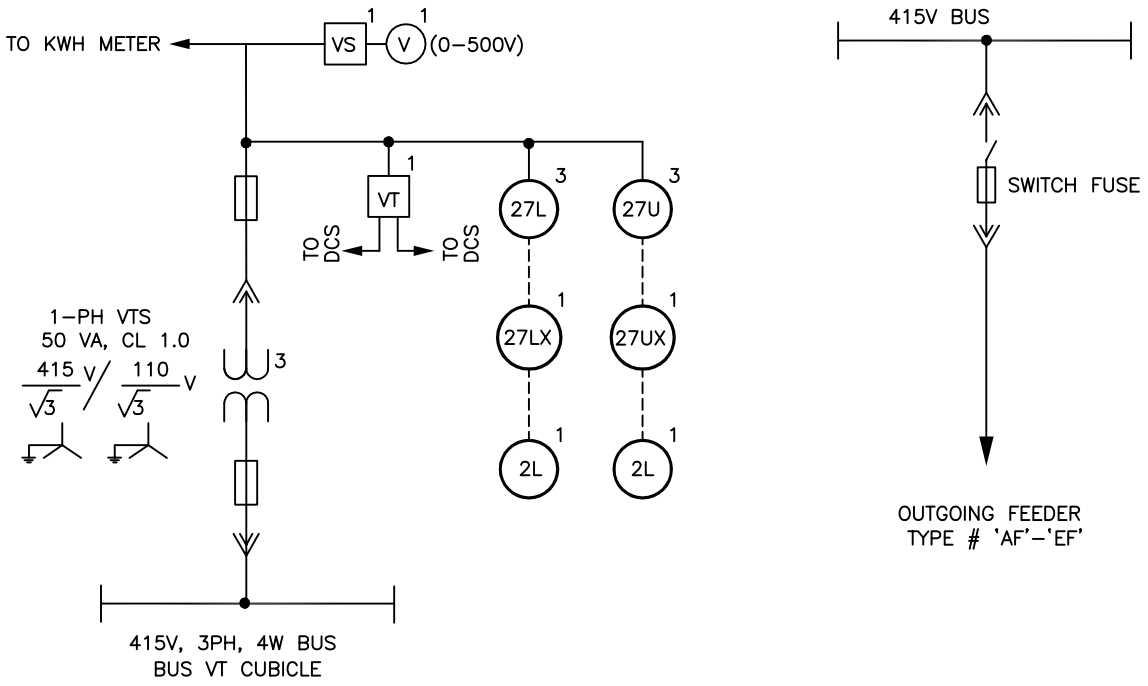
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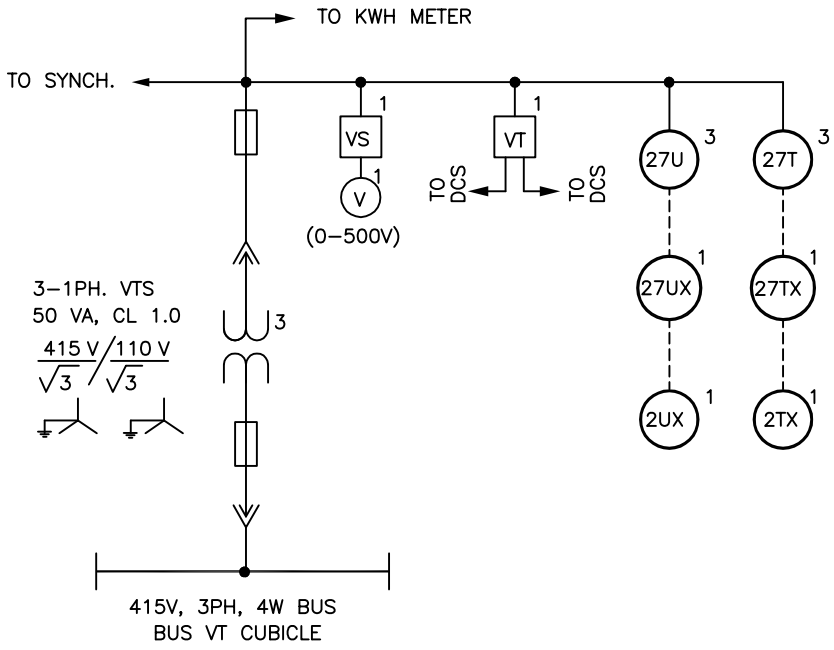
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SHT. 05 OF 10

14L08_E0106 Sh.5 of 10 19.06.15

A4_DD (9-96) [210x297]





FOR TENDER PURPOSE ONLY

BB	BM	BM	0	24.11.14
APPVD.	REVWD.	CHKD.	REV.	DATE

SINGLE LINE DIAGRAM
415V PCC/PMCC/MCC FEEDERS (TYP)

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS

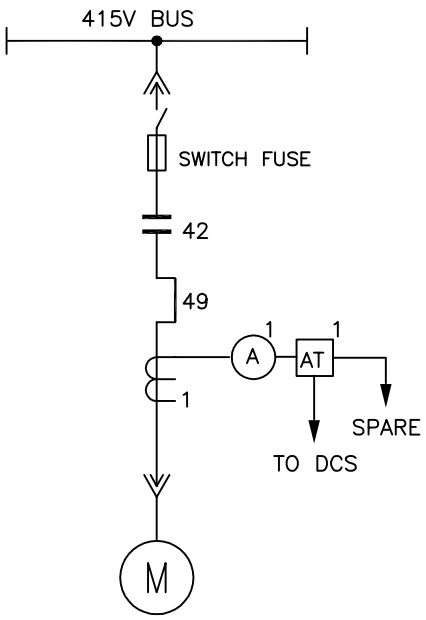
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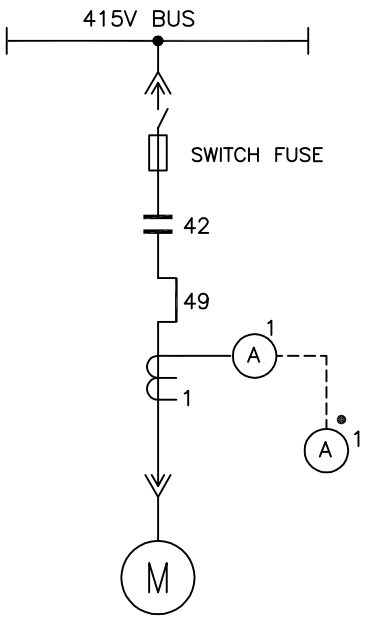
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14L08_E0106 Sh.6 of 10 24.11.14

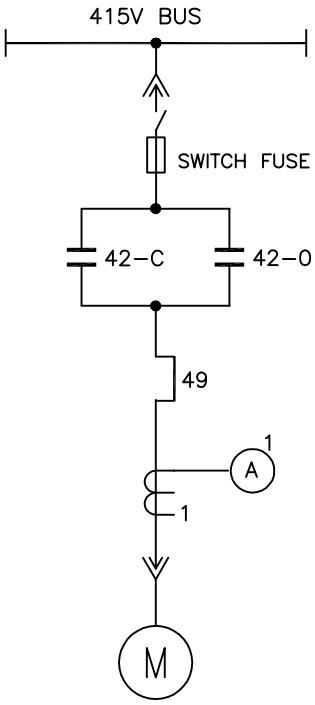
A4_DD (9–96) [210x297]



UNIDIRECTIONAL
MOTOR FEEDER
TYPE: 'DU'/'EU'/'FU'



UNIDIRECTIONAL
MOTOR FEEDER
TYPE: 'AU'/'BU'/'CU'



REVERSING MOTOR FEEDER
TYPE: 'AR'&'BR'

FOR TENDER PURPOSE ONLY

BB	BM	BM	0	24.11.14
APPVD.	REVWD.	CHKD.	REV.	DATE

SINGLE LINE DIAGRAM
415V PCC/PMCC/MCC FEEDERS (TYP)

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS

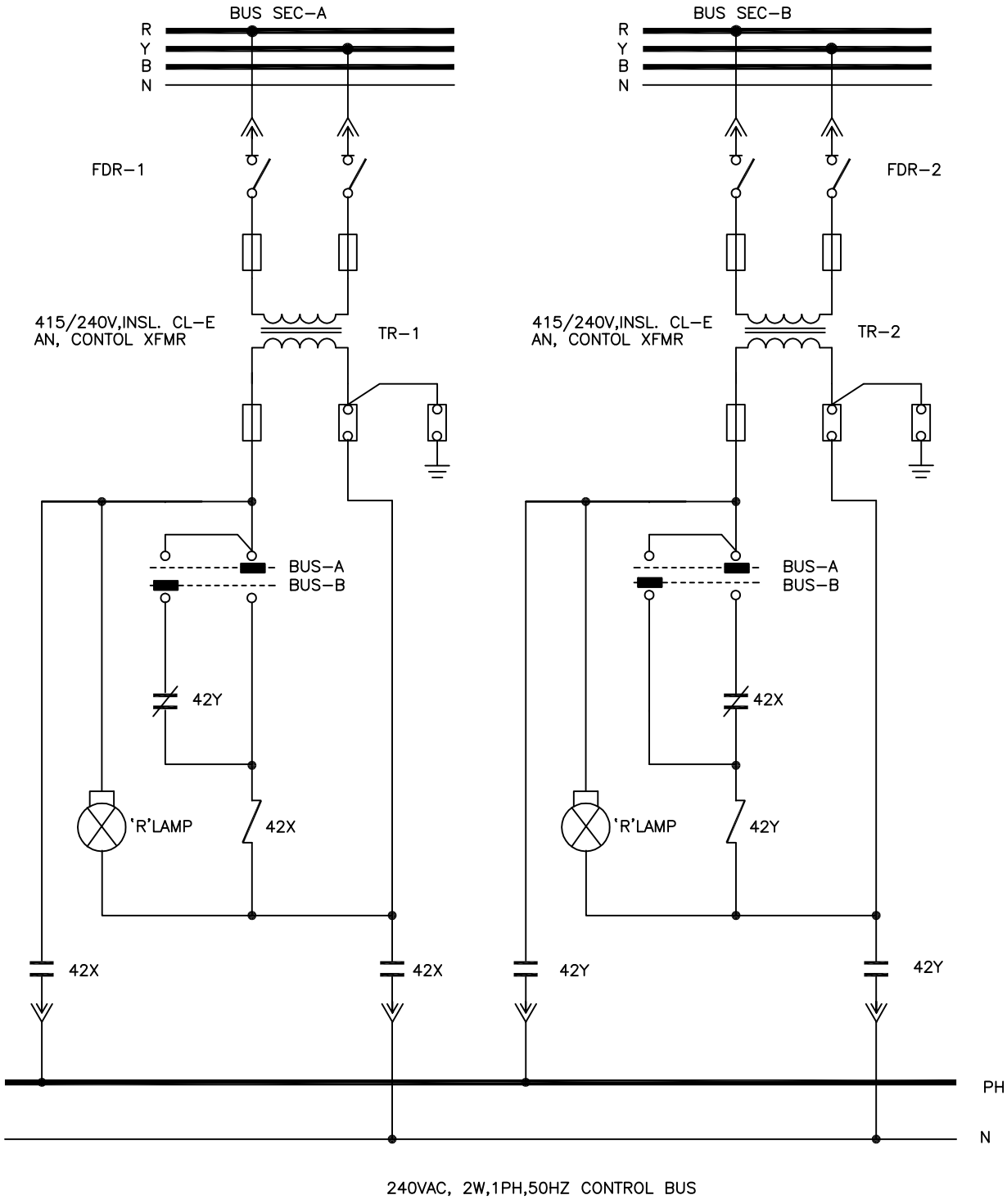
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SHT. 07 OF 10

14L08_E0106 Sh.7 of 10 24.11.14

A4_DD (9-96) [210x297]



FOR TENDER PURPOSE ONLY

BB	BM	BM	0	24.11.14
APPVD.	REVWD.	CHKD.	REV.	DATE

SINGLE LINE DIAGRAM
415V PCC/PMCC/MCC FEEDERS (TYP)

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS

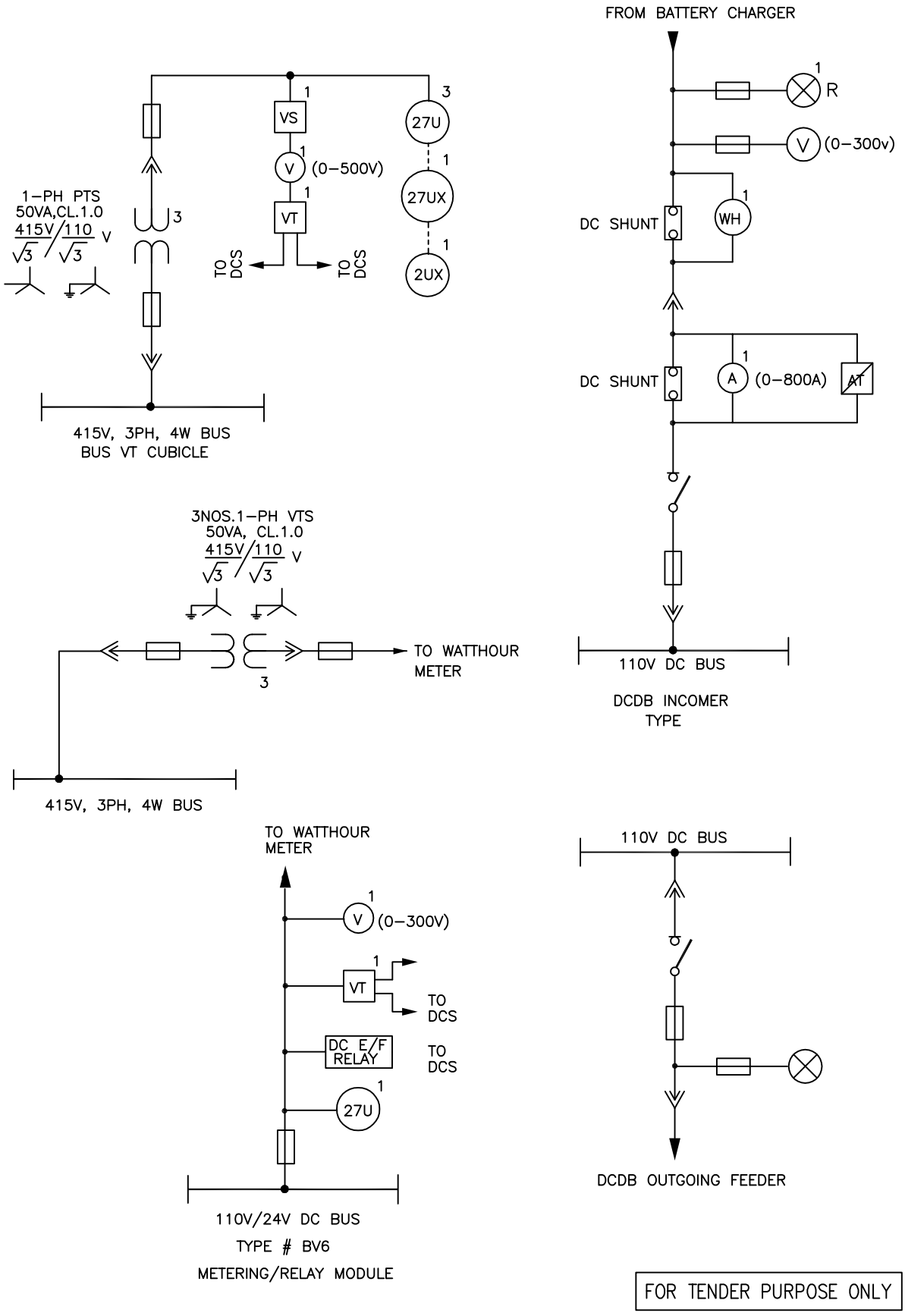
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SHT. 08 OF 10

14L08_E0106 Sh.8 of 10 24.11.14

A4_DD (9–96) [210x297]



BB	BM	BM	0	24.11.14
APPVD.	REVWD.	CHKD.	REV.	DATE

SINGLE LINE DIAGRAM
415V PCC/PMCC/MCC FEEDERS (TYP)

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS

JOB NO. 14L08	SCALE : NONE
DWG. NO. 14L08-DWG-E-0106 SHT. 09 OF 10	REV. 0

14L08_E0106 Sh.9 of 10 24.11.14

A4_DD (9-96) [210x297]

GENERAL ARRANGEMENT OF CABLE TRAY, TRENCH & SUPPORT DETAILS

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GENERAL ARRANGEMENT OF CABLE TRAY, TRENCH & SUPPORT DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT

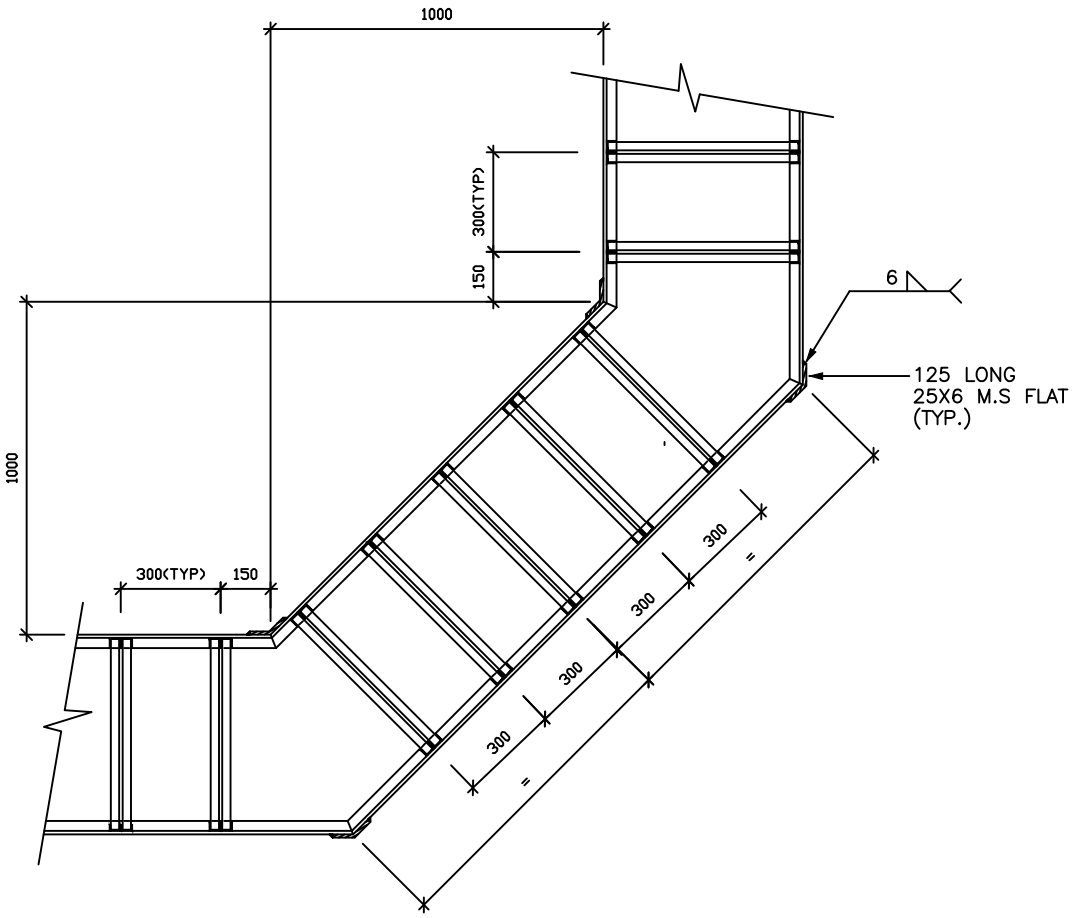
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CONSULTING ENGINEERS

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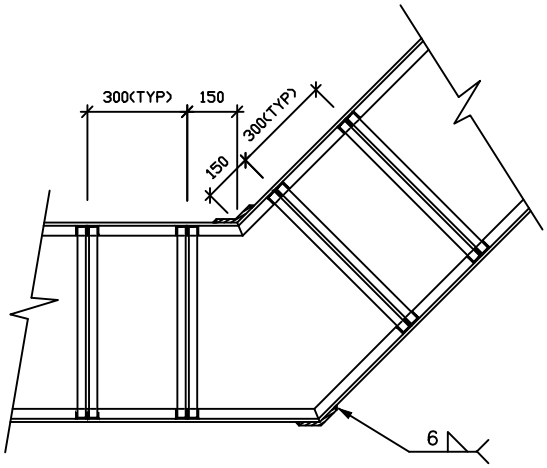
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File Name 14L08-DWG-E-0400

A4_DD (9-96) [210x297]



90° BEND
(IN SAME PLANE)



BEND >135°
(IN SAME PLANE)

NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. THE DIMENSION SHALL CORRES-PONDS TO THE MAX. BENDING RADIUS OF THE CABLE USED.
3. HORIZONTAL BEND <135° SHALL NOT BE USED.

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GENERAL ARRANGEMENT OF CABLE TRAY, TRENCH & SUPPORT DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

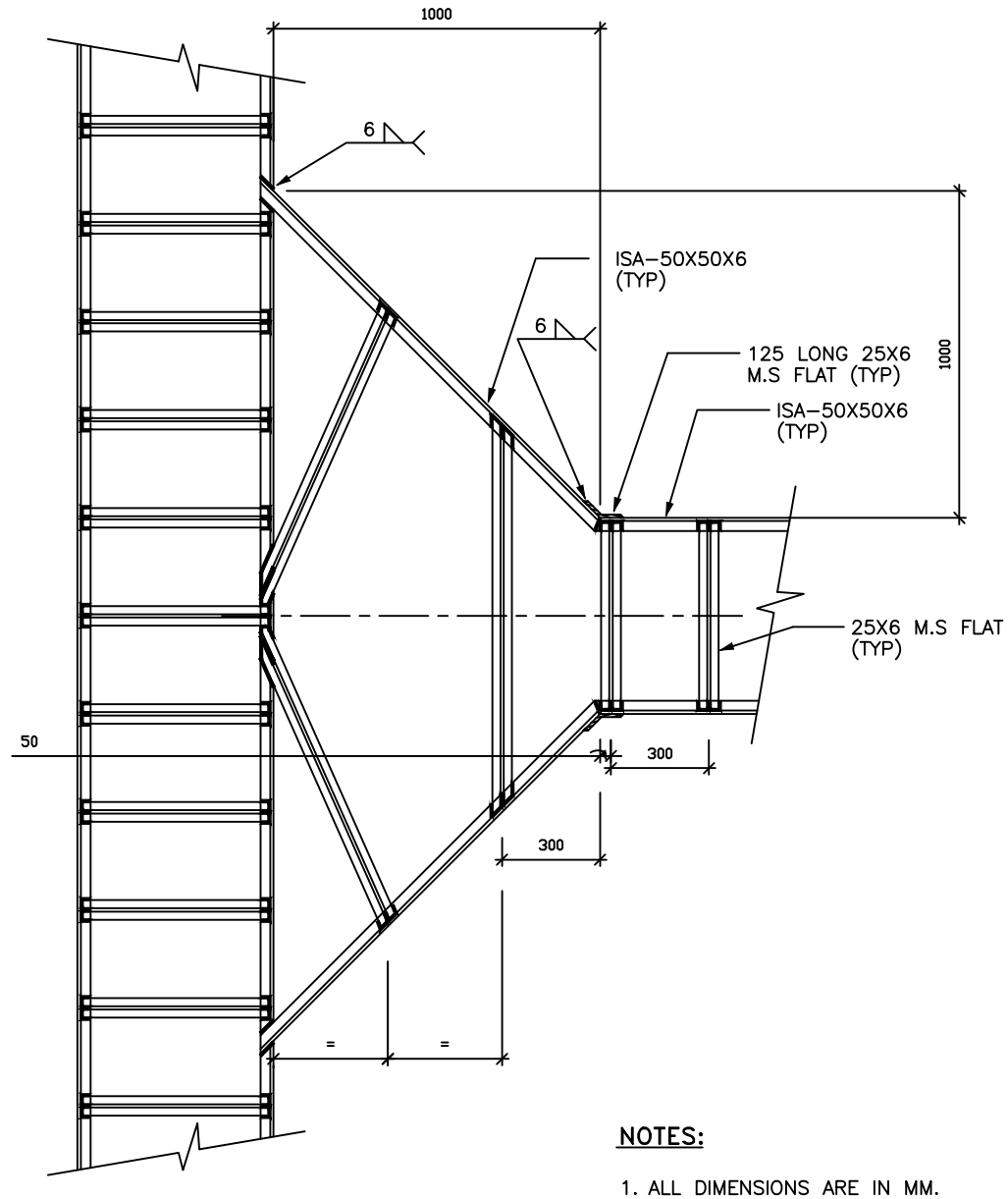
CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

DWG. NO. 14L08-DWG-E-0400 SHT. -10 | REV. 0

File Name 14L08-DWG-E-0400

A4_DD (9-96) [210x297]



90° CROSSING
(IN SAME PLANE)

NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. THE DIMENSION SHALL CORRES–PONDS TO THE MAX. BENDING RADIUS OF THE CABLE USED.
3. HORIZONTAL BEND <135° SHALL NOT BE USED.

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GENERAL ARRANGEMENT OF CABLE TRAY, TRENCH & SUPPORT DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

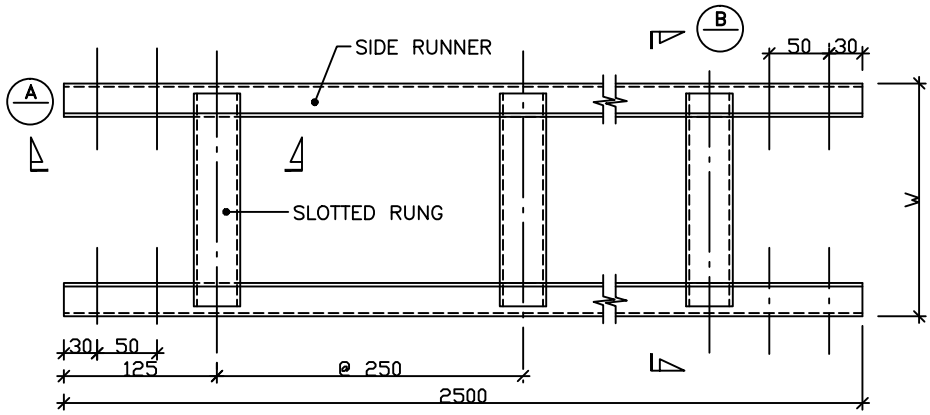
CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

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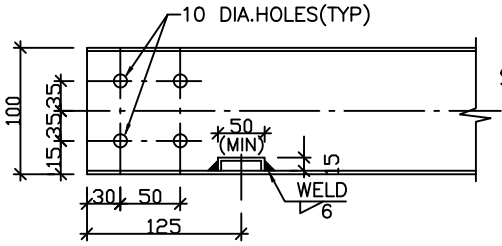
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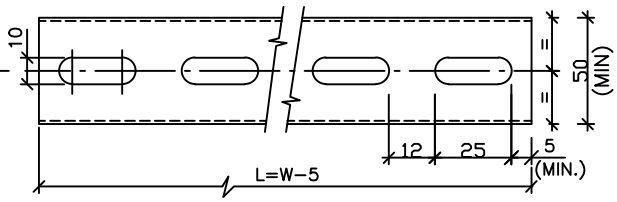
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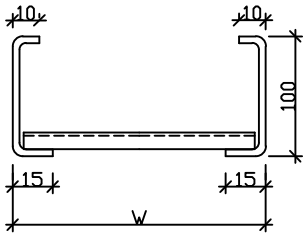
LADDER TYPE CABLE TRAY



SEC – A

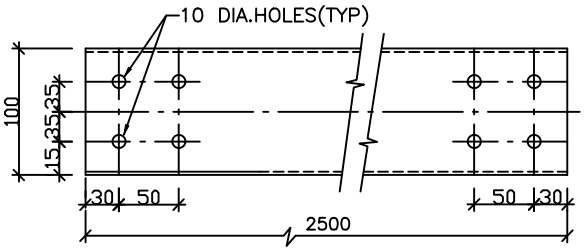


SLOTTED RUNG



SEC – B

W	300	450	600
L	295	445	595



SIDE RUNNER

MATERIAL : M.S. SHEET 14 SWG.(2mm.THK.)
FINISH : HOT DIP GALVANISED

NOTE :-

1. ALL DIMENSIONS ARE IN MM.

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GENERAL ARRANGEMENT OF CABLE TRAY, TRENCH & SUPPORT DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

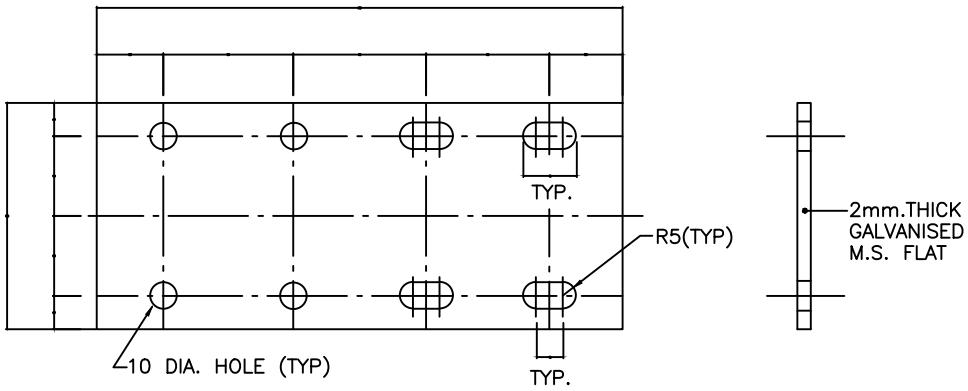
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DWG. NO. 14L08-DWG-E-0400 | REV. 0

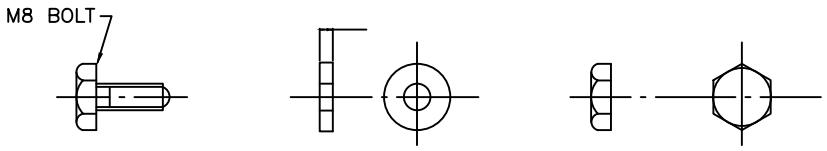
SHT. - 12

File Name 14L08-DWG-E-0400

A4_DD (9-96) [210x297]



SIDE COUPLER PLATE



M8 BOLT, WASHER & NUT

(FOR CABLE TRAY JOINT)

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GENERAL ARRANGEMENT OF CABLE TRAY, TRENCH & SUPPORT DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT

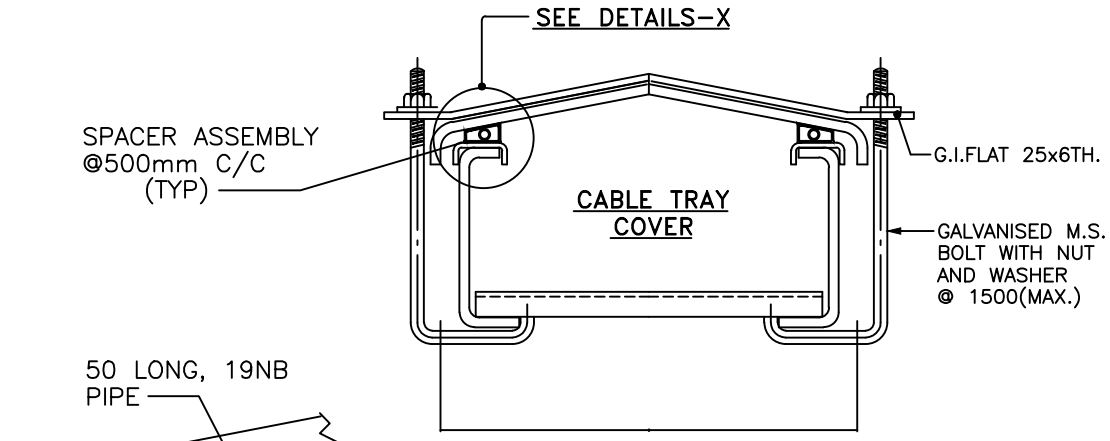
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

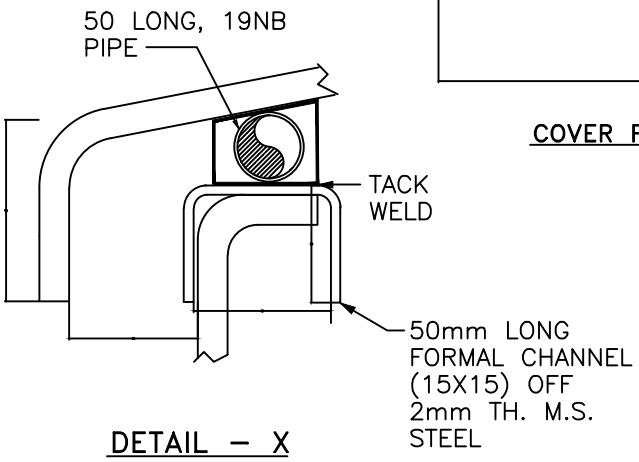
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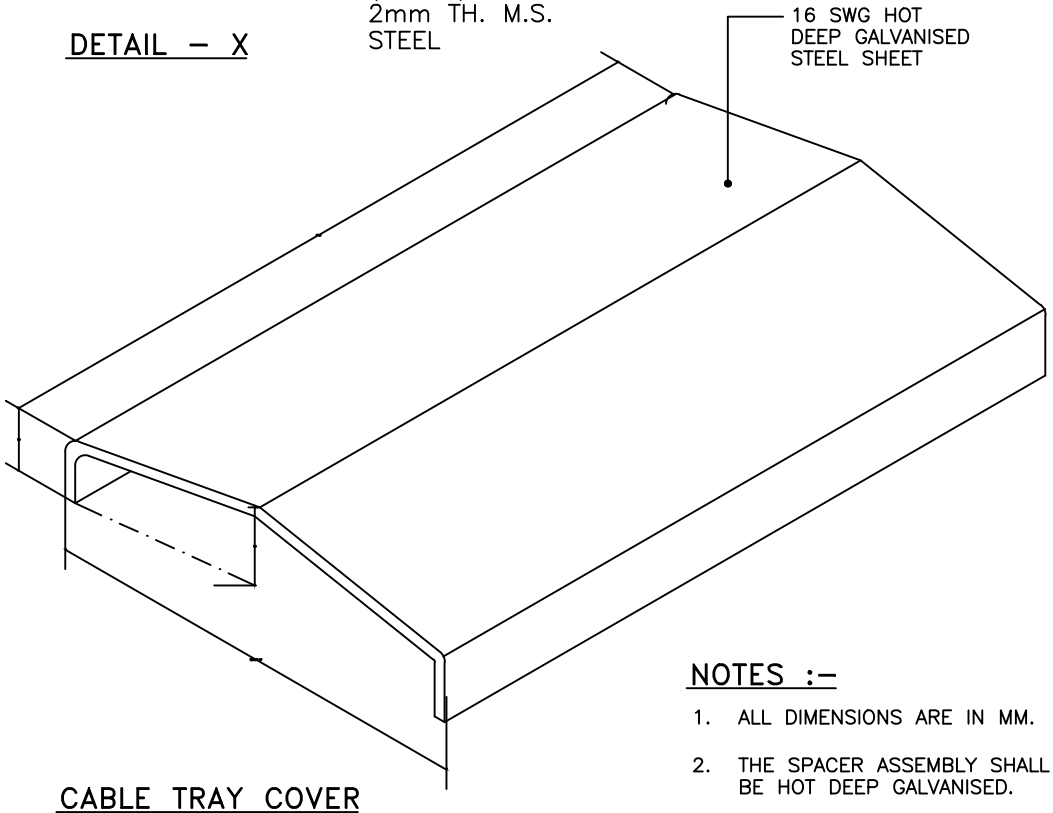
A4_DD (9-96) [210x297]



COVER FIXING(TYP.)



DETAIL – X



CABLE TRAY COVER

NOTES :-

1. ALL DIMENSIONS ARE IN MM.
2. THE SPACER ASSEMBLY SHALL BE HOT DEEP GALVANISED.

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GENERAL ARRANGEMENT OF CABLE TRAY, TRENCH & SUPPORT DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

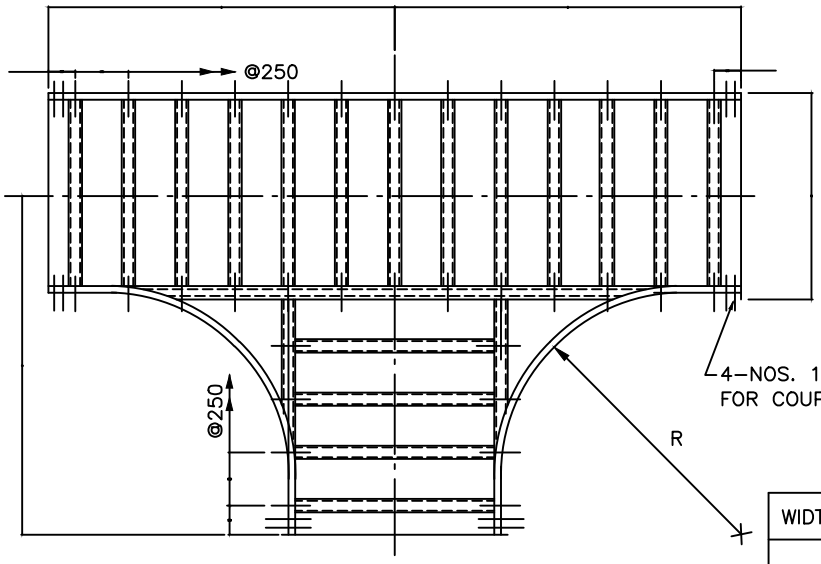
CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

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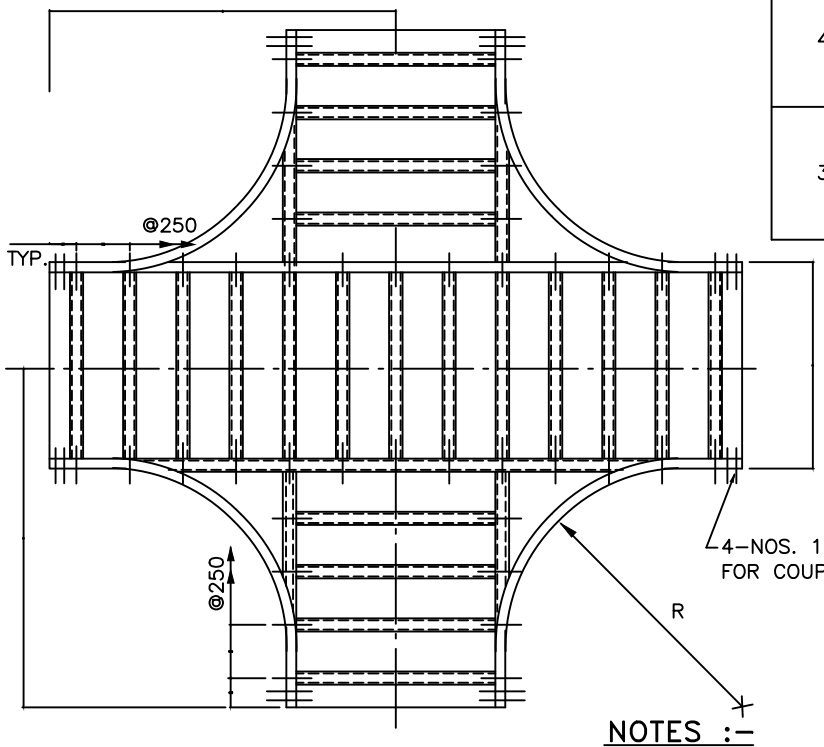
File Name 14L08-DWG-E-0400

A4_DD (9-96) [210x297]



PLAN
HORIZONTAL TEE

WIDTH (W)	RADIUS (R)	A
600	1050	1475
	600	1025
	450	875
	300	725
450	1050	1400
	600	950
	450	800
	300	650
300	1050	1325
	600	875
	450	725
	300	575



PLAN
HORIZONTAL CROSS

NOTES :–

1. ALL DIMENSIONS ARE IN MM.
2. FOR MULTITIER CABLE TRAY, THE BENDING RADIUS AT THE BENDS SHALL BE SAME FOR ALL TRAYS AND THIS RADIUS SHALL BE AS PER THE RECOMMENDED BENDING RADIUS OF LARGEST CABLE IN THE ROUTE.

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GENERAL ARRANGEMENT OF CABLE TRAY, TRENCH & SUPPORT DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

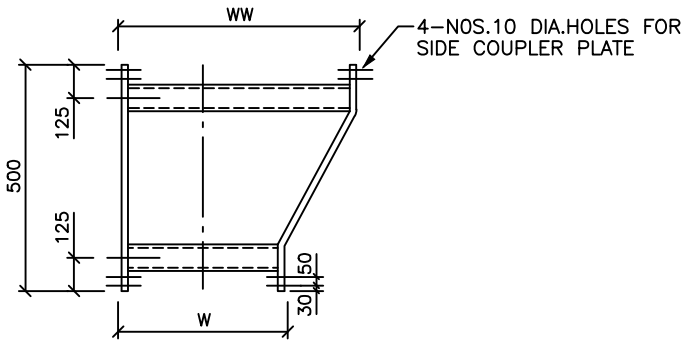
JOB NO. 14L08 | SCALE : N.T.S

DWG. NO. 14L08–DWG–E–0400 | REV. 0

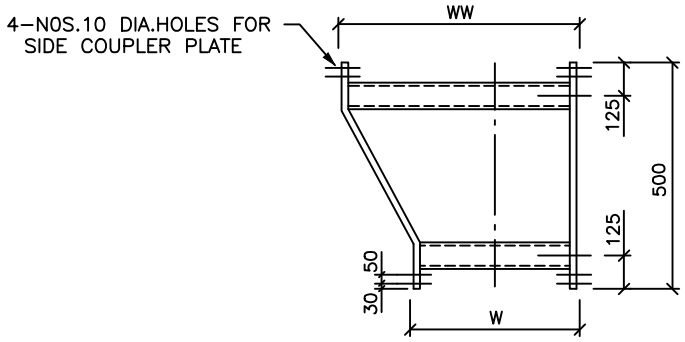
SHT. - 15

File Name 14L08–DWG–E–0400

A4_DD (9–96) [210x297]



PLAN
LEFT HAND REDUCER



PLAN
RIGHT HAND REDUCER

WIDTH	WW	600	600	450
	W	450	300	300

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GENERAL ARRANGEMENT OF CABLE TRAY, TRENCH & SUPPORT DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

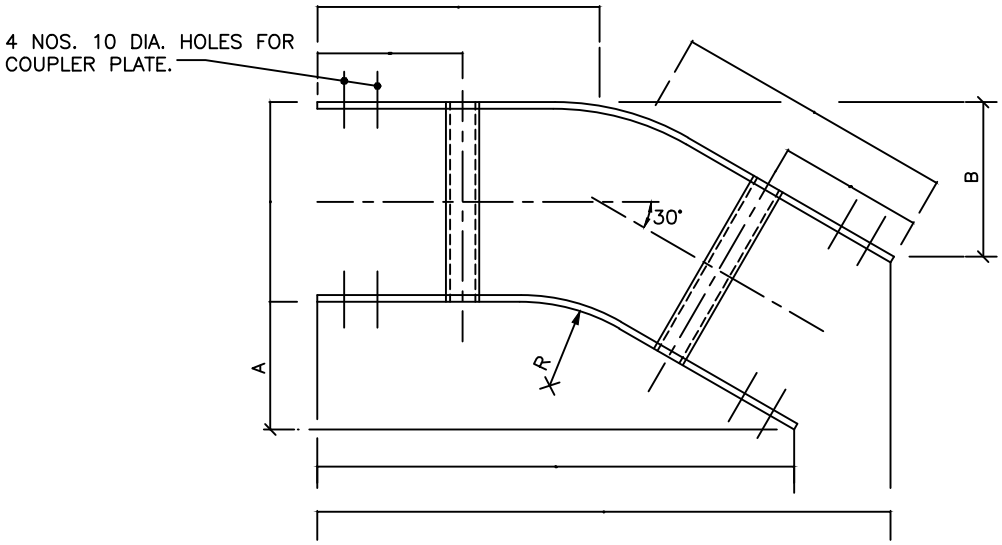
CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

DWG. NO. 14L08–DWG–E–0400 SHT. - 16 | REV. 0

File Name 14L08–DWG–E–0400

A4_DD (9–96) [210x297]



PLAN
30° HORIZONTAL ELBOW

WIDTH (W)	RADIUS (R)	A	B	C	D	E
600	1050	205	285	755	1055	485
	600	145	225	530	830	365
	450	125	205	455	755	325
	300	105	185	380	680	285
450	1050	205	265	755	980	465
	600	145	205	530	755	345
	450	125	185	455	680	305
	300	105	165	380	605	265
300	1050	205	245	755	905	445
	600	145	185	530	680	325
	450	125	165	455	605	285
	300	105	145	380	530	245

NOTE :-

1. ALL DIMENSIONS ARE IN MM.

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GENERAL ARRANGEMENT OF CABLE TRAY, TRENCH & SUPPORT DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

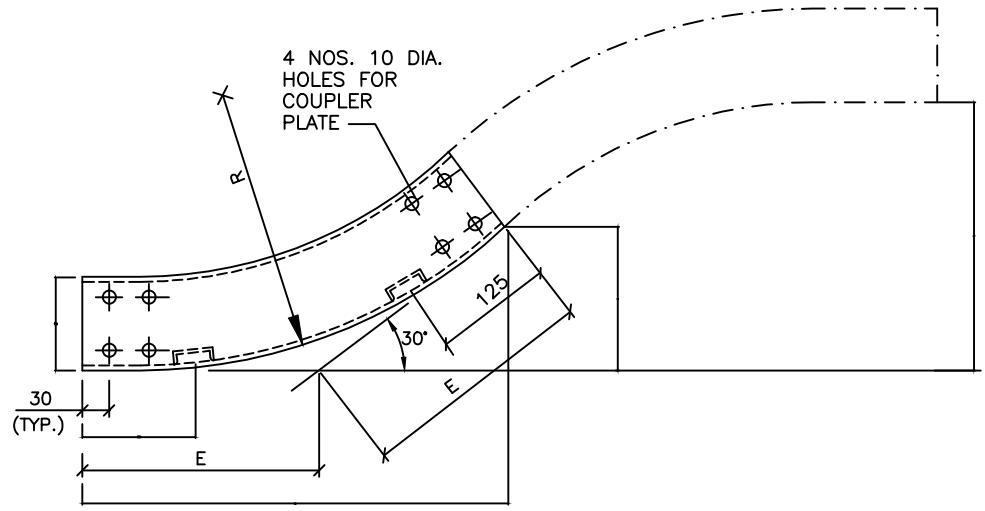
CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

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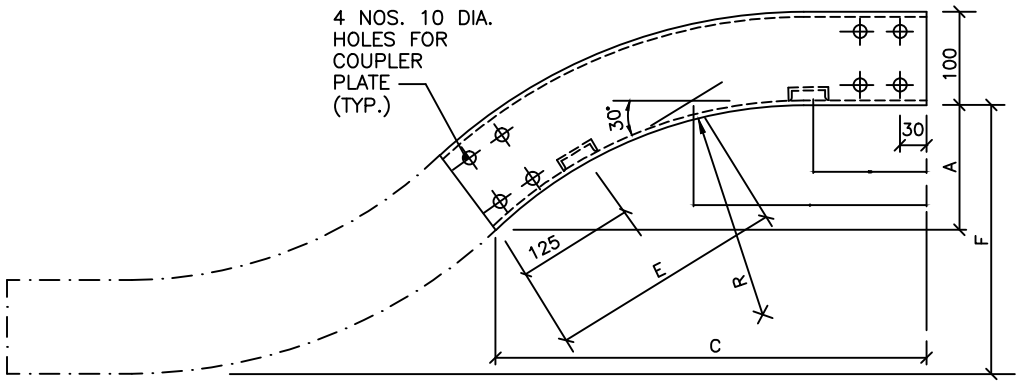
File Name 14L08-DWG-E-0400

A4_DD (9-96) [210x297]



ELEVATION
30° VERTICAL ELBOW (INSIDE)

WIDTH(W)	RADIUS(R)	A	C	E	F
600 450 & 300	1050	205	760	410	410
	600	145	535	290	290
	450	125	460	250	250
	300	105	385	210	210



ELEVATION
30° VERTICAL ELBOW (OUTSIDE)

NOTE :-

1. ALL DIMENSIONS ARE IN MM.

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GENERAL ARRANGEMENT OF CABLE TRAY, TRENCH & SUPPORT DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

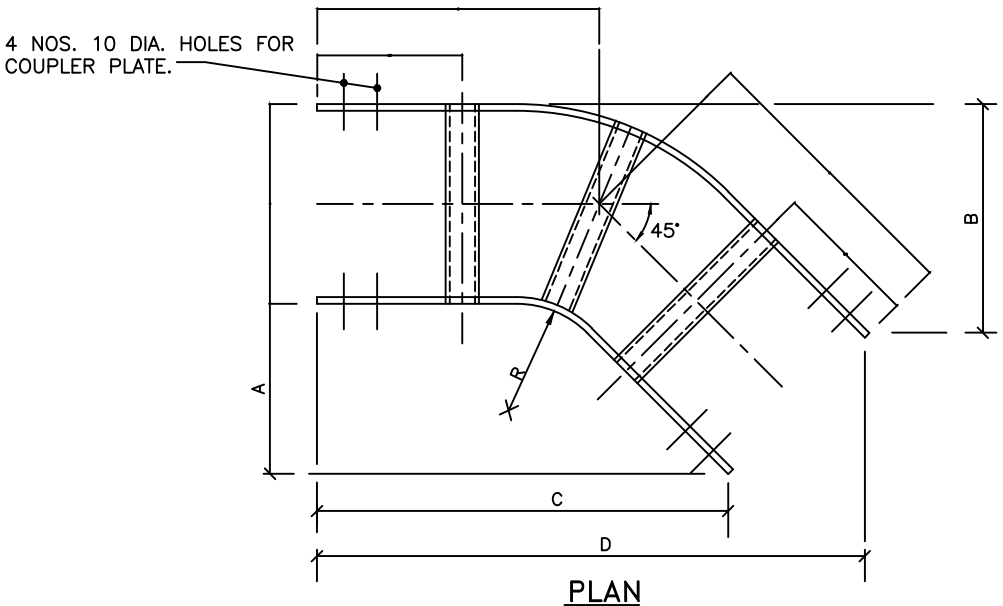
CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

DWG. NO. 14L08-DWG-E-0400 SHT. - 18 | REV. 0

File Name 14L08-DWG-E-0400

A4_DD (9-96) [210x297]



PLAN

45° HORIZONTAL ELBOW

WIDTH (W)	RADIUS (R)	A	B	C	D	E
600	1050	395	570	955	1380	685
	600	265	440	640	1065	535
	450	110	395	530	955	470
	300	175	350	425	850	410
450	1050	395	530	955	1275	690
	600	265	395	640	955	500
	450	110	350	530	850	440
	300	175	310	425	745	390
300	1050	395	485	955	1165	655
	600	265	350	640	850	470
	450	110	310	530	745	410
	300	175	265	425	635	345

NOTE :-

1. ALL DIMENSIONS ARE IN MM.

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GENERAL ARRANGEMENT OF CABLE TRAY, TRENCH & SUPPORT DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

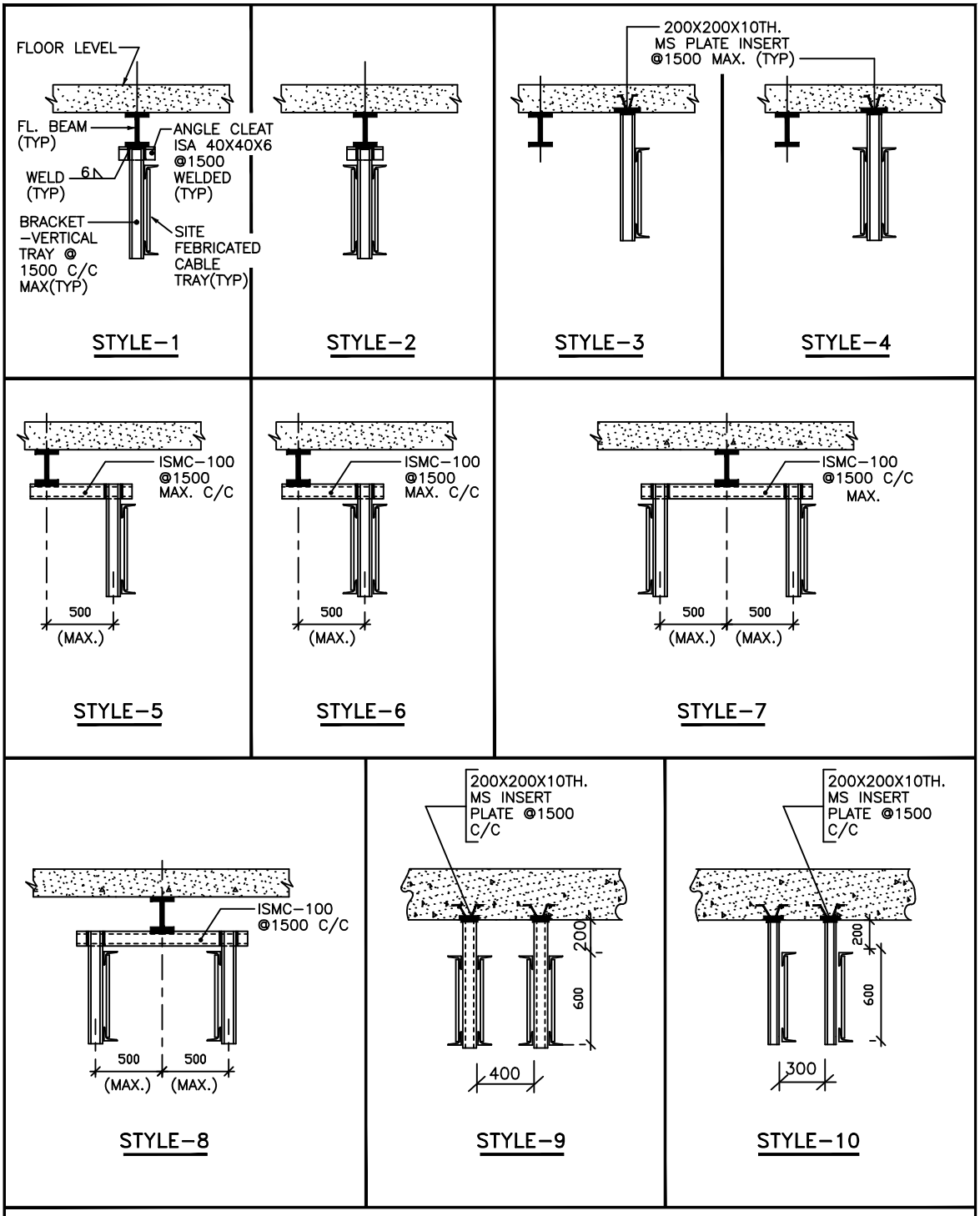
CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

DWG. NO. 14L08-DWG-E-0400 SHT. - 19 | REV. 0

File Name 14L08-DWG-E-0400

A4_DD (9-96) [210x297]



MOUNTING ARRANGEMENT

(VERTICAL CABLE TRAY)

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GENERAL ARRANGEMENT OF CABLE TRAY, TRENCH & SUPPORT DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT

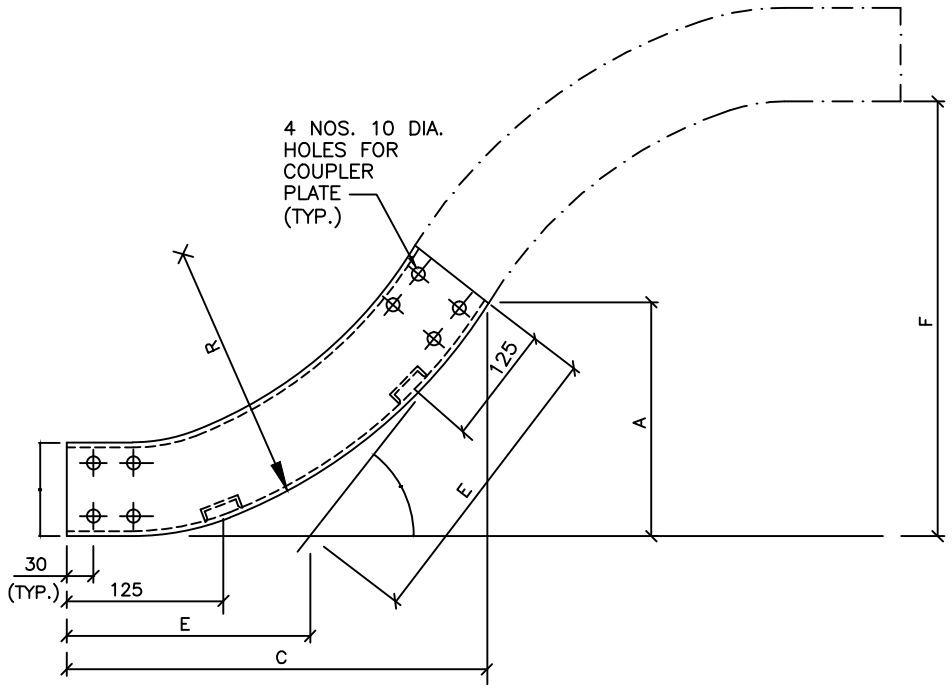
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

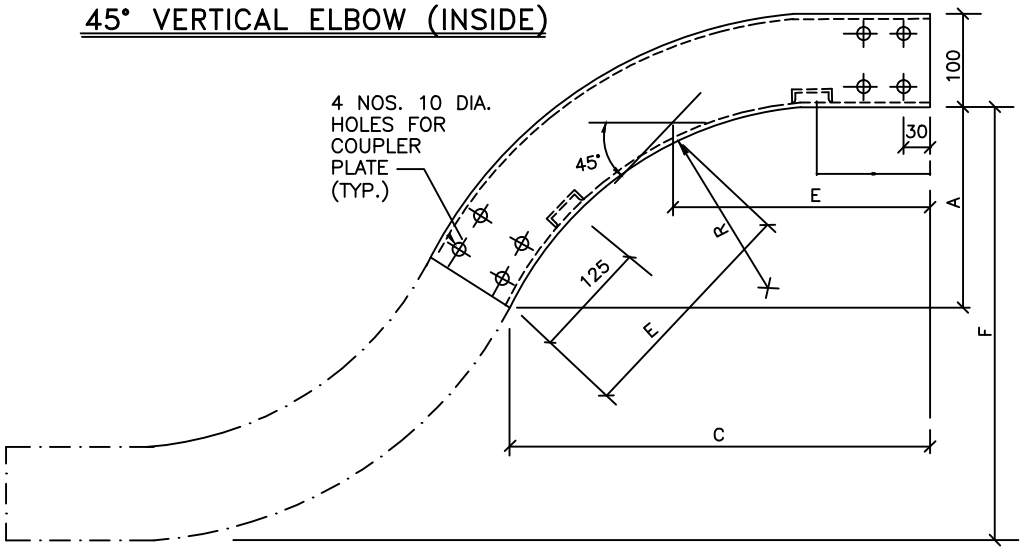
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File Name 14L08–DWG–E–0400

A4_DD (9–96) [210x297]



ELEVATION
45° VERTICAL ELBOW (INSIDE)



WIDTH(W)	RADIUS(R)	A	C	E	F
600 450 & 300	1050	395	955	560	790
	600	265	640	375	530
	450	110	530	310	440
	300	175	425	250	350

ELEVATION
45° VERTICAL ELBOW (OUTSIDE)

NOTE :-

1. ALL DIMENSIONS ARE IN MM.

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GENERAL ARRANGEMENT OF CABLE TRAY, TRENCH & SUPPORT DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

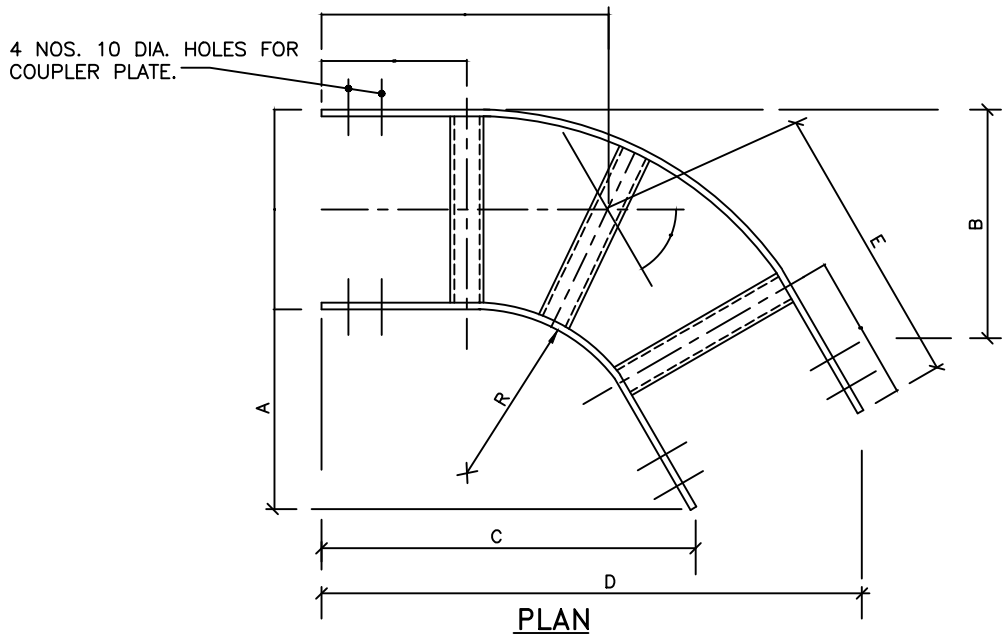
CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

DWG. NO. 14L08-DWG-E-0400 SHT. -20 | REV. 0

File Name 14L08-DWG-E-0400

A4_DD (9-96) [210x297]



PLAN

60° HORIZONTAL ELBOW

WIDTH (W)	RADIUS (R)	A	B	C	D	E
600	1050	635	935	1095	1615	905
	600	410	710	705	1225	645
	450	335	635	575	1095	560
	300	250	550	450	965	470
450	1050	635	860	1095	1485	860
	600	410	635	705	1095	600
	450	335	550	575	965	515
	300	250	485	450	835	425
300	1050	635	785	1095	1355	815
	600	410	560	705	965	555
	450	335	485	575	835	470
	300	250	410	450	705	385

NOTE :-

1. ALL DIMENSIONS ARE IN MM.

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GENERAL ARRANGEMENT OF CABLE TRAY, TRENCH & SUPPORT DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

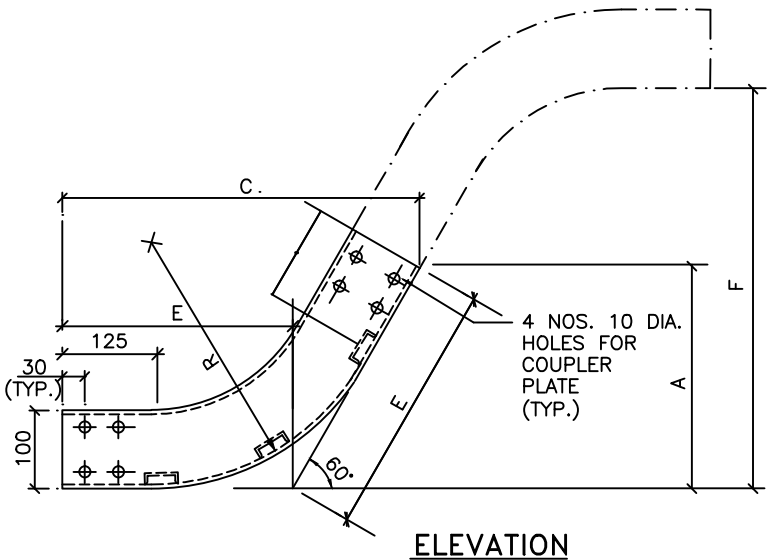
CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

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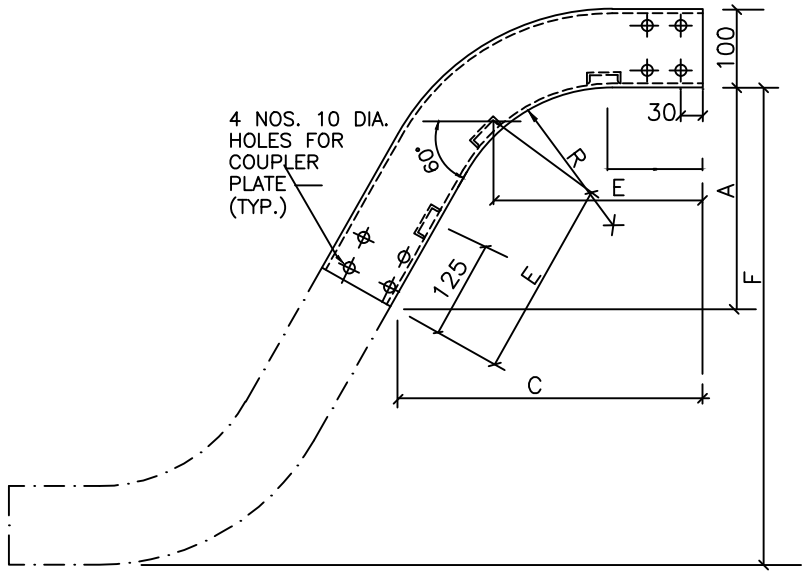
File Name 14L08-DWG-E-0400

A4_DD (9-96) [210x297]



ELEVATION

60° VERTICAL ELBOW (INSIDE)



ELEVATION

60° VERTICAL ELBOW (OUTSIDE)

WIDTH(W)	RADIUS(R)	A	C	E	F
600 450 & 300	1050	635	1095	730	1270
	600	410	705	470	820
	450	335	575	385	670
	300	260	450	300	520

NOTE :-

1. ALL DIMENSIONS ARE IN MM.

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GENERAL ARRANGEMENT OF CABLE TRAY, TRENCH & SUPPORT DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT

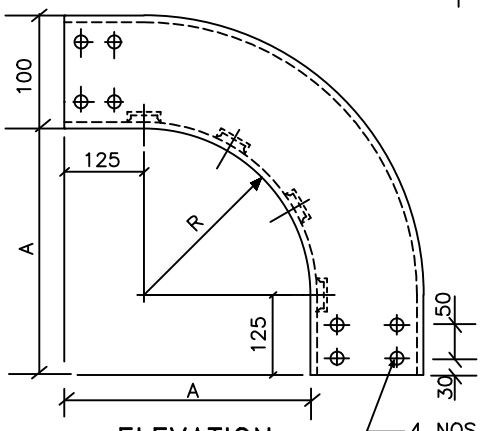
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

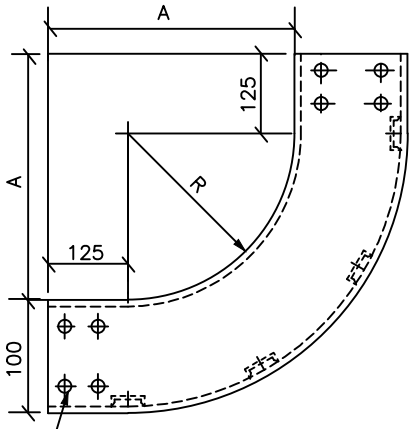
DWG. NO. 14L08-DWG-E-0400 SHT. -22 | REV. 0

File Name 14L08-DWG-E-0400

A4_DD (9-96) [210x297]



ELEVATION
90° VERTICAL ELBOW
(OUTSIDE)

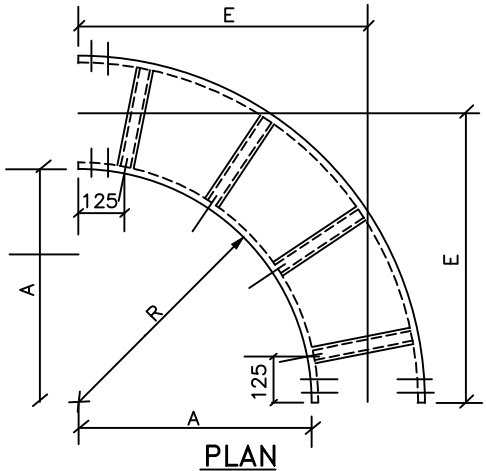


4 NOS. 10 DIA. HOLES
FOR COUPLER PLATE

ELEVATION
90° VERTICAL ELBOW
(INSIDE)

VERTICAL ELBOW		
WIDTH (W)	RADIUS (R)	A
600 450 & 300	1050	1175
	600	725
	450	575
	300	425

HORIZONTAL ELBOW			
WIDTH (W)	RADIUS (R)	A	E
600	1050	1175	1475
	600	725	1025
	450	575	875
	300	425	725
450	1050	1175	1400
	600	725	950
	450	575	800
	300	425	650
300	1050	1175	1325
	600	725	875
	450	575	725
	300	425	575



PLAN
90°HORIZONTAL ELBOW

NOTES :-

1. ALL DIMENSIONS ARE IN MM.
2. FOR MULTITIER CABLE TRAY, THE BENDING RADIUS AT THE BENDS SHALL BE SAME FOR ALL TRAYS AND THIS RADIUS SHALL BE AS PER THE RECOMMENDED BENDING RADIUS OF LARGEST CABLE IN THE ROUTE

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GENERAL ARRANGEMENT OF CABLE TRAY, TRENCH & SUPPORT DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

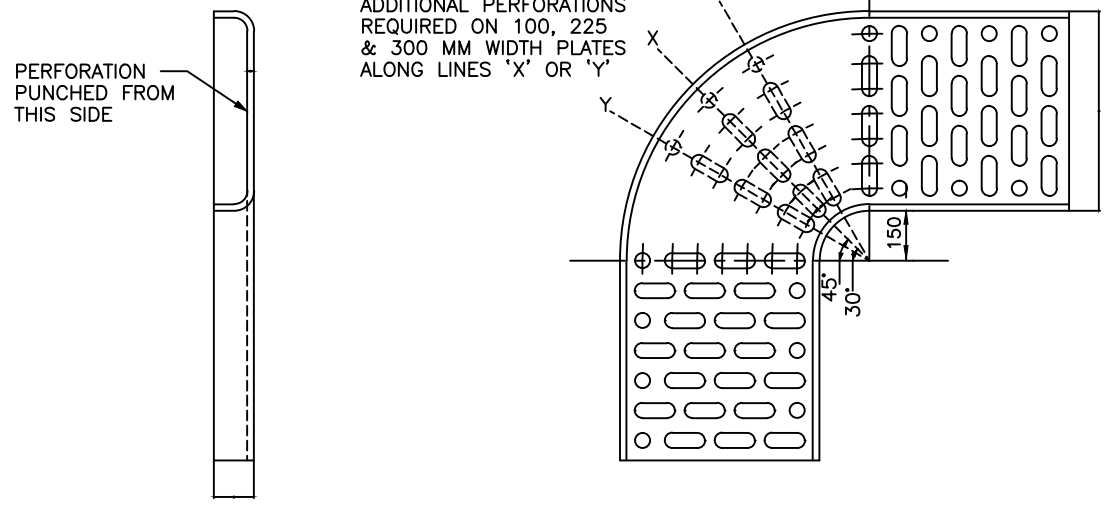
CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

DWG. NO. 14L08-DWG-E-0400 SHT. -23 | REV. 0

File Name 14L08-DWG-E-0400

A4_DD (9-96) [210x297]

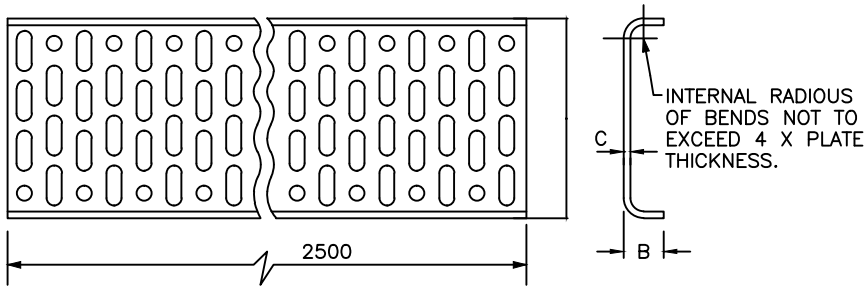


END ELEVATION

PLAN

90° HORIZONTAL ELBOW

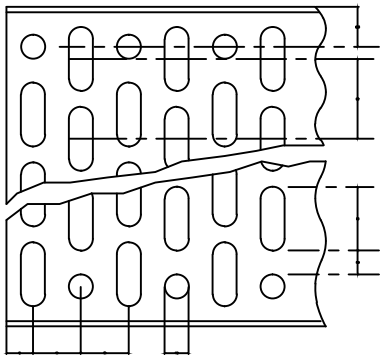
DIMENSIONS IN MM	
WIDTH–A	DEPTH–B
100	50
150/225	
300	50



PLAN

END ELEVATION

STRAIGHT LENGTH



DETAILS OF PERFORATION

NOTES :

1. ALL CUTTING & FORMING OPERATIONS TO BE COMPLETED PRIOR TO GALVANIZING.
2. FINISHED TRAYS TO BE FREE FROM BURRS AND SHARP EDGES.
3. ALL DIMENSIONS ARE IN MM.

PERFORATED TYPE CABLE TRAY

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GENERAL ARRANGEMENT OF CABLE TRAY, TRENCH & SUPPORT DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT

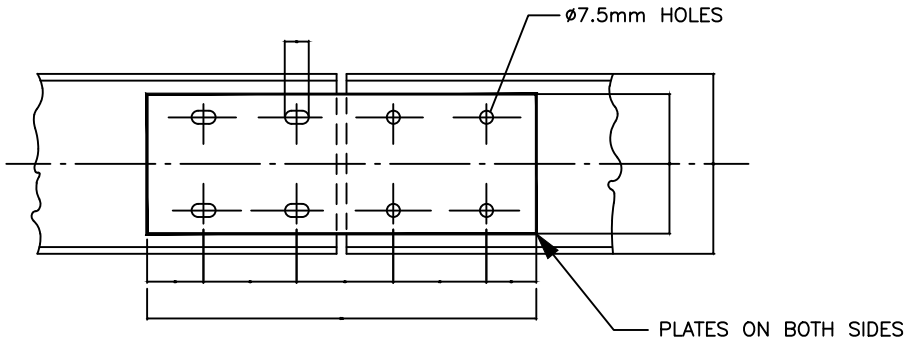
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CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

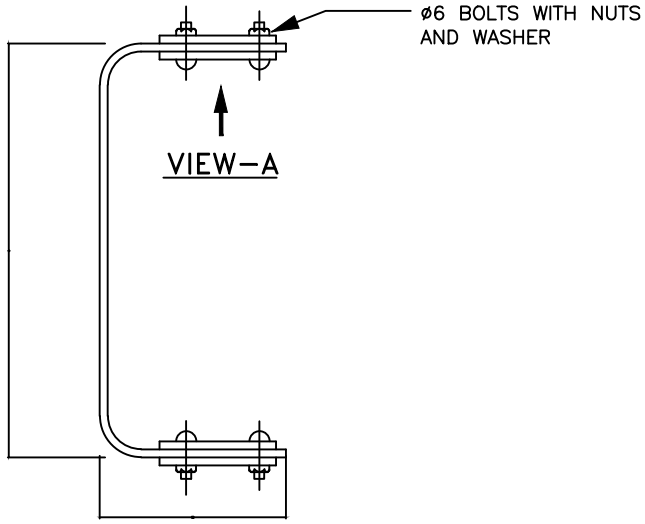
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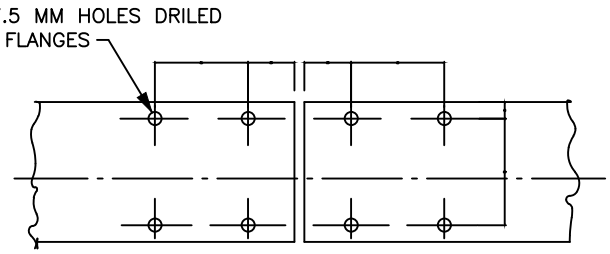
A4_DD (9–96) [210x297]



VIEW–A



END ELEVATION



COUPLING PLATE

NOTES:–

1. COUPLING PLATES 2 MM THICK M.S.
2. ALL DIMENSIONS ARE IN MM.

PERFORATED TRAY JOINING BY COUPLING PLATES

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GENERAL ARRANGEMENT OF CABLE TRAY, TRENCH & SUPPORT DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

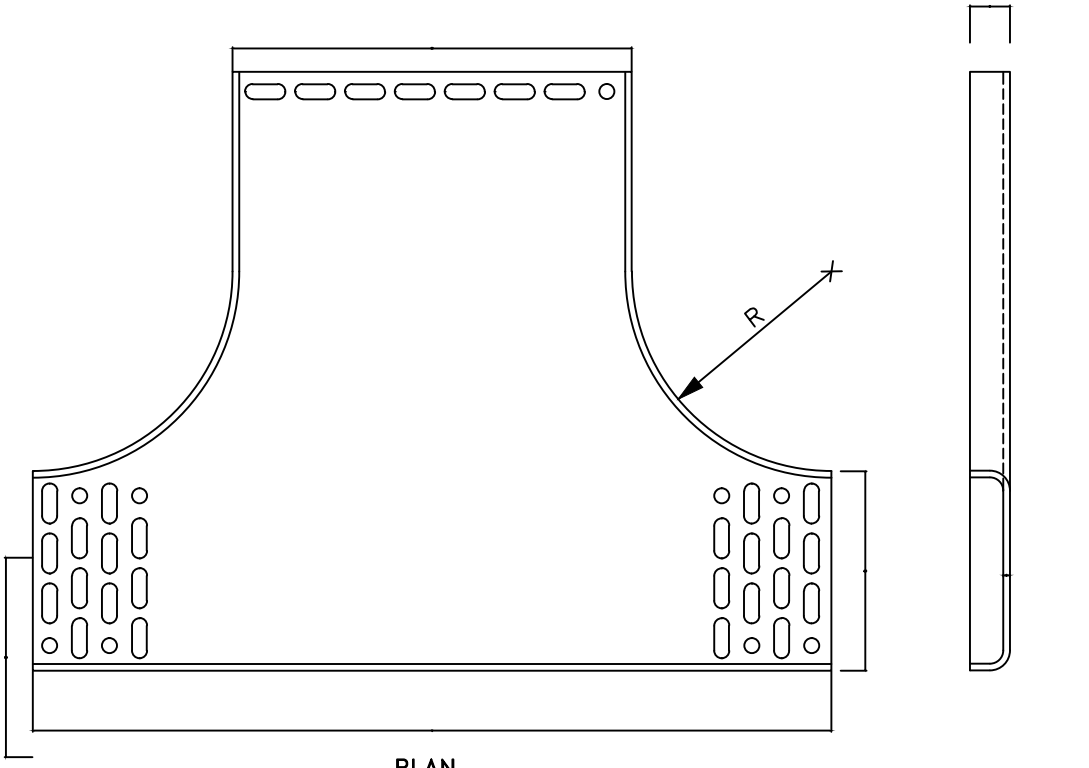
CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

DWG. NO. 14L08–DWG–E–0400 SHT. -25 | REV. 0

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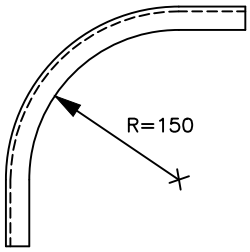
A4_DD (9–96) [210x297]



PLAN

END ELEVATION

HORIZONTAL TEE



VERTICAL ELBOW (90°)

TYPE	DIMENSIONS IN MM				
	D1	D2	B	R	Y
A	225	100	50	150	500
B	300	150	50	200	600

PERFORATED TRAY FITTINGS

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GENERAL ARRANGEMENT OF CABLE TRAY, TRENCH & SUPPORT DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

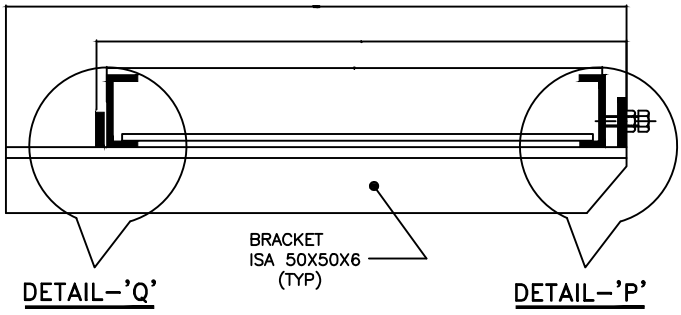
CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

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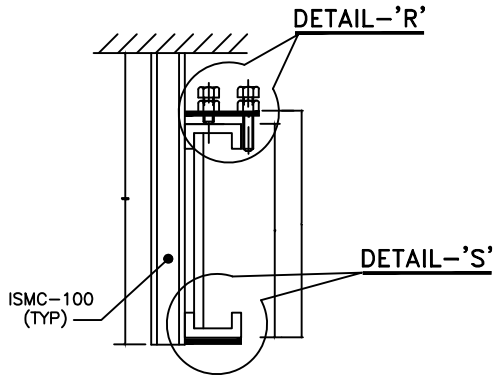
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A4_DD (9-96) [210x297]



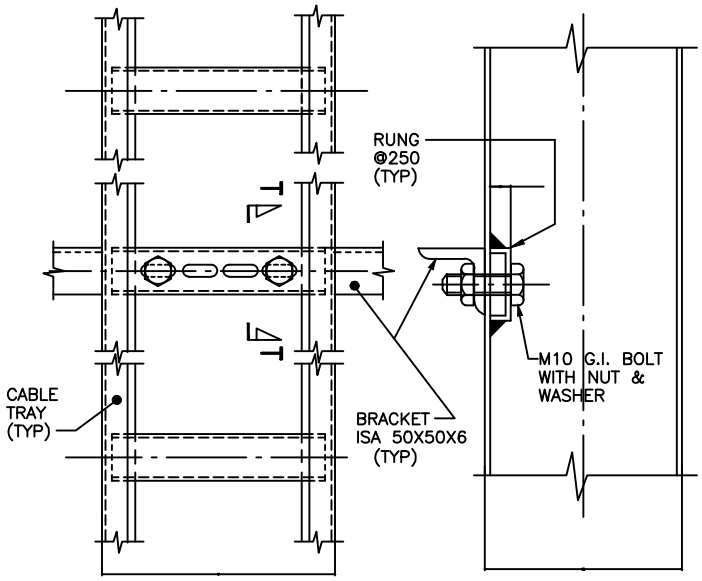
BRACKET

(HORIZONTAL CABLE TRAY)



BRACKET

(VERTICAL CABLE TRAY)

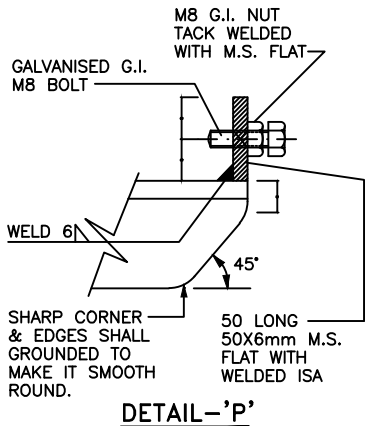


BRACKET

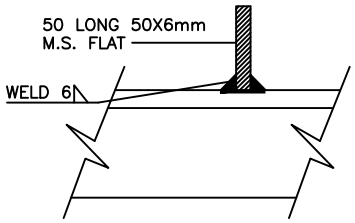
(VERTICAL CABLE SHAFT)

SEC.–'T–T'

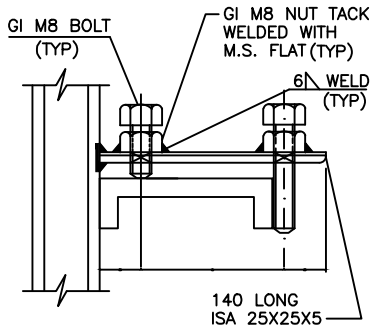
W	600	450	300	
L	625	475	325	



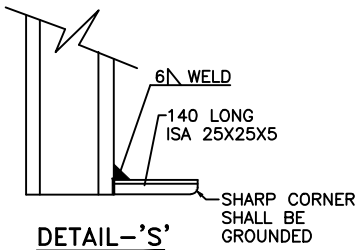
DETAIL–'P'



DETAIL–'Q'



DETAIL–'R'



DETAIL–'S'

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GENERAL ARRANGEMENT OF CABLE TRAY, TRENCH & SUPPORT DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT

DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

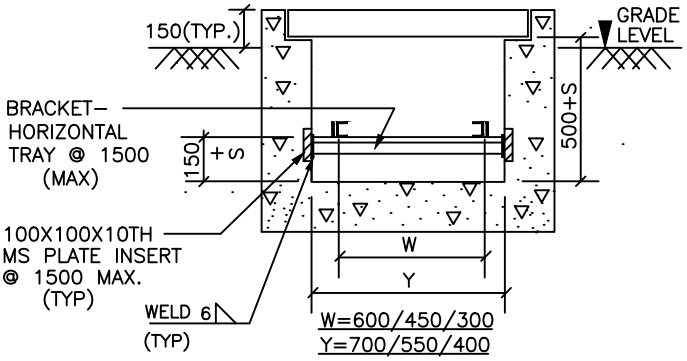
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File Name 14L08–DWG–E–0400

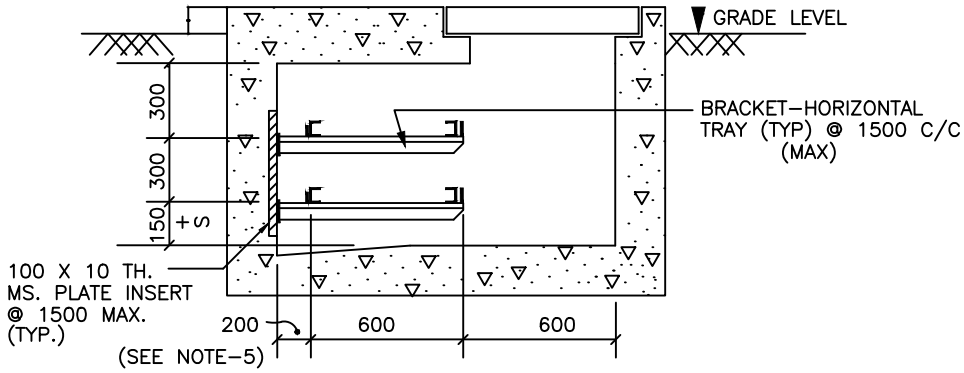
A4_DD (9–96) [210x297]

NOTES :-

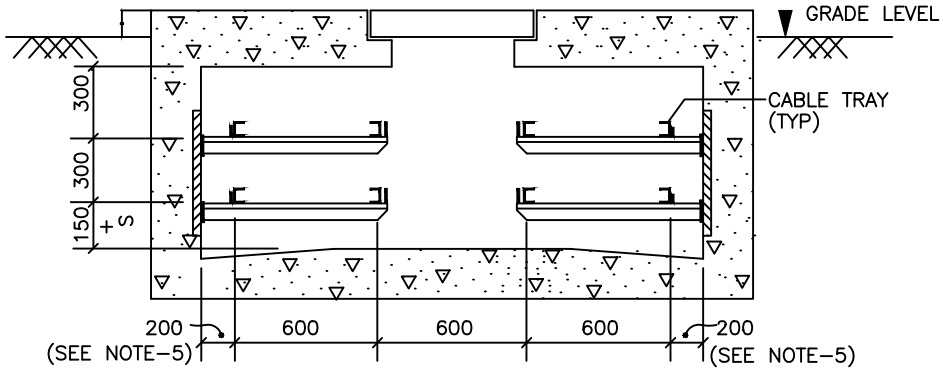
1. ALL DIMENSIONS ARE IN MM.
2. +S INDICATES DISTANCE TO MAINTAIN THE 'SLOPE' OF THE TRENCH.
3. MOUNTING ARRANGEMENT IN CABLE TRENCH TYPE–C,CC,DD ETC. SHALL BE SIMILAR.
4. FOR CABLE TRENCH GROUNDING REFER DWG.NO. ELEC/4.4/GRD/002
5. FOR LONG TRENCH WITHOUT ANY INTERMEDIATE CABLE EXIT, THE GAP "200" MAY BE DISPENSED WITH. HOWEVER, THE SAME SHALL BE PROVIDED FOR AT LEAST 1500mm ON EITHER SIDE OF THE EXIT.



TR – A



TR – B



TR – BB

MOUNTING ARRANGEMENT
(IN CABLE TRENCH)

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GENERAL ARRANGEMENT OF CABLE TRAY, TRENCH & SUPPORT DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

DWG. NO. 14L08–DWG–E–0400 SHT. -28 | REV. 0

File Name 14L08–DWG–E–0400

A4_DD (9–96) [210x297]

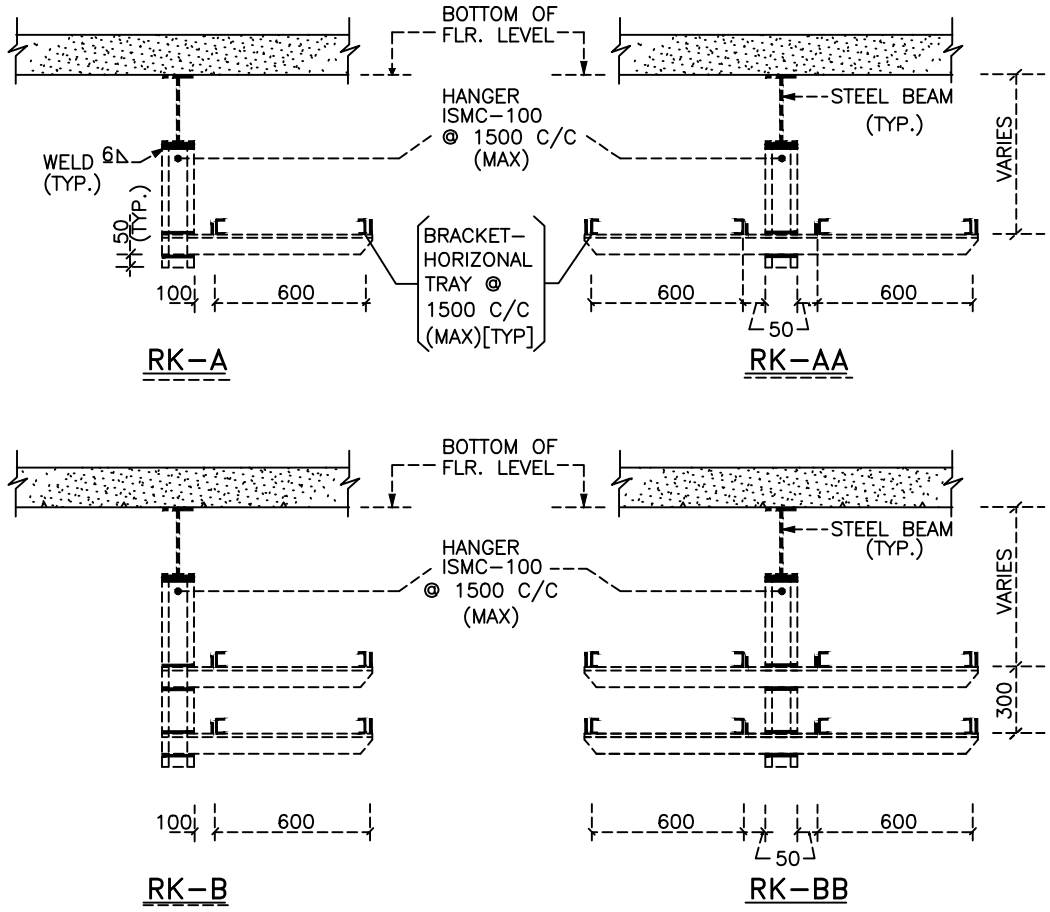


TABLE-1

RACK		NO. OF
TYPE	WIDTH	TIER
A1	450	1
B1	450	2
A2	300	1
B2	300	2

NOTES :-

1. ALL DIMENSIONS ARE IN MM.
2. FOR OVERHEAD CABLE TRAY GROUNDING REFER DWG.NO. ELEC/4.4/GRD/002.
3. FOR RACK TYPE RK-C, RK-CC, RK-D, RK-DD ETC. THE ARRANGEMENT SHALL BE SIMILAR.

MOUNTING ARRANGEMENT

(FROM BEAM)

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GENERAL ARRANGEMENT OF CABLE TRAY, TRENCH & SUPPORT DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

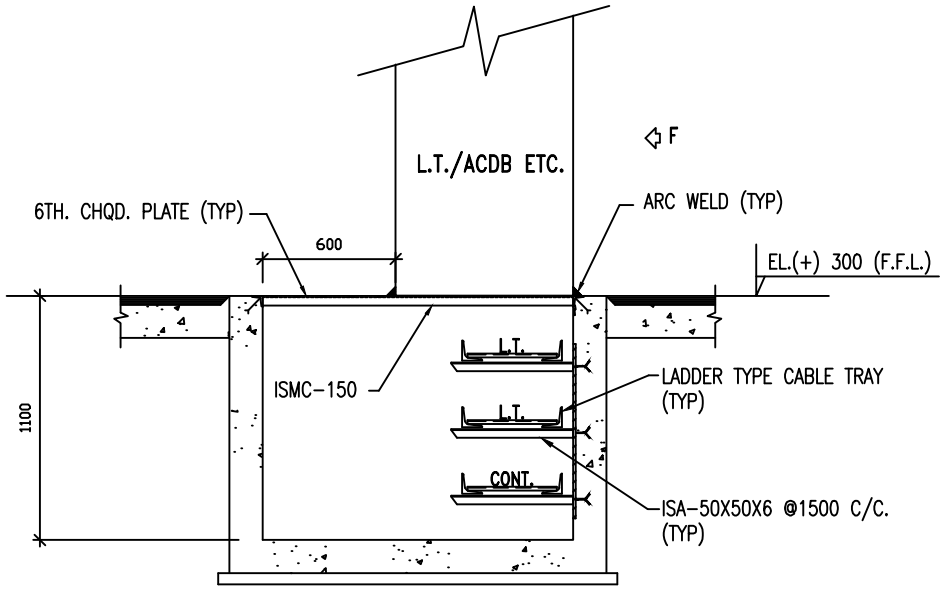
NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

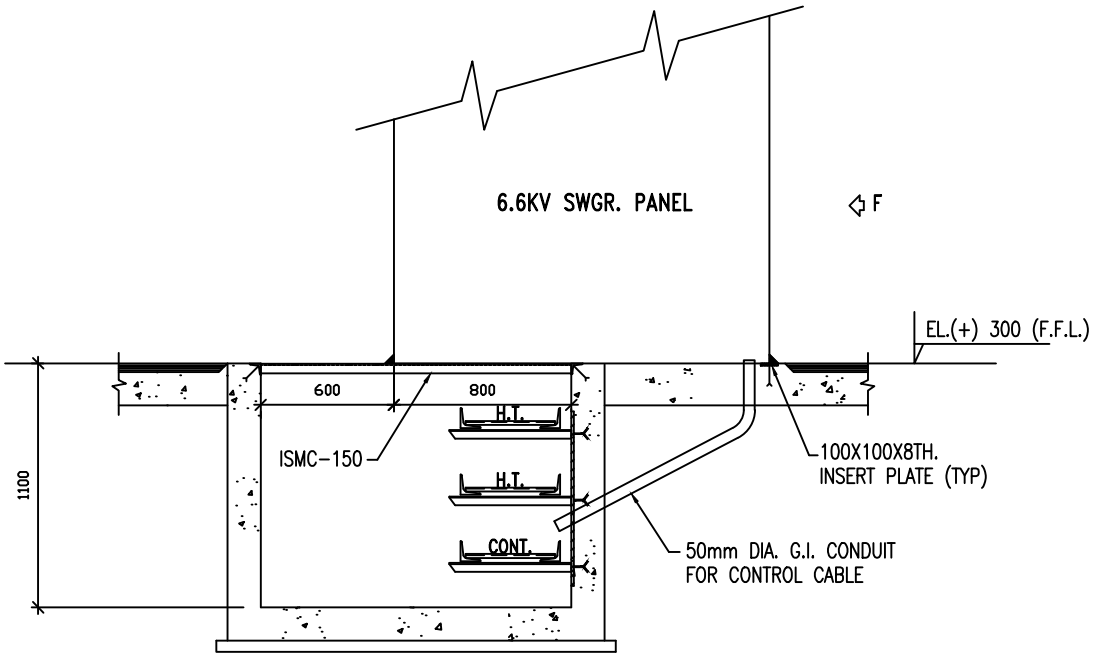
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DWG. NO. 14L08-DWG-E-0400 SHT.-29	REV. 0

File Name 14L08-DWG-E-0400

A4_DD (9-96) [210x297]



EQUIPMENT FDN. DETAILS (LT. SWGR, ACDB ETC.)



EQUIPMENT FDN. DETAILS (6.6KV SWGR)

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GENERAL ARRANGEMENT OF CABLE TRAY, TRENCH & SUPPORT DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

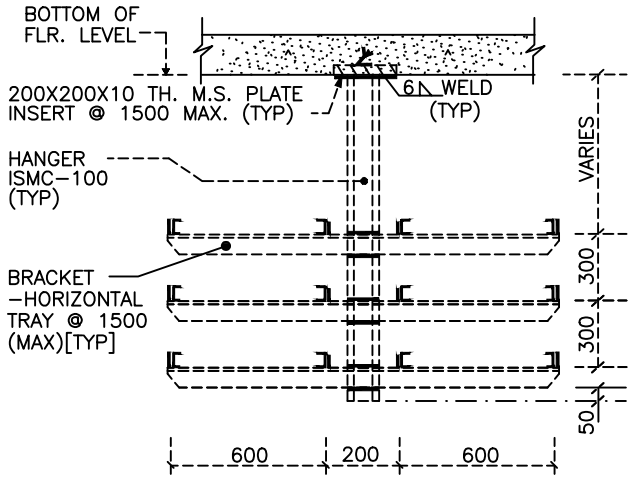
NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

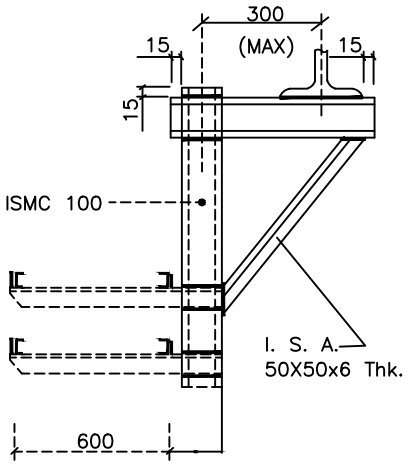
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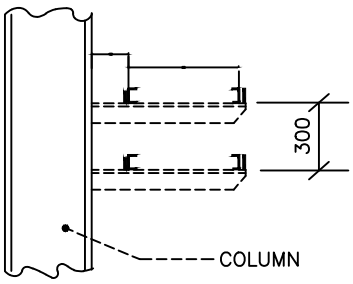
MOUNTING ARRANGEMENT

(FROM CEILING)



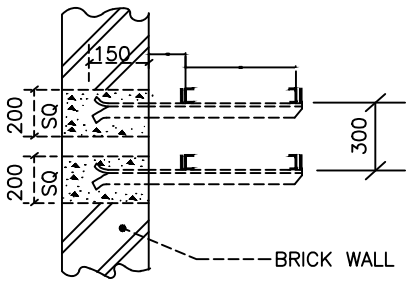
MOUNTING ARRANGEMENT

(FROM FLOOR BEAM)



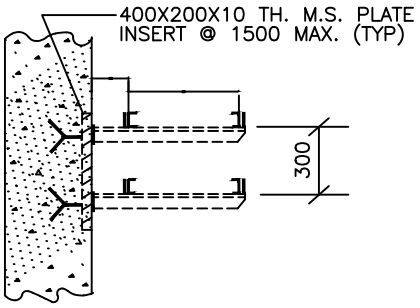
MOUNTING ARRANGEMENT

(FROM STEEL COLUMN)



MOUNTING ARRANGEMENT

(FROM BRICK WALL)



MOUNTING ARRANGEMENT

(FROM CONCRETE COLUMN)

NOTES :-

1. ALL DIMENSIONS ARE IN MM.
2. THE NOS. OF TIER AND WIDTH OF EACH TRAY SHALL BE AS PER RACK TYPE NOS.
3. FOR OVERHEAD CABLE TRAY GROUNDING REFER DWG.NO. ELEC/4.4/GRD/002.

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GENERAL ARRANGEMENT OF CABLE TRAY, TRENCH & SUPPORT DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT

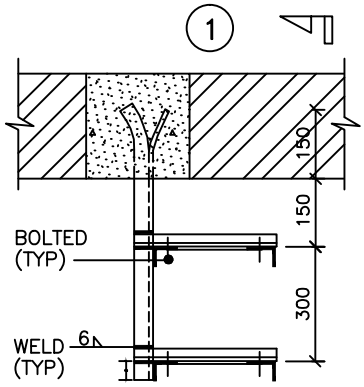
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

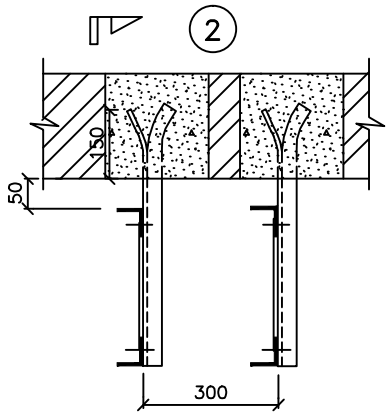
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DWG. NO. 14L08-DWG-E-0400 SHT. -30 | REV. 0

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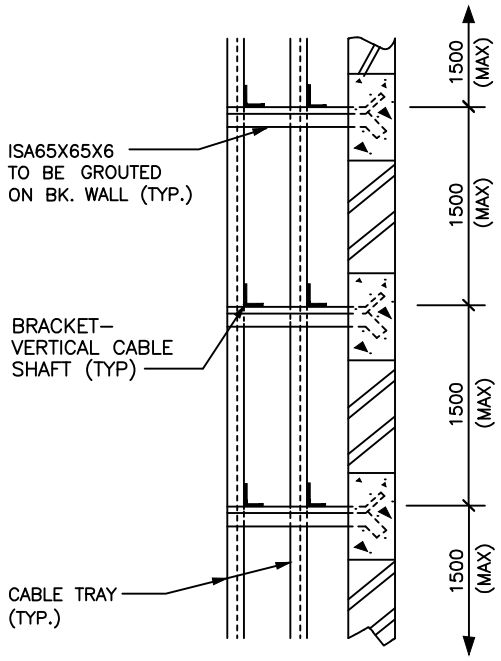
A4_DD (9-96) [210x297]

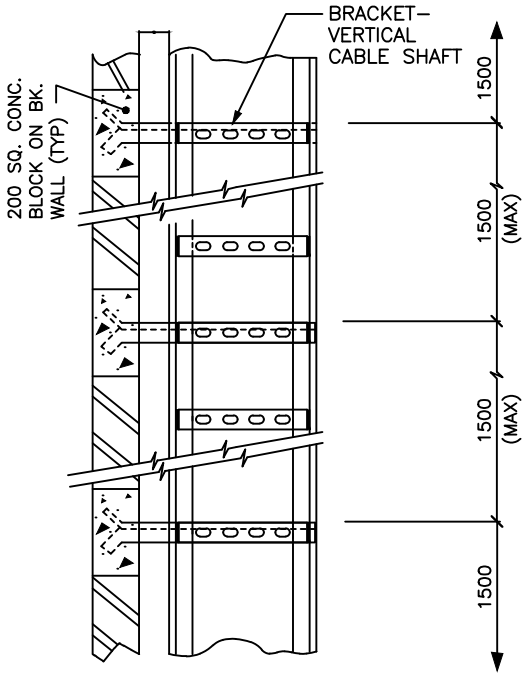




PLAN
ALT.1

PLAN
ALT.2





SEC:1–1

SEC:2–2

MOUNTING ARRANGEMENT
(CABLE SHAFT ON BRICKWALL)

NOTE

FOR CABLE SHAFT OF TYPE SH.–A, SH–C, THE ARRANGEMENT SHALL BE SIMILAR TO SH–B SHOWN HERE IN.

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GENERAL ARRANGEMENT OF CABLE TRAY, TRENCH & SUPPORT DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

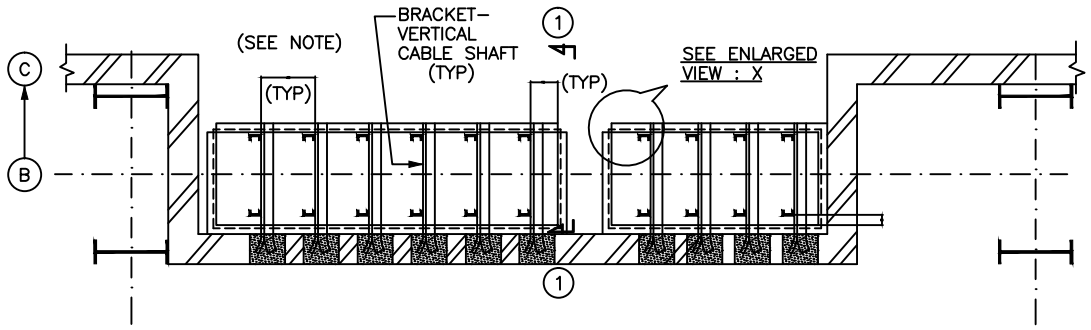
CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

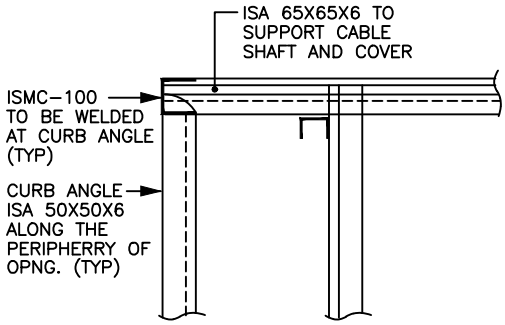
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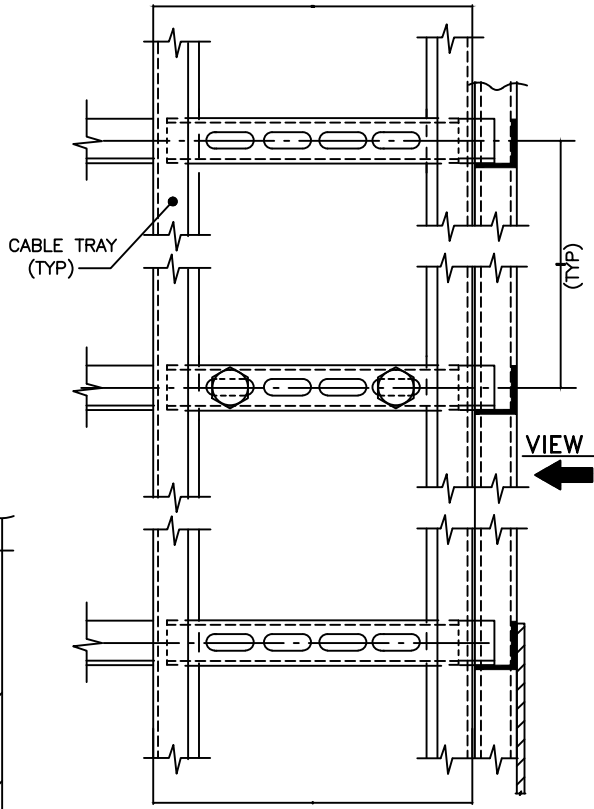
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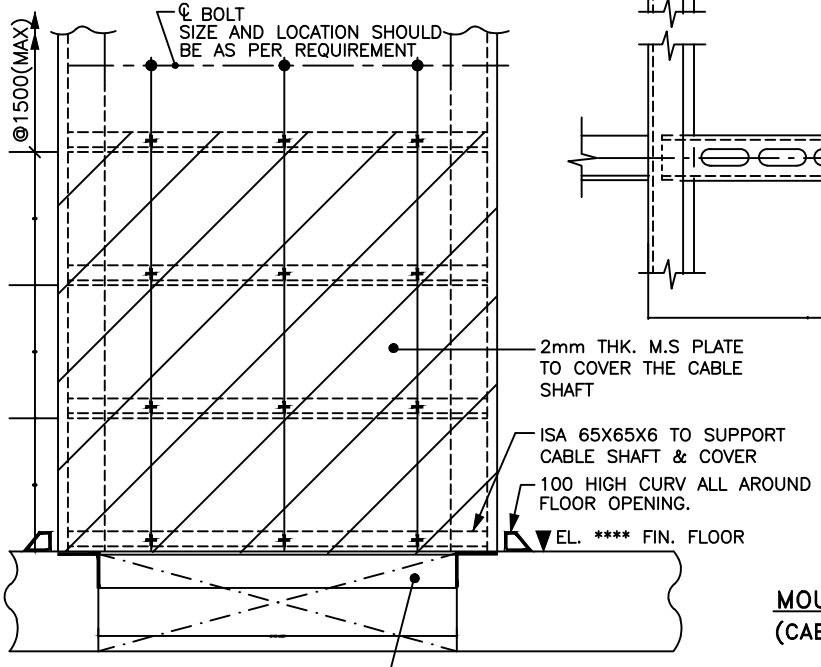


PLAN AT EL.3.5M



ENLARGED VIEW : X
TYPICAL DETAILS OF CABLE SHAFT





VIEW : Y

NOTE:–

THE SPACING MAY BE REDUCED TO 300, IF CABLE TRAY IS APPLICABLE FROM BOTH SIDE.

MOUNTING ARRANGEMENT
(CABLE SHAFT MAIN PLANT)

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GENERAL ARRANGEMENT OF CABLE TRAY, TRENCH & SUPPORT DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

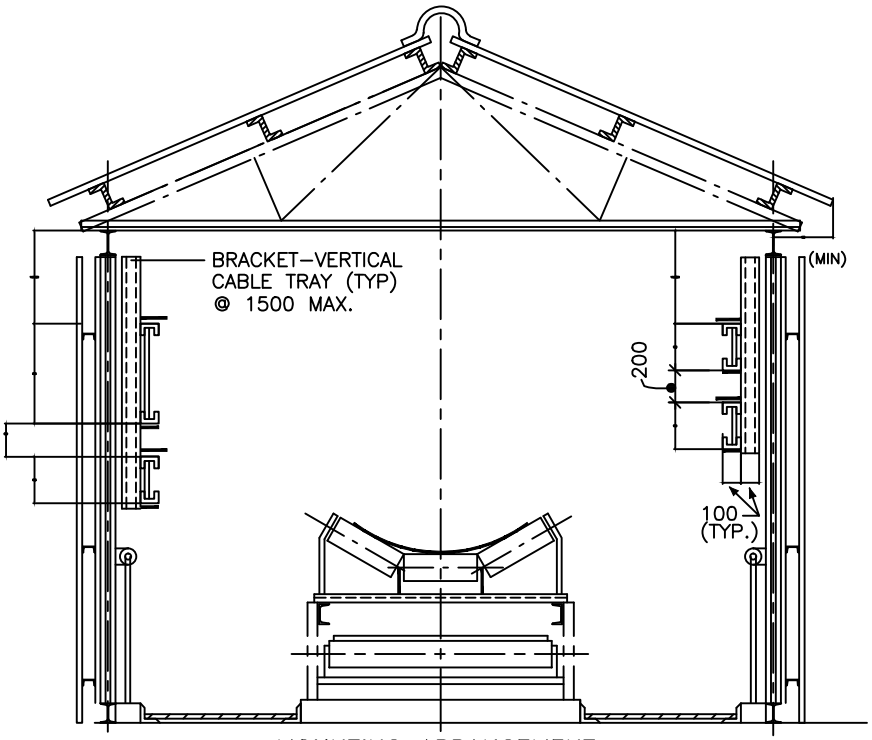
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DWG. NO. 14L08–DWG–E–0400 | REV. 0

SHT. -32

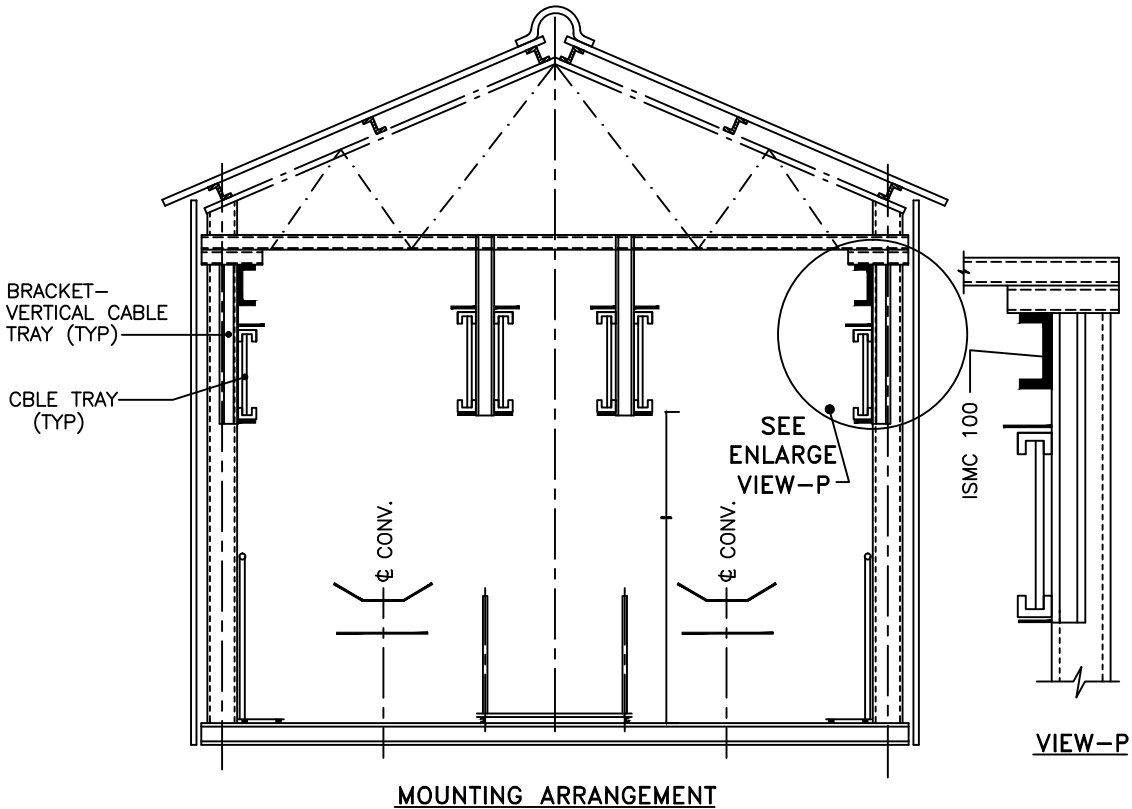
File Name 14L08–DWG–E–0400

A4_DD (9–96) [210x297]



MOUNTING ARRANGEMENT

(INSIDE CONV. GALLERY–ALT–I)



MOUNTING ARRANGEMENT

(INSIDE CONV. GALLERY–ALT–II)

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GENERAL ARRANGEMENT OF CABLE TRAY, TRENCH & SUPPORT DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT

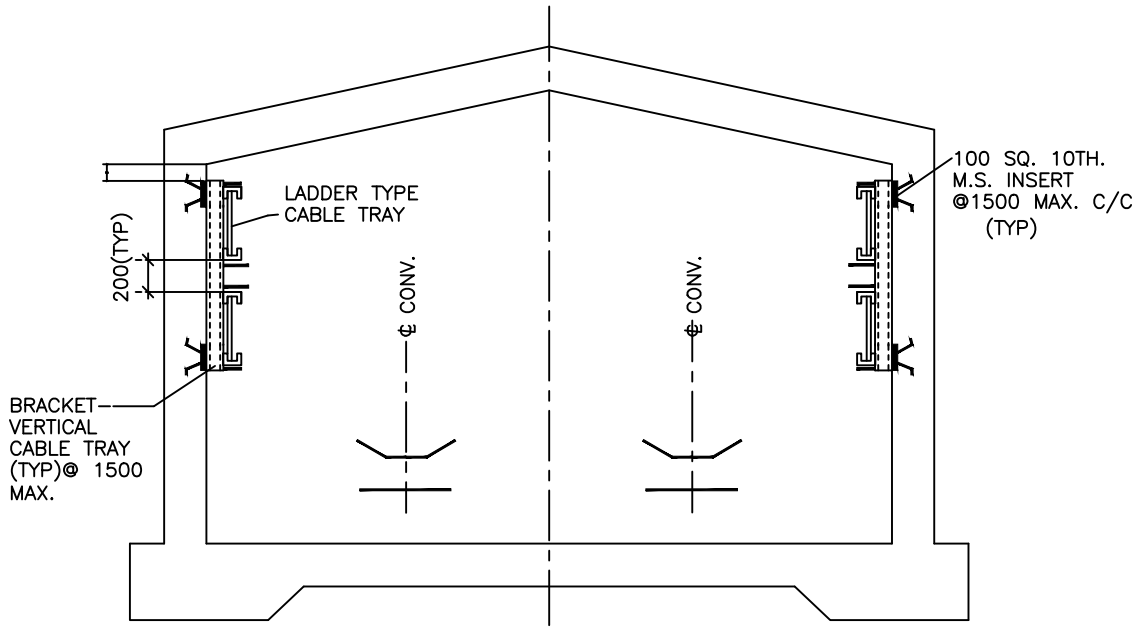
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

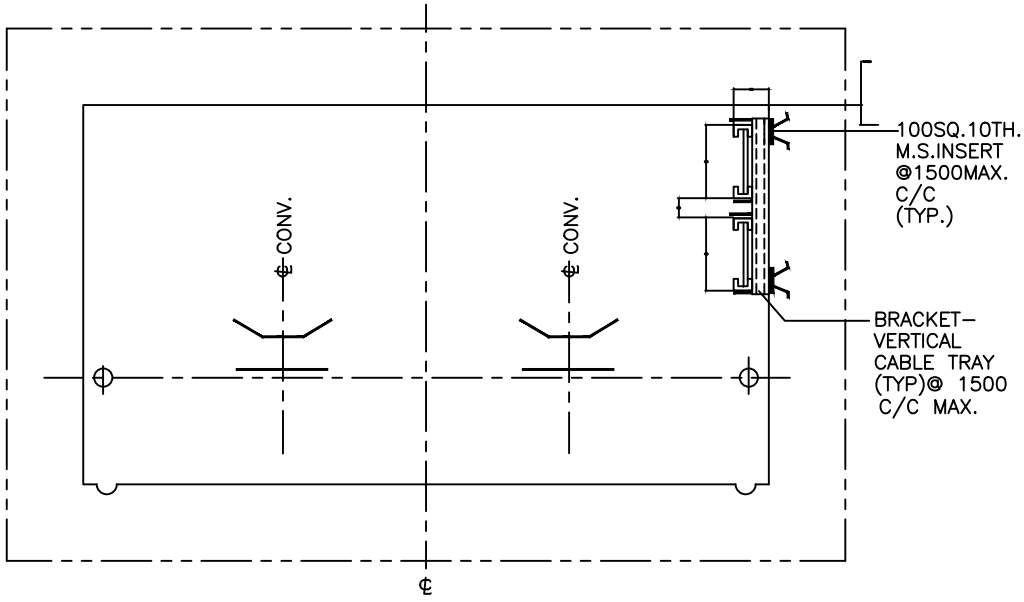
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File Name 14L08–DWG–E–0400

A4_DD (9–96) [210x297]



MOUNTING ARRANGEMENT
(IN CONVEYOR TUNNEL–ALT–I)



MOUNTING ARRANGEMENT
(IN CONVEYOR TUNNEL–ALT–II)

NOTE:–

ALL DIMENSIONS ARE IN MM.

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GENERAL ARRANGEMENT OF CABLE TRAY, TRENCH & SUPPORT DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT

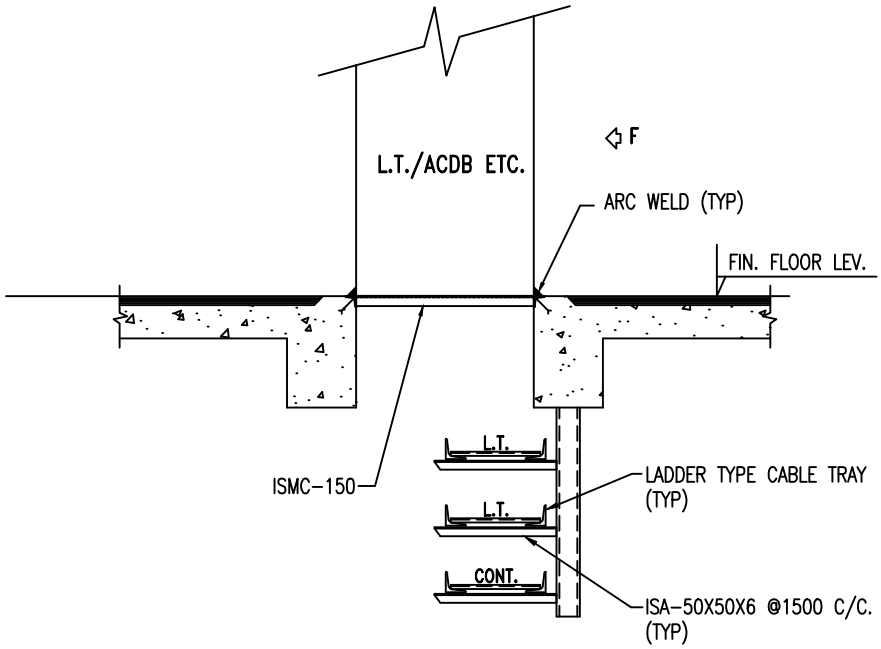
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CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

DWG. NO. 14L08–DWG–E–0400 SHT. -34 | REV. 0

File Name 14L08–DWG–E–0400

A4_DD (9–96) [210x297]



EQUIPMENT FDN. DETAILS (FLOOR MOUNTED)

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GENERAL ARRANGEMENT OF CABLE TRAY, TRENCH & SUPPORT DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

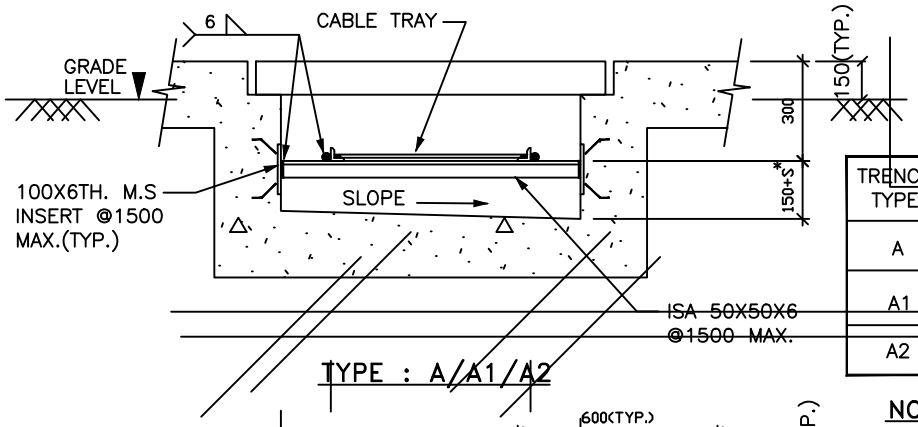
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DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

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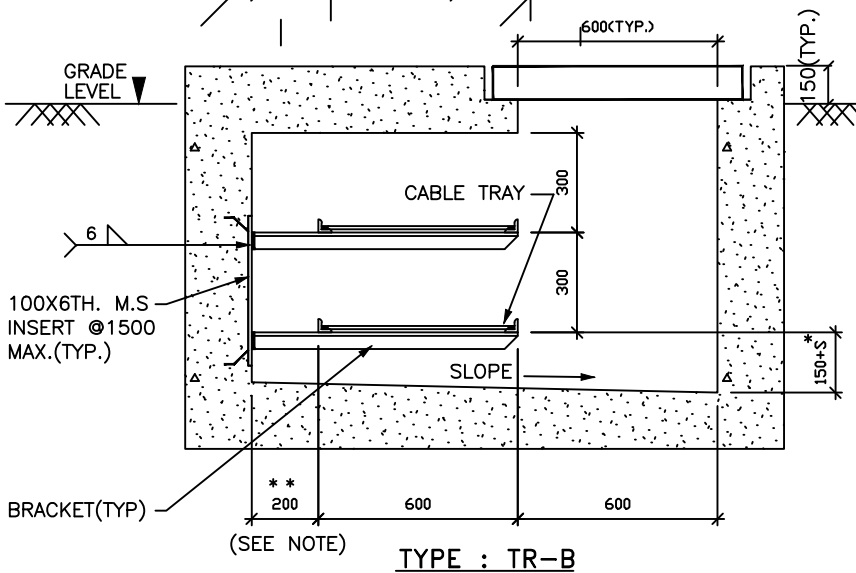
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A4_DD (9-96) [210x297]

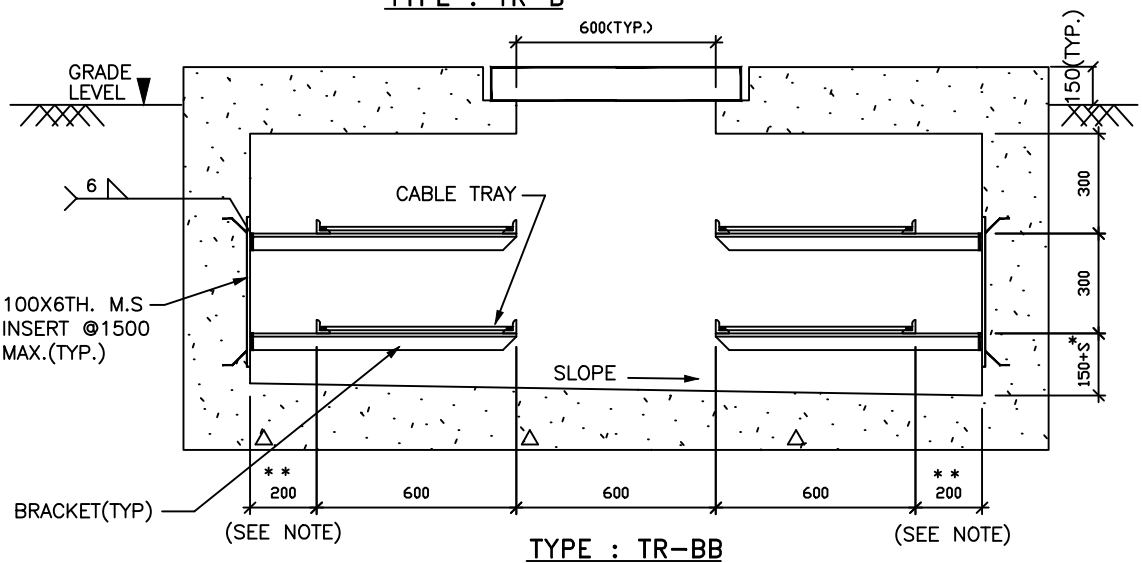


TRENCH TYPE	W	L
A	600	650
A1	450	500
A2	300	350

TYPE : A/A1/A2



TYPE : TR-B



TYPE : TR-BB

NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. * S INDICATES THE INCREMENTAL DEPTH TO MATCH THE SLOPE OF THE TRENCH.
3. FOR LONG TRENCH WITHOUT ANY INTERMEDIATE CABLE EXIT, THE GAP **200 MAY BE DISPENSED WITH. HOWEVER, THE SAME SHALL BE MAINTAINED AT LEAST 1500mm ON EITHER SIDE OF THE CABLE EXIT/ENTRY.
4. THE CABLE TRAY MOUNTING ARRANGEMENT FOR TRENCH TYPE TR-C, TR-CC, TR-D, ETC. SHALL BE SIMILAR.
5. EACH REMOVABLE TRENCH COVER SHALL BE 300MM WIDE.

MOUNTING ARRANGEMENT (IN CABLE TRENCH)

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GENERAL ARRANGEMENT OF CABLE TRAY, TRENCH & SUPPORT DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT

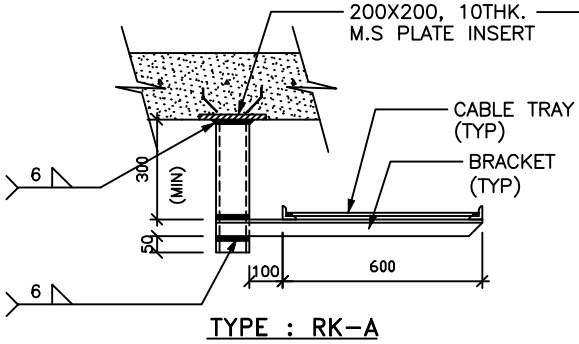
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CONSULTING ENGINEERS

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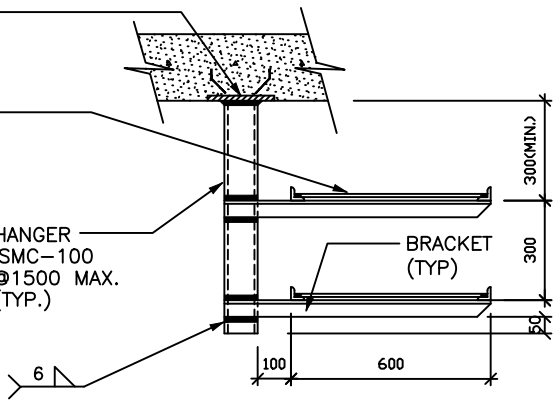
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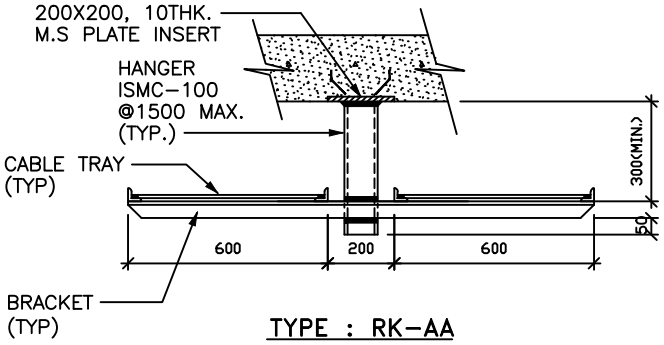
A4_DD (9-96) [210x297]



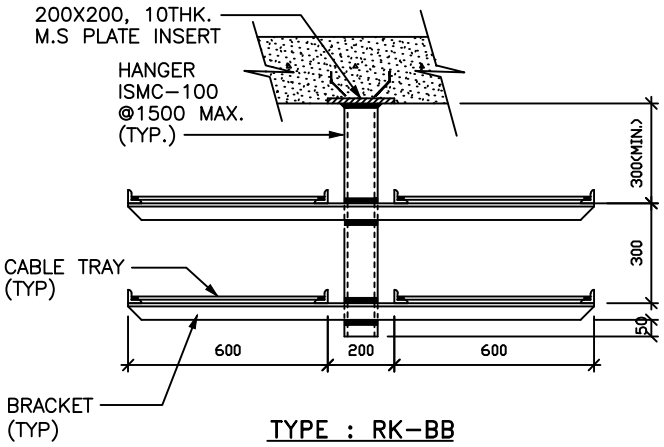
TYPE : RK–A



TYPE : RK–B



TYPE : RK–AA



TYPE : RK–BB

NOTES:–

1. ALL DIMENSIONS ARE IN MM.
2. MOUNTING ARRANGEMENT OF TRAYS FOR RACK TYPE RK–C, RK–CC, RK–D & RK–DD SHALL BE SIMILAR.
3. ISMC–100 HANGER MAY BE SIMILARLY SUPPORTED FROM STRUCTURAL STEEL BEAM/ COLUMN, IF AVAILABLE, IN PLACE OF PLATE INSERT.

MOUNTING ARRANGEMENT– HORIZONTAL TRAY (FROM CONCRETE SLAB)

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GENERAL ARRANGEMENT OF CABLE TRAY, TRENCH & SUPPORT DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT

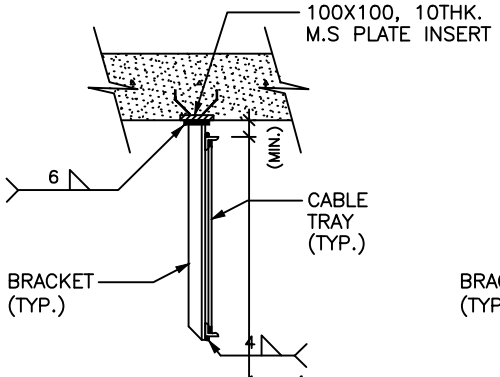
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

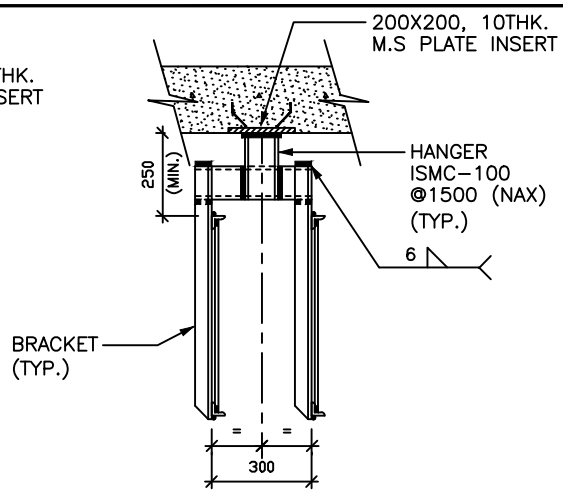
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File Name 14L08–DWG–E–0400

A4_DD (9–96) [210x297]

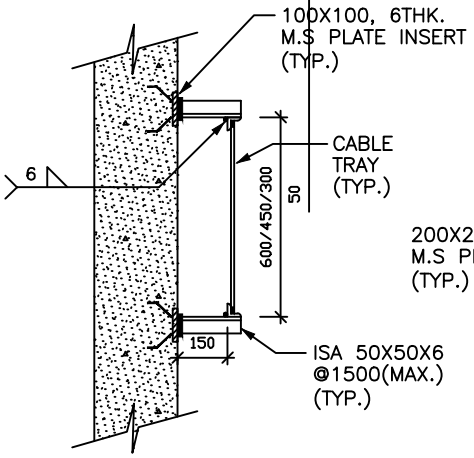


TYPE : RK-A/A1/A2

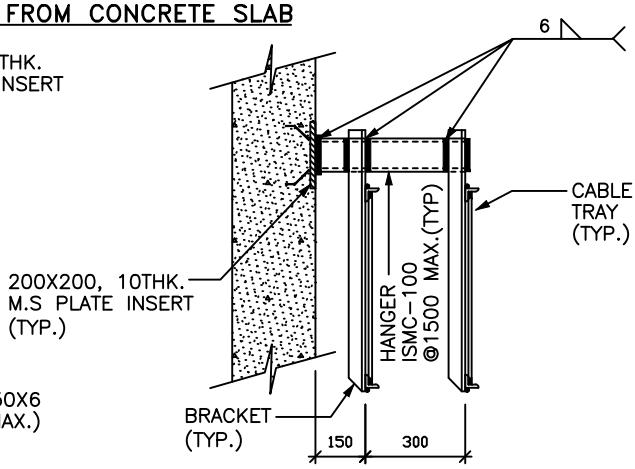


TYPE : RK-B

VERTICAL TRAY SUPPORTED FROM CONCRETE SLAB

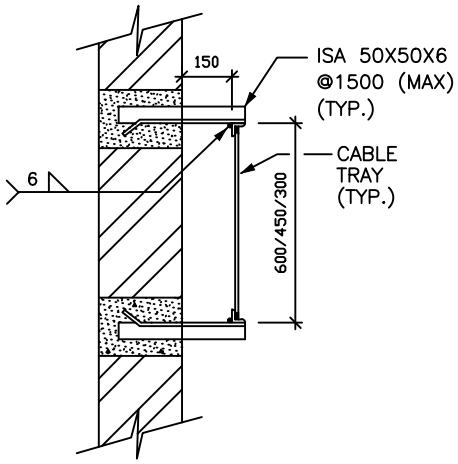


TYPE : RK-A/A1/A2



TYPE : RK-B

VERTICAL TRAY SUPPORTED FROM CONCRETE COLUMN



SINGLE VERTICAL TRAY ON BRICK WALL

NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. ISMC-100 HANGER MAY SIMILARLY SUPPORTED FROM STEEL BEAM / COLUMN IF AVAILABLE.
3. MOUNTING ARRANGEMENT FOR RACK TYPE RK-C, RK-D SHALL BE SIMILAR.

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GENERAL ARRANGEMENT OF CABLE TRAY, TRENCH & SUPPORT DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

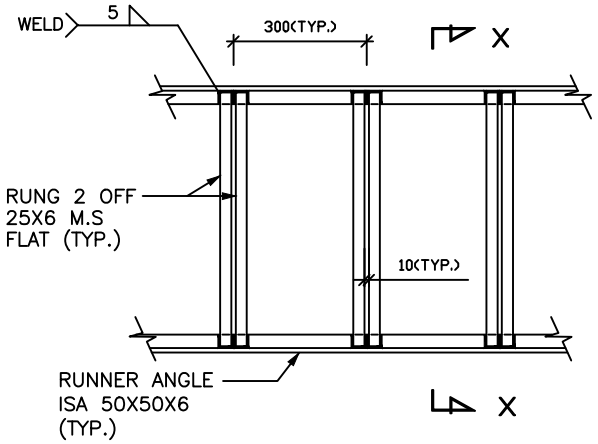
CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

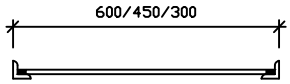
JOB NO. 14L08 | SCALE : N.T.S

DWG. NO. 14L08-DWG-E-0400 SHT.-07 | REV. 0

File Name 14L08-DWG-E-0400

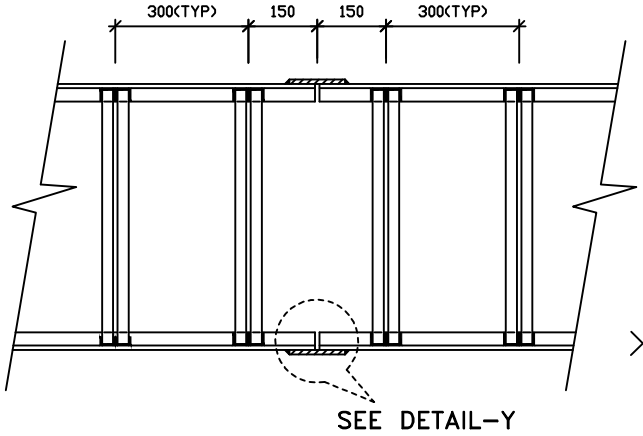
A4_DD (9-96) [210x297]

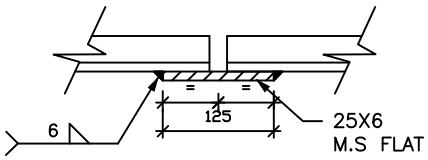




VIEW X–X

TYPICAL TRAY DETAILS

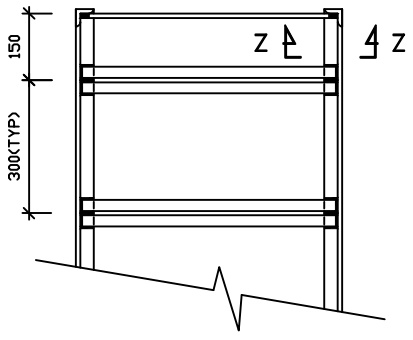




DETAIL–Y

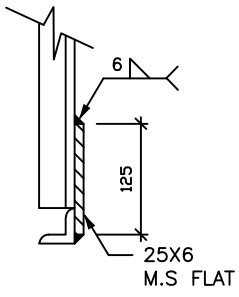
TYPICAL CABLE TRAY JOINTS

(STRAIGHT THROUGH)



CABLE TRAY JOINTS

(IN TWO VERTICAL PLANES)



VIEW Z–Z

NOTES:

1. ALL DIMENSIONS ARE IN MM.
2. THE CABLE TRAY SHALL BE PAINTED AFTER FABRICATION.
3. THE CABLLE TRAY SHALL BE SUPPORTED AT A DISTANCE NOT EXCEEDING 1500mm.

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GENERAL ARRANGEMENT OF CABLE TRAY, TRENCH & SUPPORT DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT

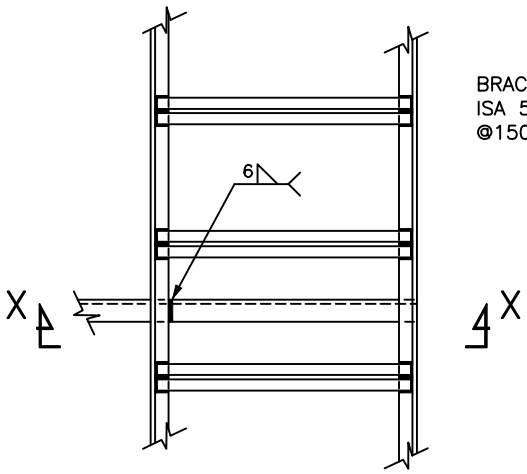
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

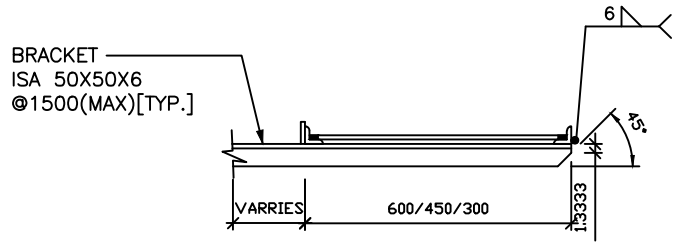
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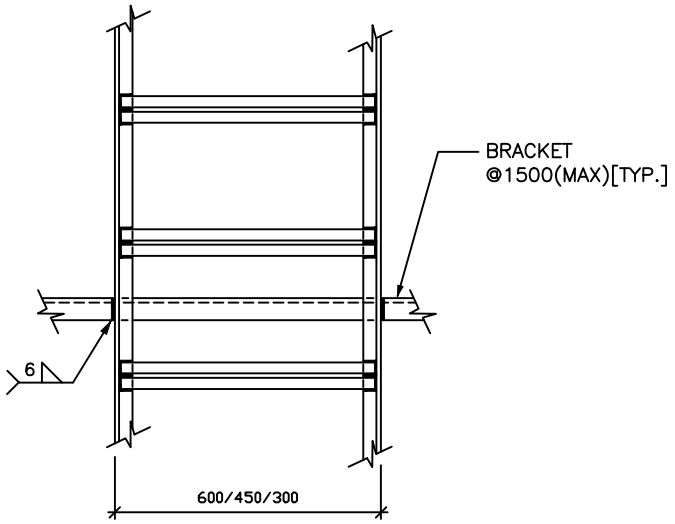
A4_DD (9–96) [210x297]



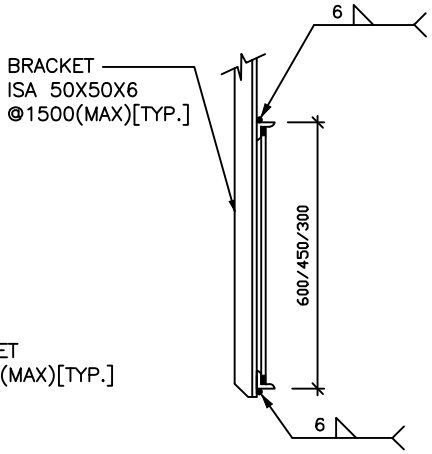
PLAN VIEW : HORIZONTAL TRAY



VIEW X–X



ELEVATION : CABLE SHAFT



END VIEW

VERTICAL CABLE TRAY

NOTE:

1. ALL DIMENSIONS ARE IN MM.
2. THE BRACKET SHALL BE PAINTED AFTER FABRICATION.

CABLE TRAY BRACKET

FOR TENDER ONLY

B.B	KKB	B.M	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GENERAL ARRANGEMENT OF CABLE TRAY, TRENCH & SUPPORT DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT

DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08	SCALE : N.T.S
DWG. NO. 14L08–DWG–E–0400 SHT. -09	REV. 0

File Name 14L08–DWG–E–0400

A4_DD (9–96) [210x297]

GROUNDING NOTES AND DETAILS

FOR TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GROUNDING NOTES & DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT

DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

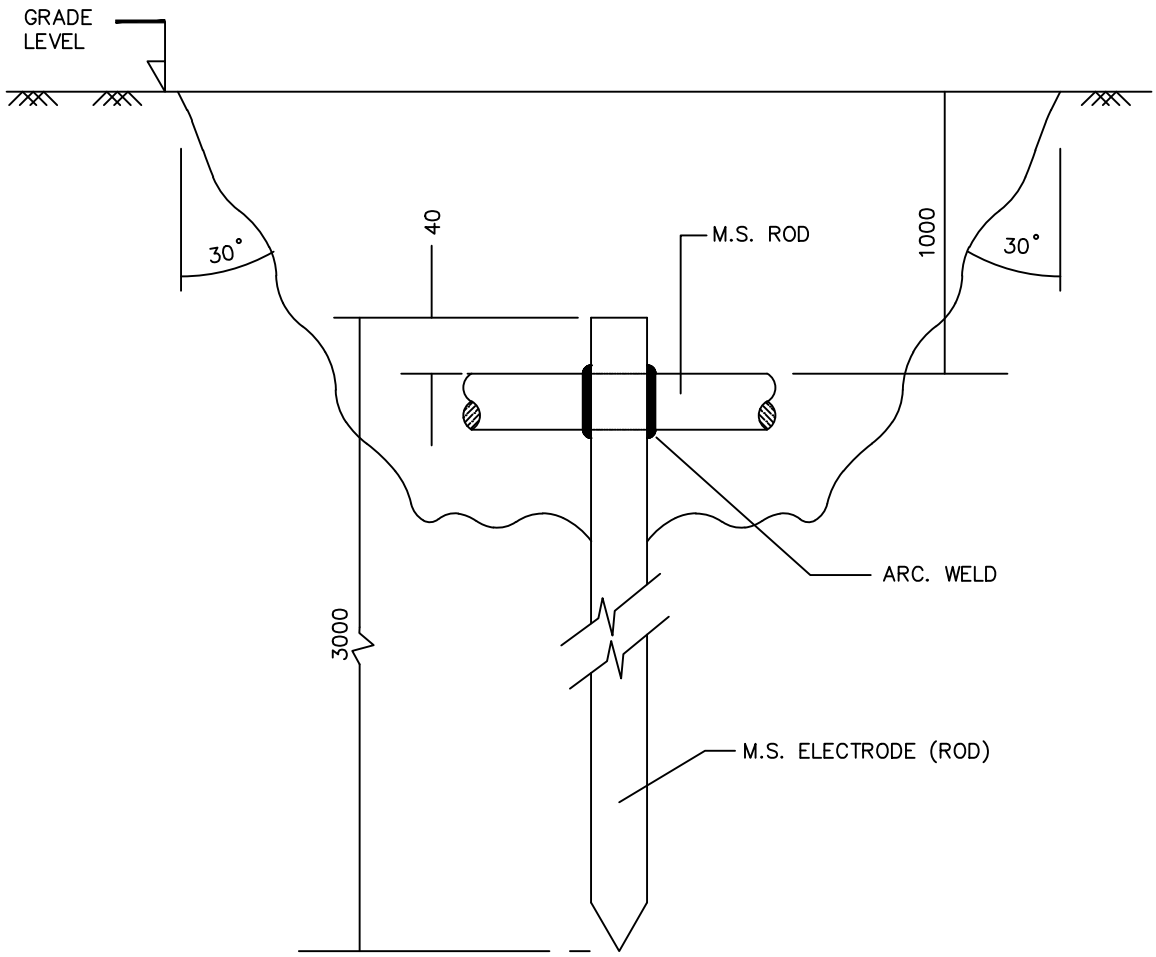
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DWG. NO. 14L08-DWG-E-0600 | REV. 0

SHT.-01 OF 30

File Name 14L08-DWG-E-0600

A4_DD (9-96) [210x297]



GROUND ELECTRODE

FOR TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GROUNDING NOTES & DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

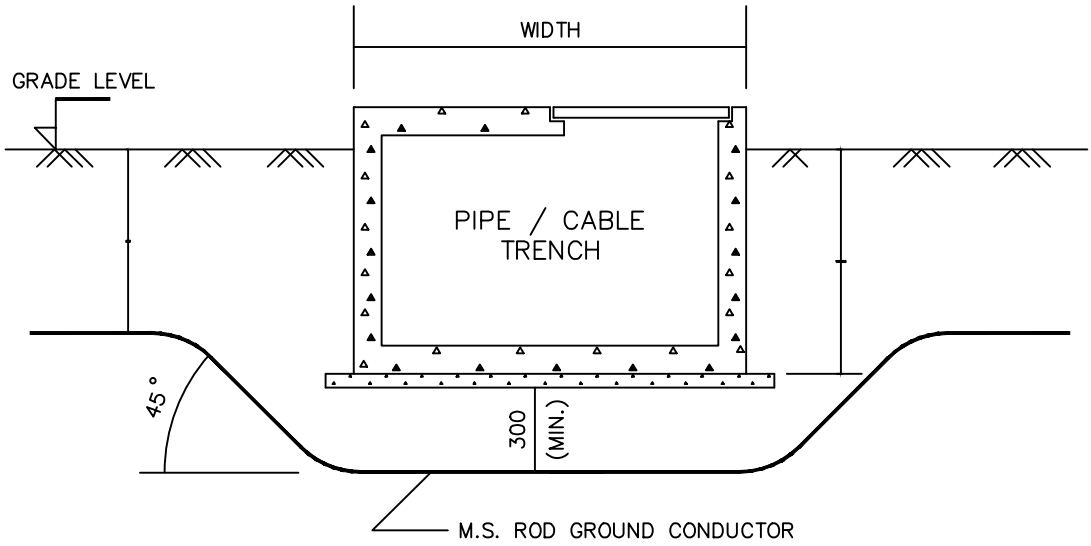
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DWG. NO. 14L08-DWG-E-0600 | REV. 0

SHT. - 10 OF 30

File Name 14L08-DWG-E-0600

A4_DD (9-96) [210x297]



TRENCH CROSSING OF GROUNDING CONDUCTOR

FOR TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GROUNDING NOTES & DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

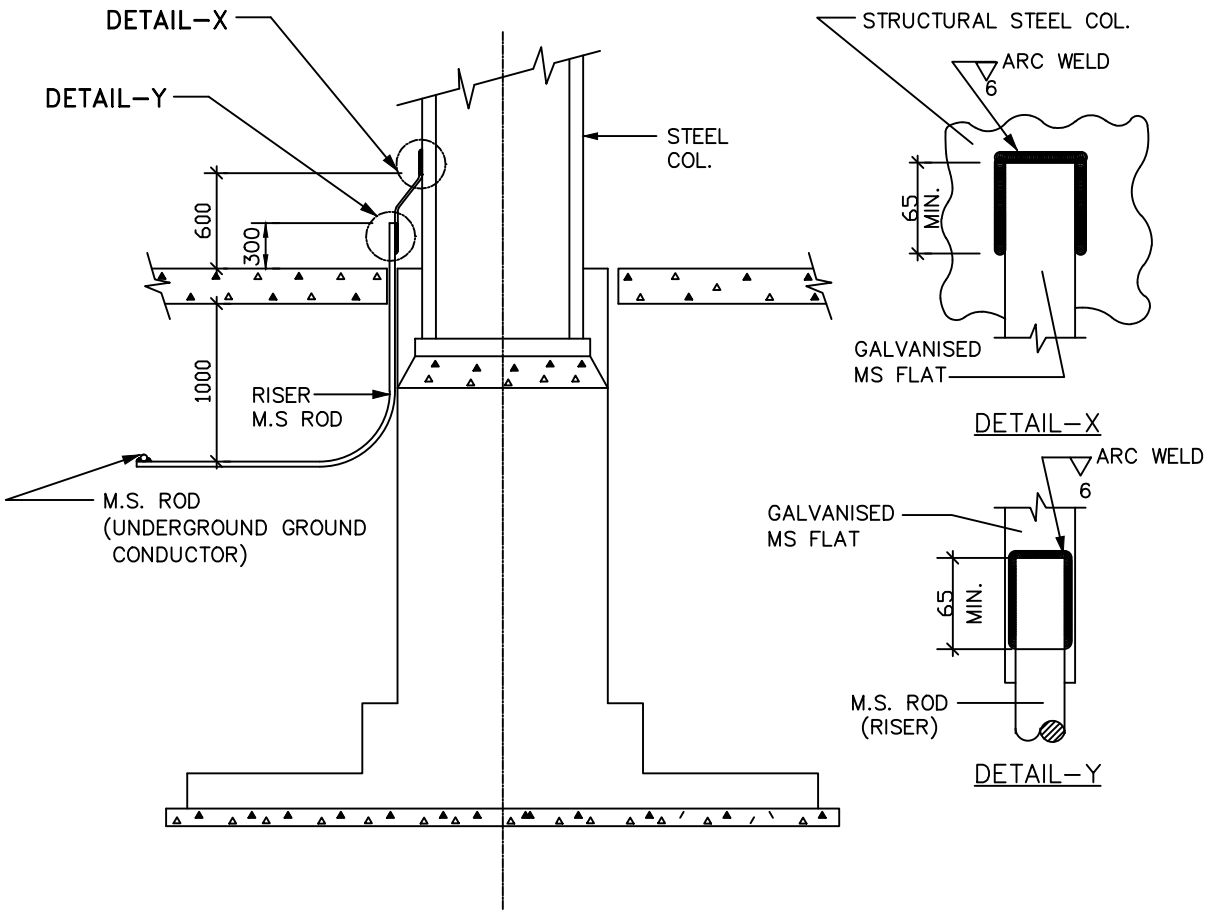
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DWG. NO. 14L08-DWG-E-0600 | REV. 0

SHT. - 11 OF 30

File Name 14L08-DWG-E-0600

A4_DD (9-96) [210x297]



GROUNDING OF STEEL COL.

FOR TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GROUNDING NOTES & DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

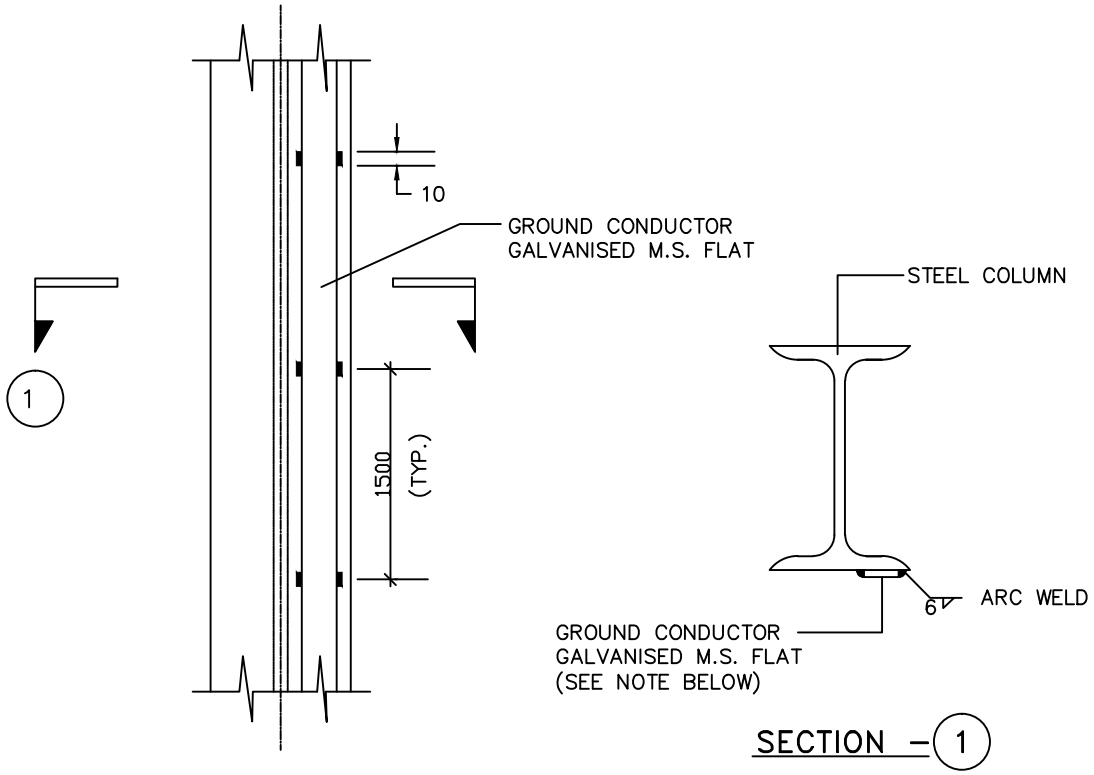
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DWG. NO. 14L08–DWG–E–0600 | REV. 0

SHT. - 12 OF 30

File Name 14L08–DWG–E–0600

A4_DD (9–96) [210x297]



GROUNDING CONDUCTOR ALONG STEEL COLUMN

NOTE: THIS CONDUCTOR MAY BE AVOIDED IF THE DIFFERENT SECTIONS OF STEEL COLUMNS ARE BOLTED/WELDED TO ENSURE ELECTRICAL CONTINUITY.

FOR TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GROUNDING NOTES & DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

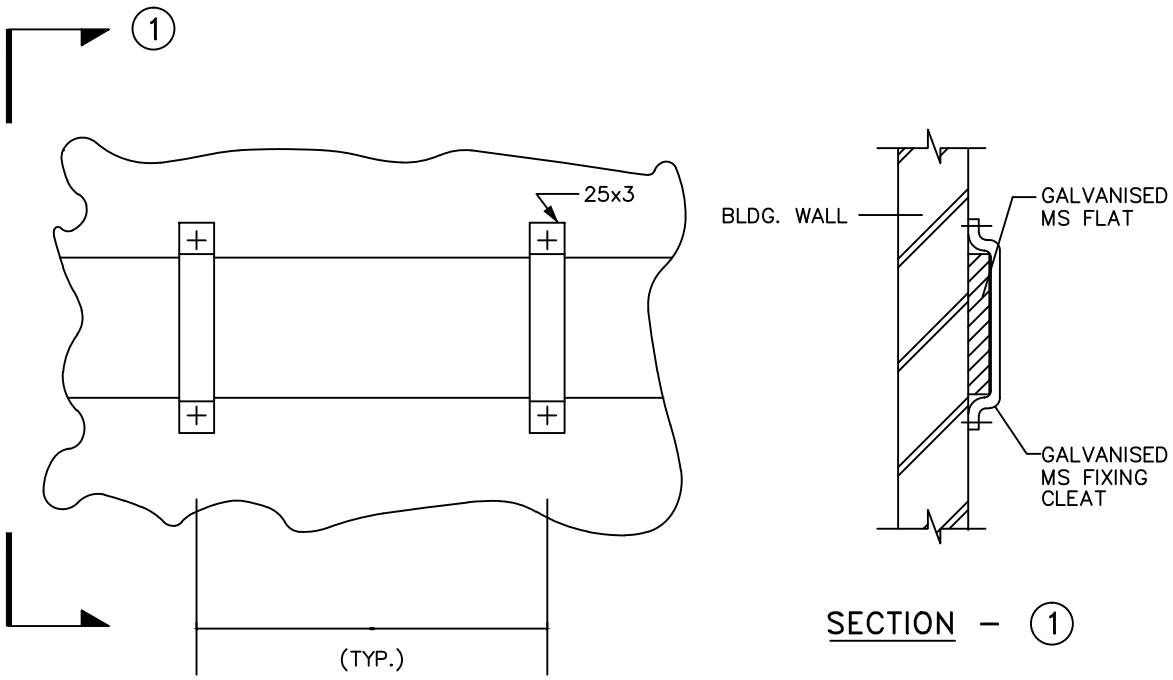
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DWG. NO. 14L08-DWG-E-0600 | REV. 0

SHT. - 13 OF 30

File Name 14L08-DWG-E-0600

A4_DD (9-96) [210x297]



GROUNDING CONDUCTOR ALONG BUILDING WALL

FOR TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GROUNDING NOTES & DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

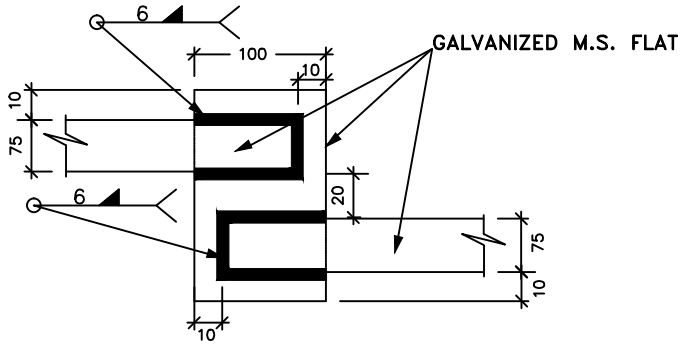
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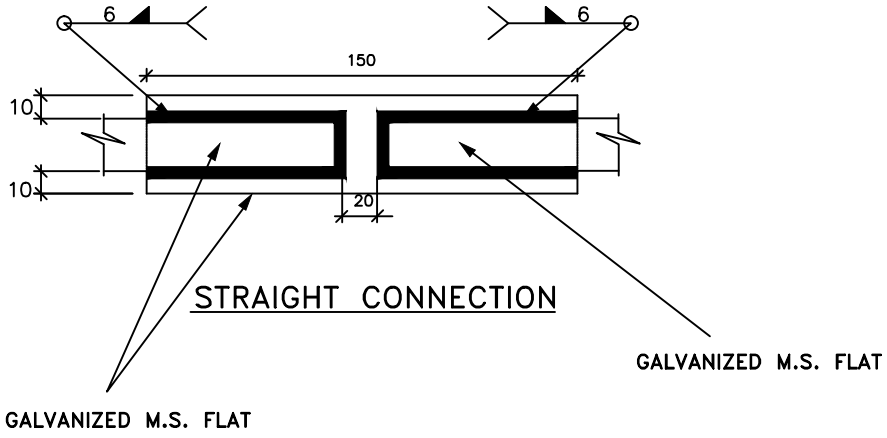
SHT. - 14 OF 30

File Name 14L08-DWG-E-0600

A4_DD (9-96) [210x297]



FLAT CONDUCTOR
CONNECTION



STRAIGHT CONNECTION

BUTT JOINT
BETWEEN GALVANIZED STEEL FLATS

NOTE: 1) ALL THE SIDES OF THE GROUNDING CONDUCTORS SHALL BE WELDED WITH THE CONNECTION PLATE.

2) THE PORTION OF THE CONNECTION MADE AFTER REMOVING GALVANIZING, SHALL BE COATED WITH COLD GALVANIZING/WEATHER RESISTANT PAINT.

FOR TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GROUNDING NOTES & DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

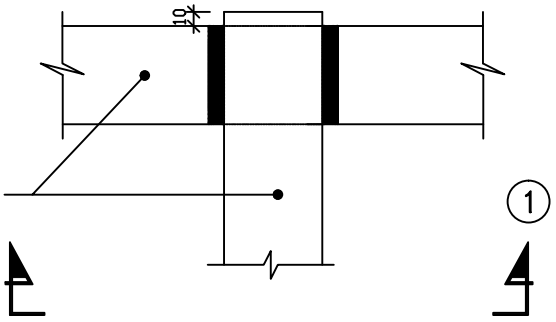
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DWG. NO. 14L08-DWG-E-0600 | REV. 0

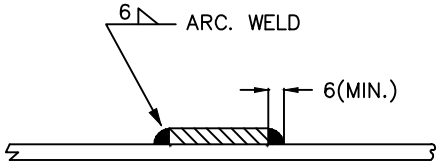
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File Name 14L08-DWG-E-0600

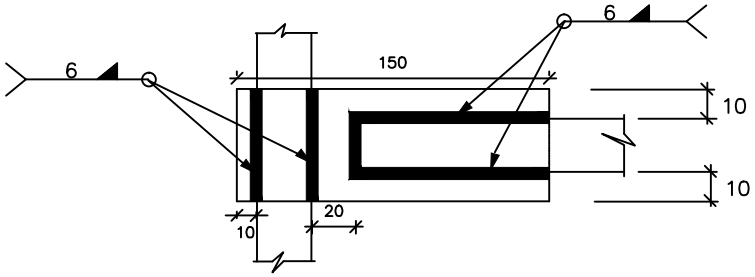
A4_DD (9-96) [210x297]



GALVANISED M.S. FLATS



SECTION – (1)



'T'CROSS CONNECTON

CROSS JOINT
BETWEEN GALVANISED M.S. FLATS

NOTE: 1) ALL THE SIDES OF THE GROUNDING CONDUCTORS SHALL BE WELDED WITH THE CONNECTION PLATE.

2) THE PORTION OF THE CONNECTION MADE AFTER REMOVING GALVANIZING, SHALL BE COATED WITH COLD GALVANIZING/WEATHER RESISTANT PAINT.

FOR TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GROUNDING NOTES & DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

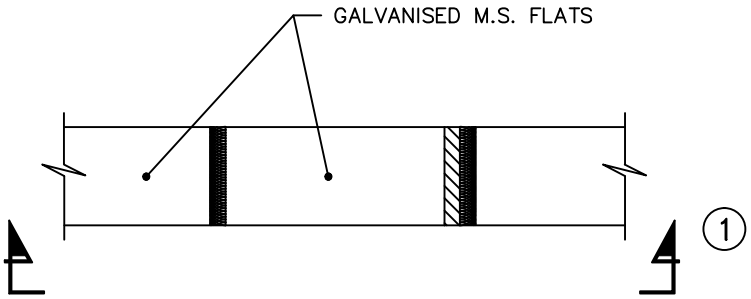
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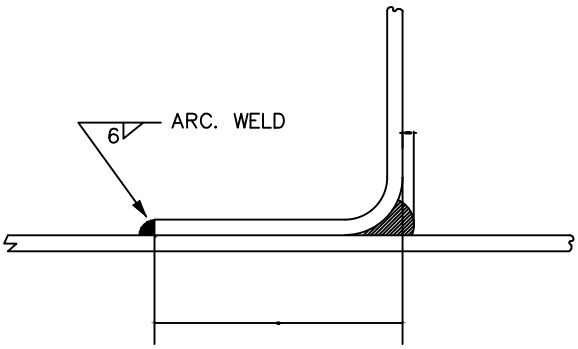
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A4_DD (9-96) [210x297]





SECTION – (1)

ANGULAR JOINT
BETWEEN GALVANISED M.S. FLATS

NOTE: THE PORTION OF THE CONNECTION MADE AFTER REMOVING GALVANIZING, SHALL BE COATED WITH COLD GALVANIZING/WEATHER RESISTANT PAINT.

FOR TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GROUNDING NOTES & DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
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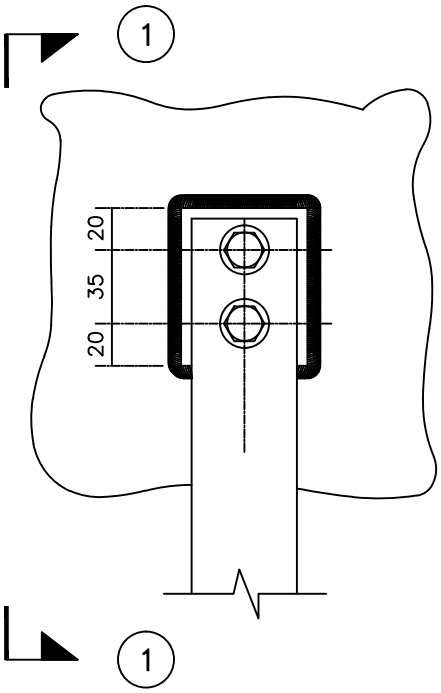
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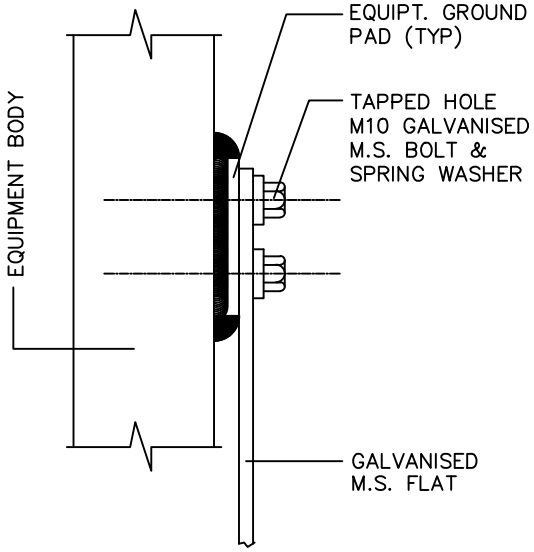
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File Name 14L08-DWG-E-0600

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SECTION – (1) – (1)

EQUIPMENT GROUNDING

FOR TENDER ONLY

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GROUNDING NOTES & DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

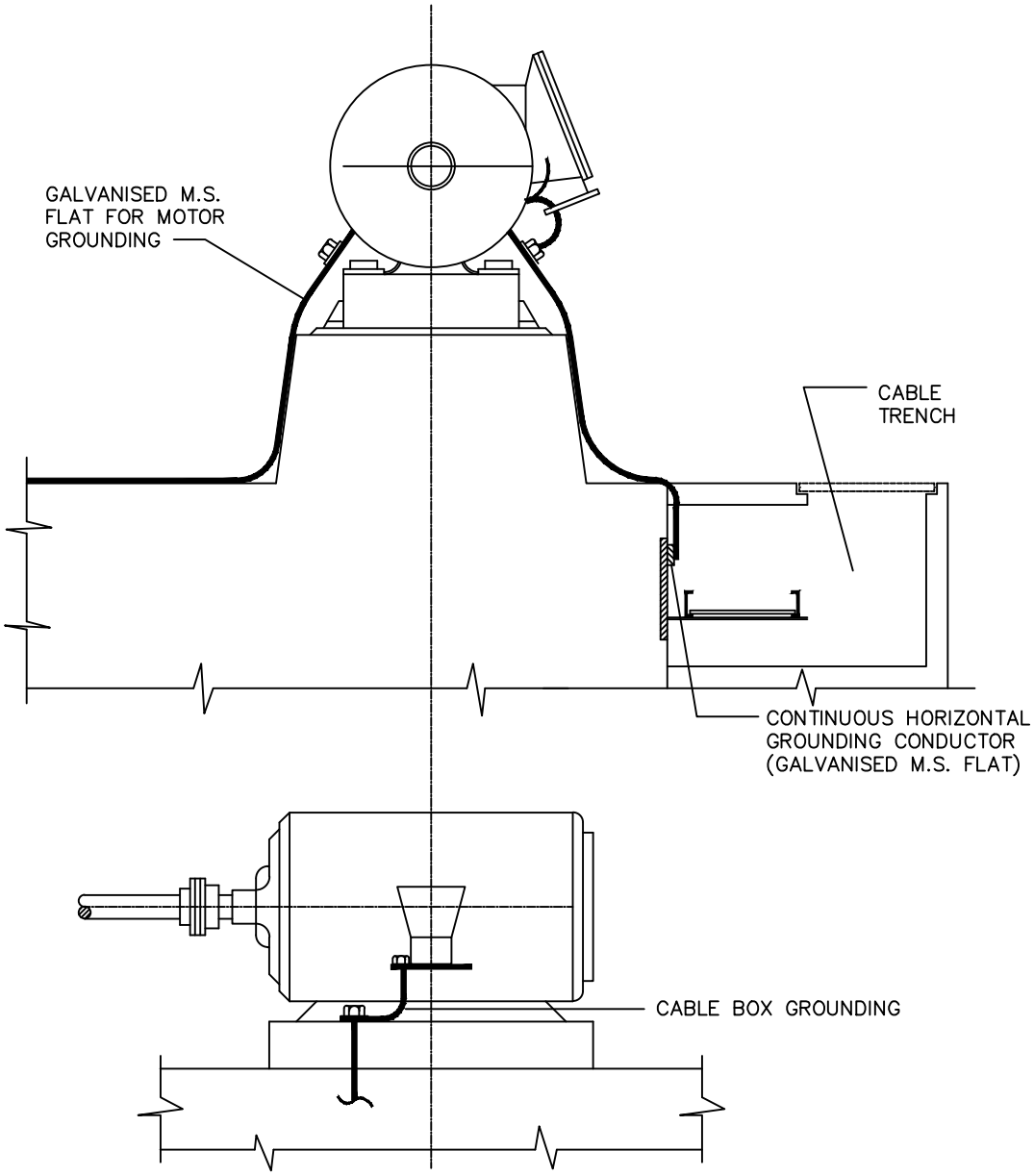
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DWG. NO. 14L08-DWG-E-0600 | REV. 0

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File Name 14L08-DWG-E-0600

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MOTOR GROUNDING

FOR TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GROUNDING NOTES & DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
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JOB NO. 14L08 | SCALE : N.T.S

DWG. NO. 14L08-DWG-E-0600 | REV. 0

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File Name 14L08-DWG-E-0600

A4_DD (9-96) [210x297]

GROUNDING NOTES

1.0 These grounding notes and details shall be read and construed in conjunction with grounding drawings and specification. These notes & details deal with grounding system using mild steel & galvanized mild steel conductor.

2.0 The recommended grounding conductor sizes to be used for grounding of equipment, structure etc. are given hereinafter. Same shall be followed unless otherwise specified.

The grounding installation work shall conform to the requirements of the Indian Electricity Rules and Code of Practice for Earthing (IS : 3043) as amended upto date in India. For the work in other country, the statutory rules and Code of Practice in vogue there in shall be followed.

3.0 The main ground grid shall be buried in earth at a minimum depth of 1000 mm below grade. A minimum earth coverage of 300 mm shall be provided between the ground grid conductor and the bottom of trench / foundation / underground pipe at the crossing.

4.0 Ground grid conductors around a building / switchyard fence shall be buried outside the boundary at a minimum distance of 1200 mm.

5.0 An additional grid of 1500 mm x 1500 mm comprising of closely spaced (300 mm x 300 mm) conductor at a depth of 300 mm from finished grade level shall be provided below the operating handle of Isolators and Circuit Breaker operating boxes located in outdoor HV/EHV sub-station. This grid shall be connected to the main ground grid. The ground grid connection to operating handle shall be made of flexible connection.

6.0 The ground grid conductor below grade shall be bare mild steel rod of adequate size. Ground electrode shall be of same diameter of grid conductor and 3000 mm long mild steel rod, driven into the ground and connected to the ground grid conductor. The diameter of the conductor shall be determined based on system fault current, soil corrosion factor etc. as described in the specification.

7.0 Riser / pigtail from the ground grid shall also be mild steel rod of same diameter of grid conductor. They shall project 300 mm above grade / concrete floor level unless otherwise shown.

8.0 All ground connections below grade shall be made by electric arc welding with low hydrogen content electrode. Bending of the conductor where necessary shall be done by gas heating.

FOR TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GROUNDING NOTES & DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

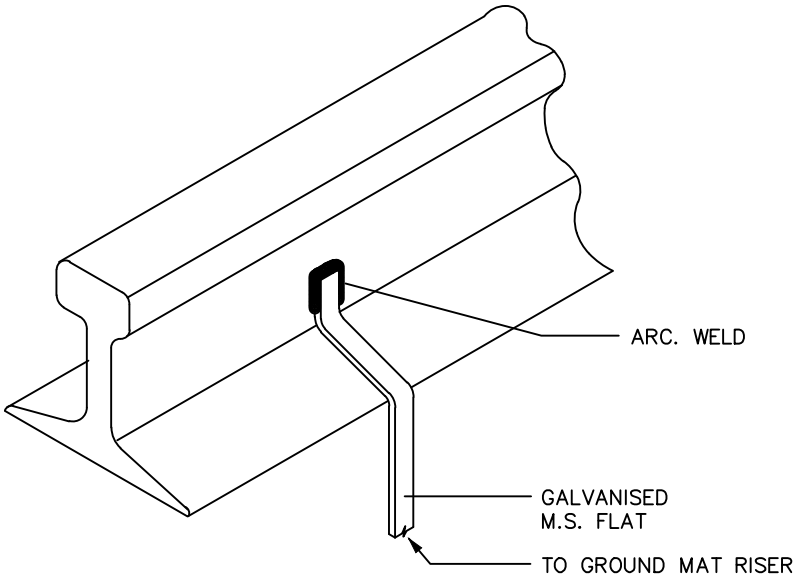
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File Name 14L08-DWG-E-0600

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RAIL GROUNDING

FOR TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GROUNDING NOTES & DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

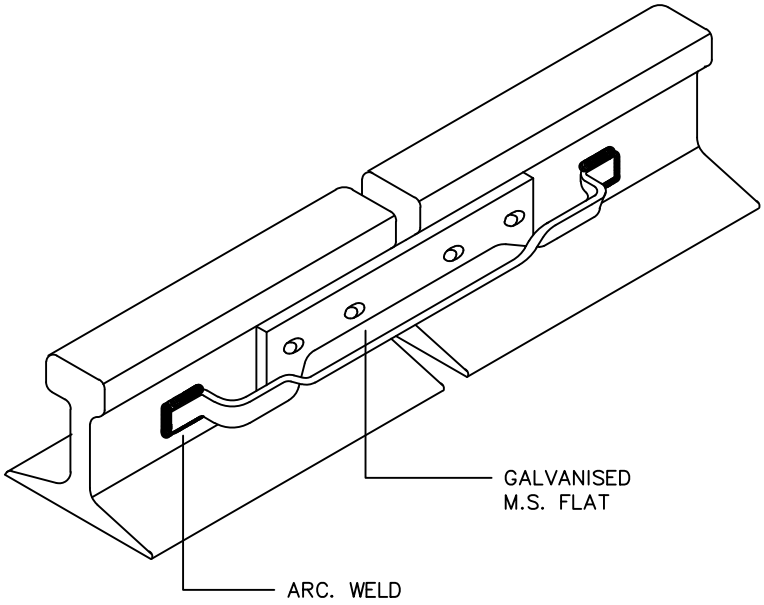
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File Name 14L08-DWG-E-0600

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RAIL BONDING

FOR TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GROUNDING NOTES & DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
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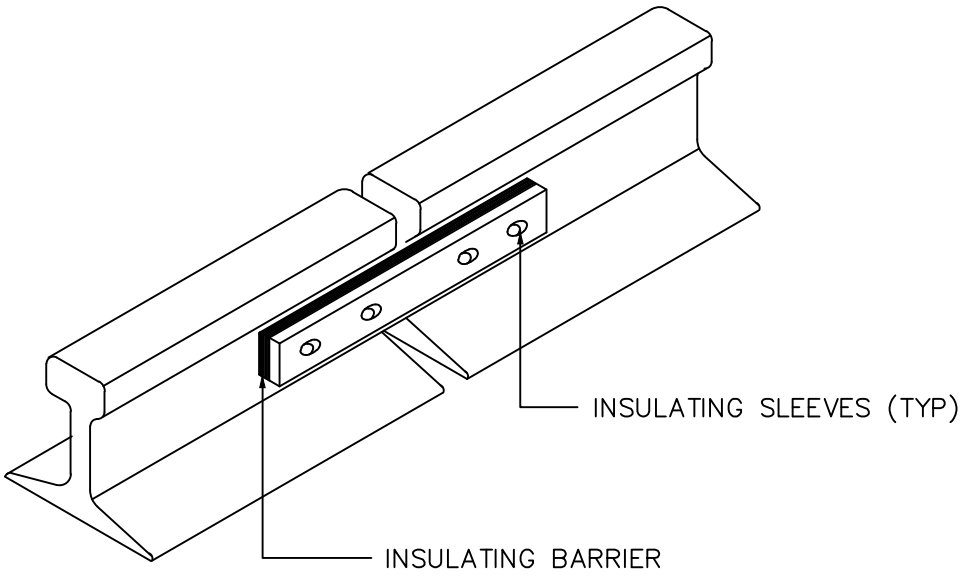
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RAIL SECTIONS
LEAVING THE GROUND MAT

FOR TENDER ONLY

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GROUNDING NOTES & DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
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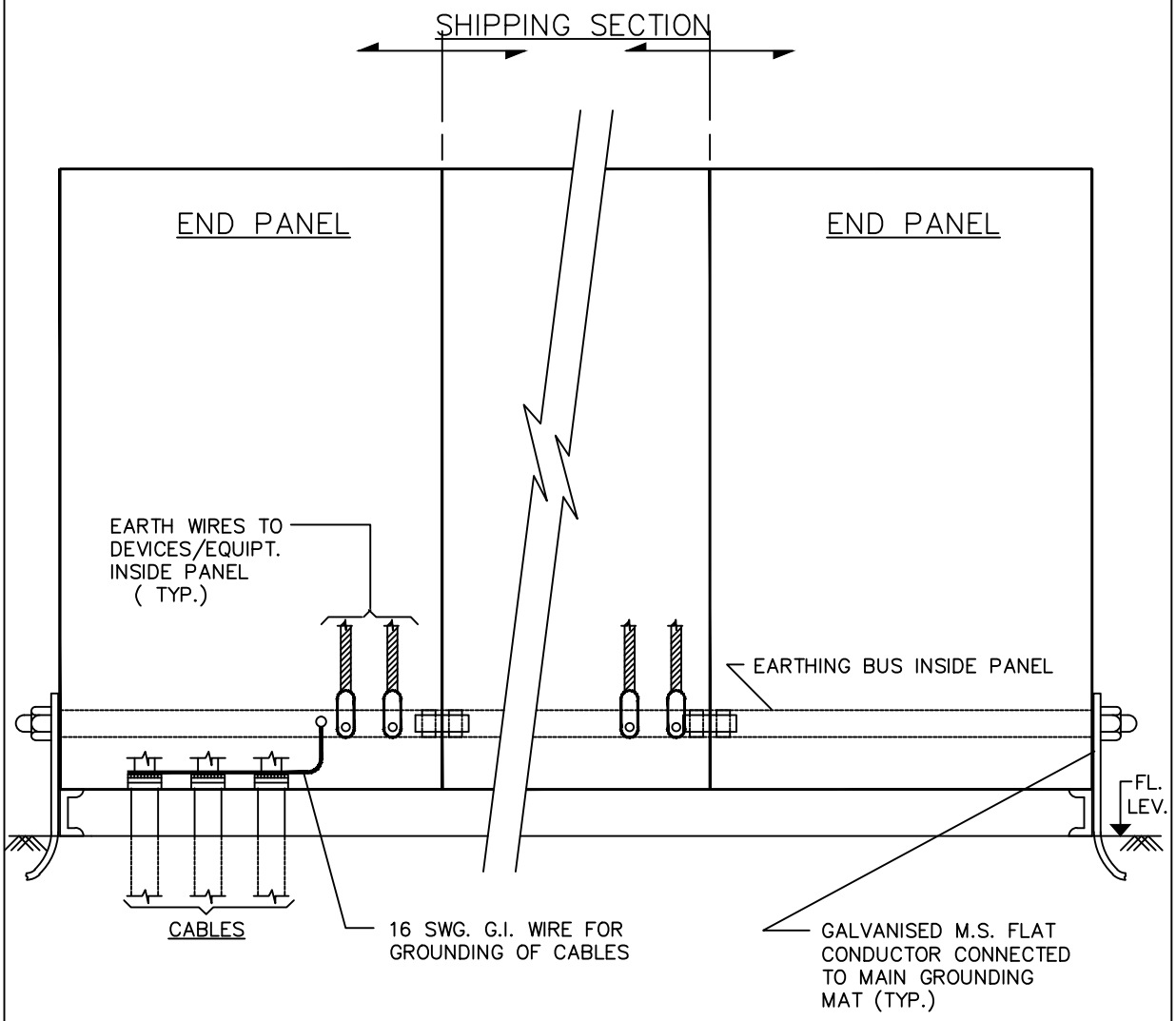
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DWG. NO. 14L08-DWG-E-0600 | REV. 0

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File Name 14L08-DWG-E-0600

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GROUNDING OF MCC, SWITCHGEAR

FOR TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GROUNDING NOTES & DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

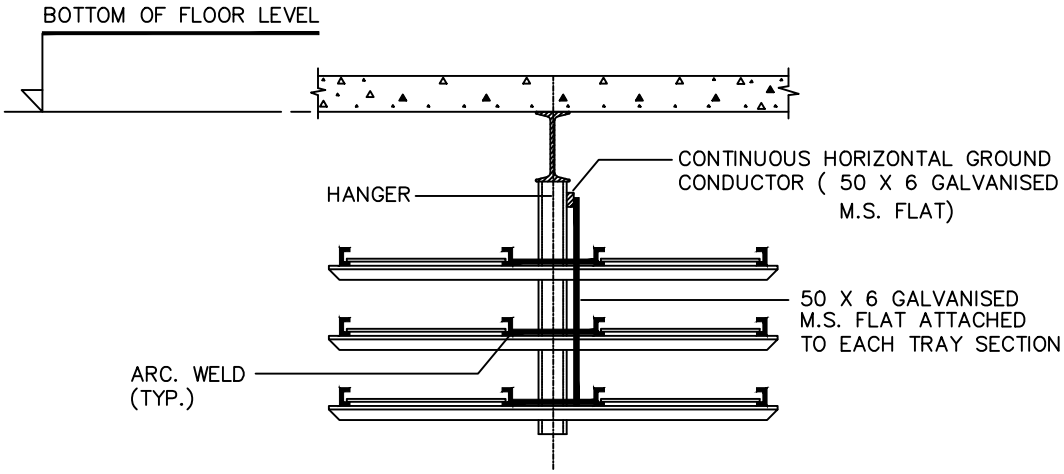
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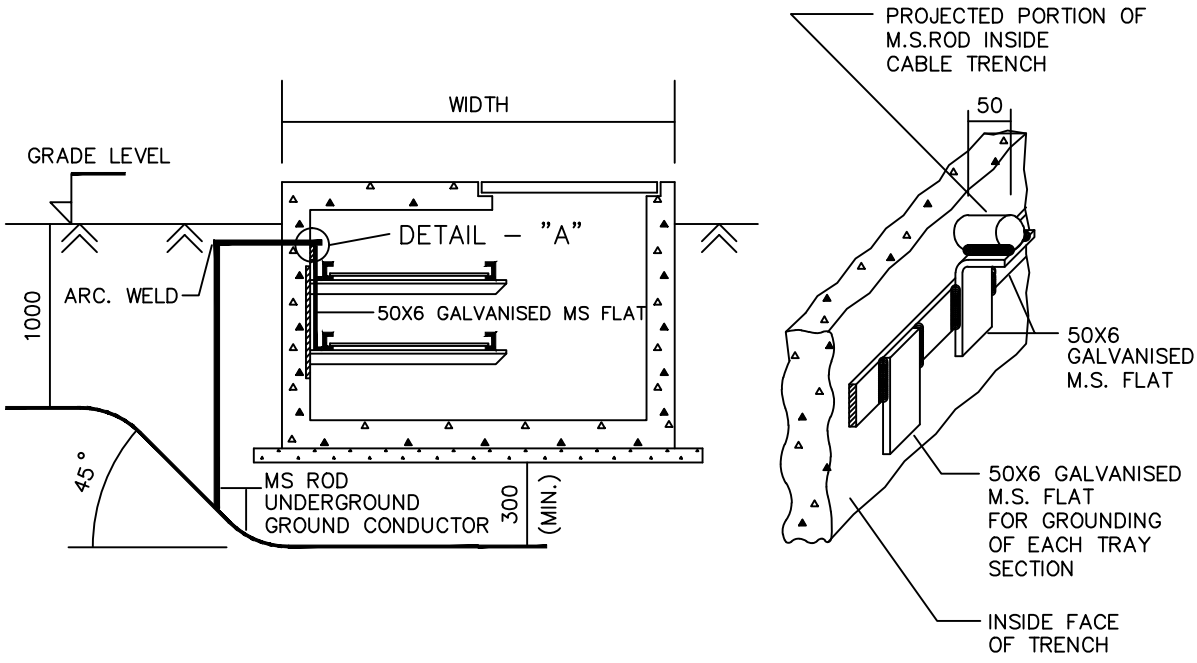
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File Name 14L08-DWG-E-0600

A4_DD (9-96) [210x297]



OVERHEAD CABLE TRAY GROUNDING



DETAIL – A

CABLE TRENCH GROUNDING

FOR TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GROUNDING NOTES & DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
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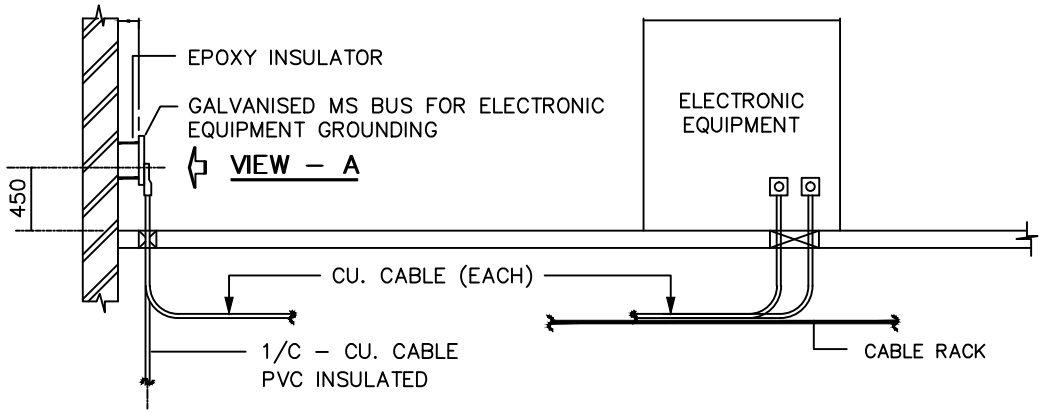
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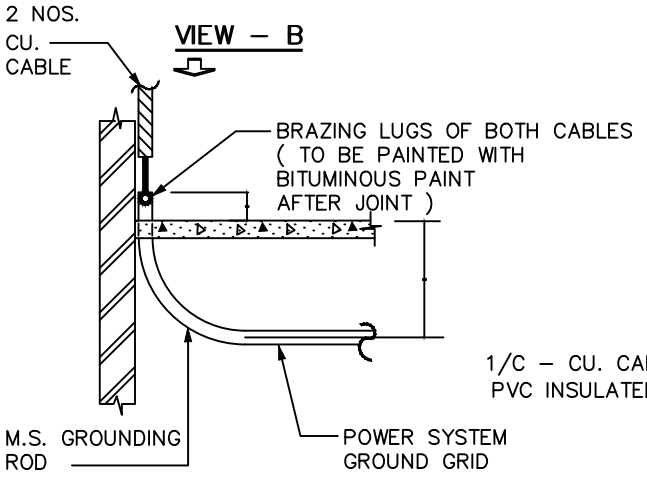
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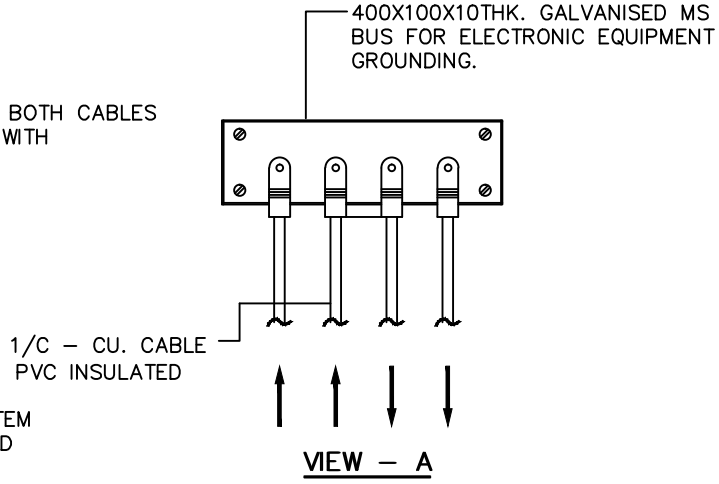
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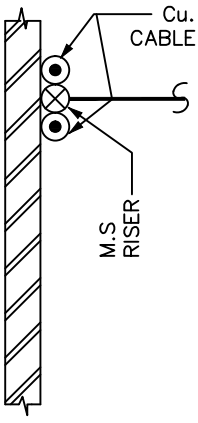
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A4_DD (9–96) [210x297]









VIEW – B

NOTES :

1. GALVANISED MS BUS SHALL BE MOUNTED ON INSULATOR BASE AT TWO SUITABLE LOCATIONS.
2. EACH ELECTRONIC EQUIPMENT/PANEL GROUND TERMINAL SHALL BE CONNECTED TO THE BUS BY MEANS OF CU. CABLE.(1/C–2.5sq.mm)
3. GROUND BUS SHALL IN TURN BE CONNECTED BY MEANS OF 2–1/C–16sq.mm. PVC INSULATED CU. CABLE TO THE POWER SYSTEM GROUND MAT AT SINGLE POINT ONLY.

ELECTRONIC EQUIPMENT GROUNDING.

FOR TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GROUNDING NOTES & DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
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CONSULTING ENGINEERS

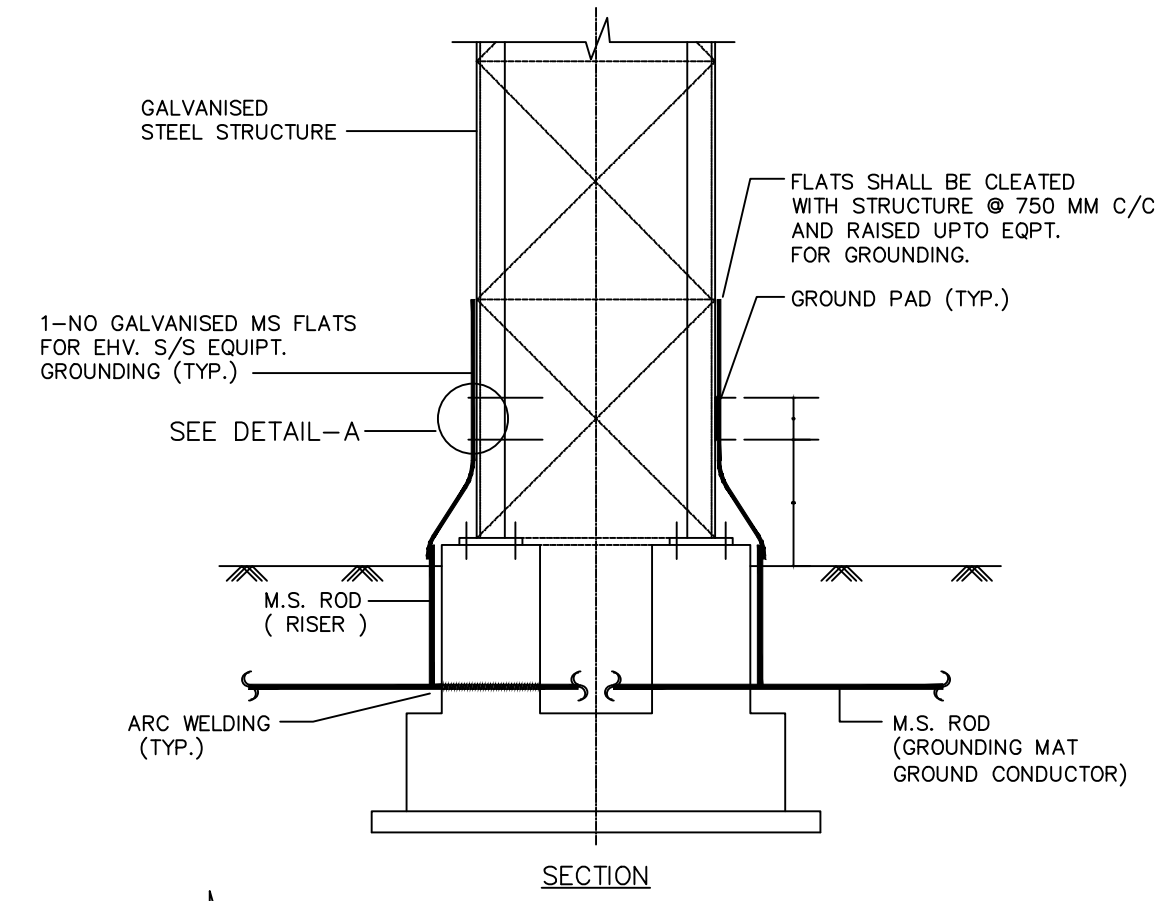
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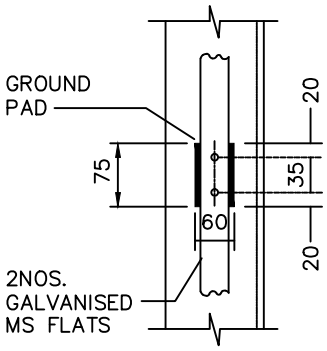
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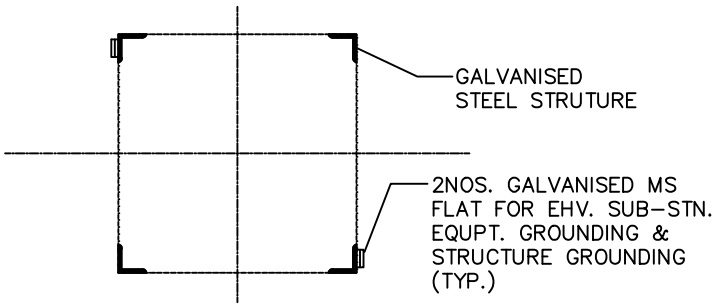
A4_DD (9-96) [210x297]



SECTION



DETAIL – 'A'



PLAN

GALVANISED STRUCTURE AND EQUIPMENT GROUNDING IN EHV SUBSTATION

FOR TENDER ONLY

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GROUNDING NOTES & DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
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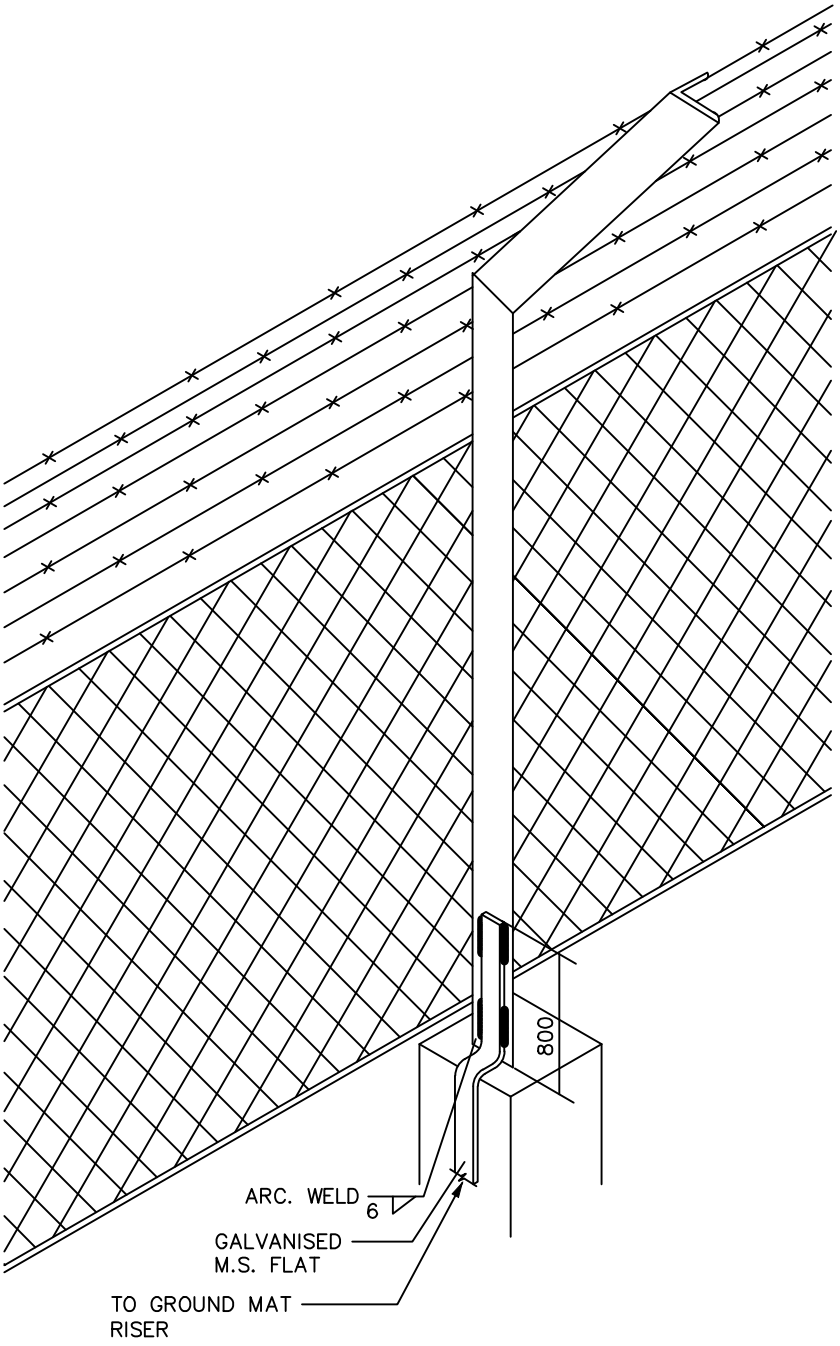
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FENCE GROUNDING

FOR TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GROUNDING NOTES & DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

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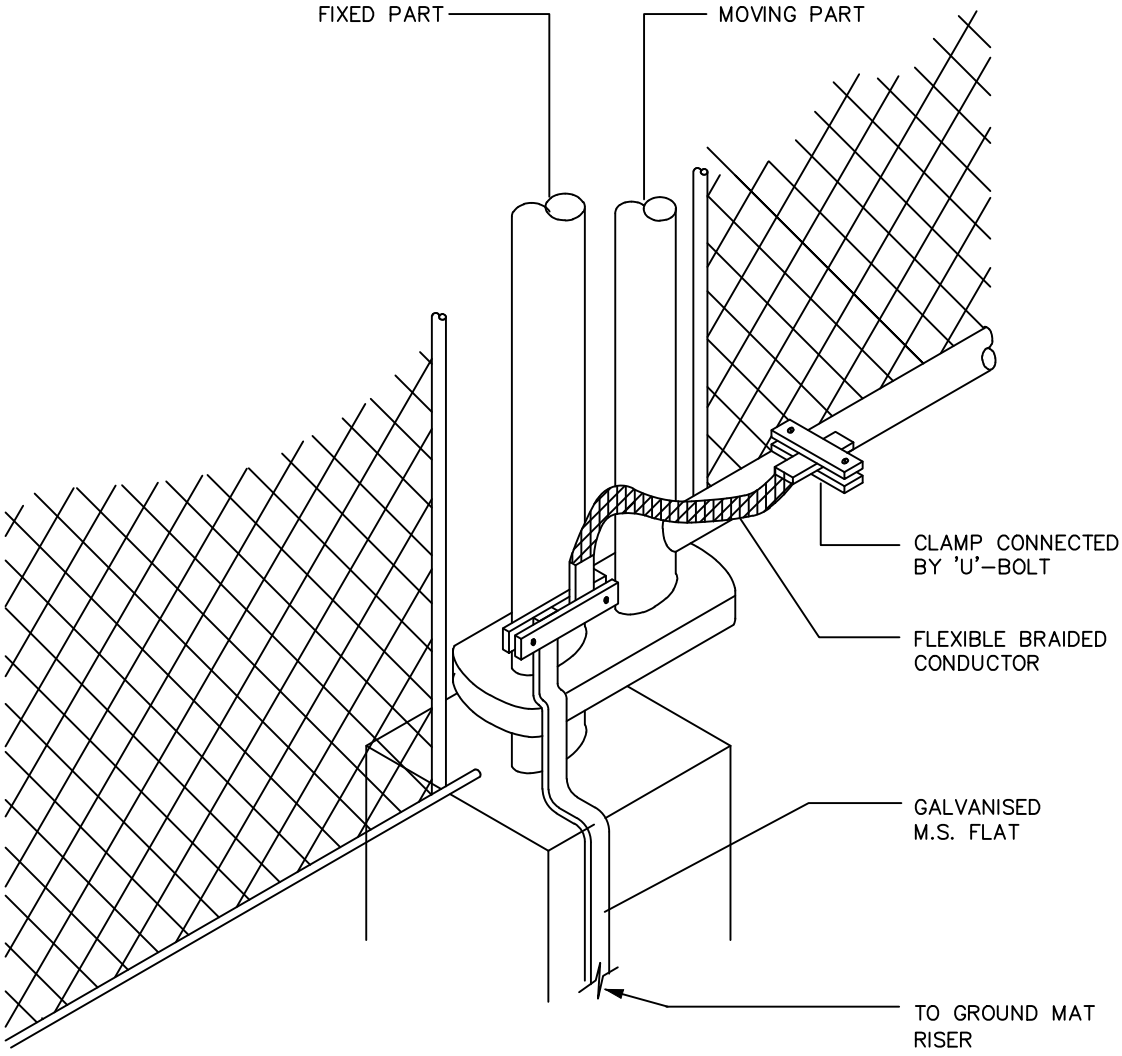
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File Name 14L08-DWG-E-0600

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FENCE GATE GROUNDING

FOR TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GROUNDING NOTES & DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

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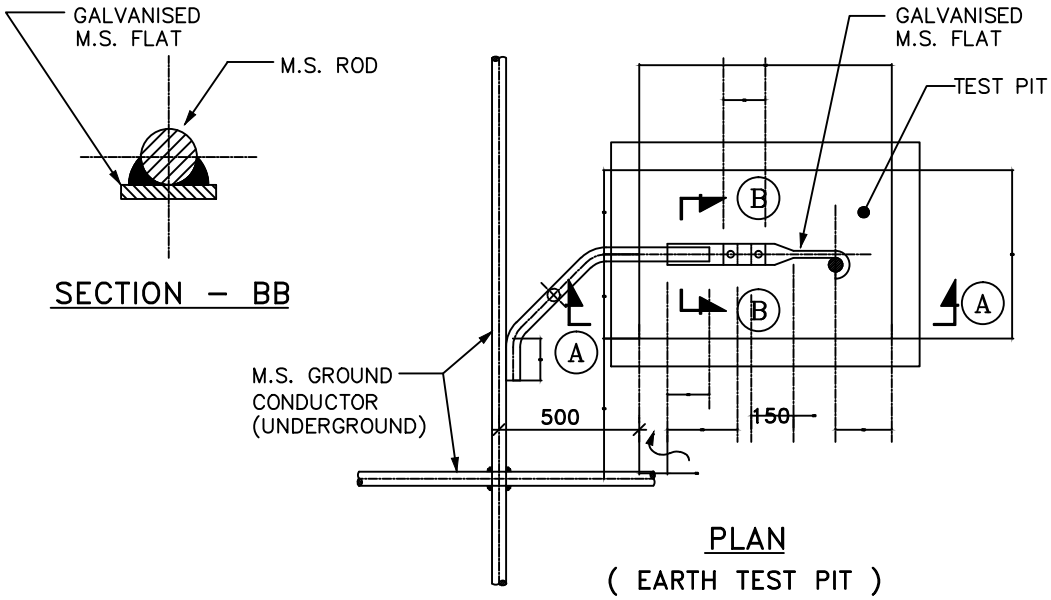
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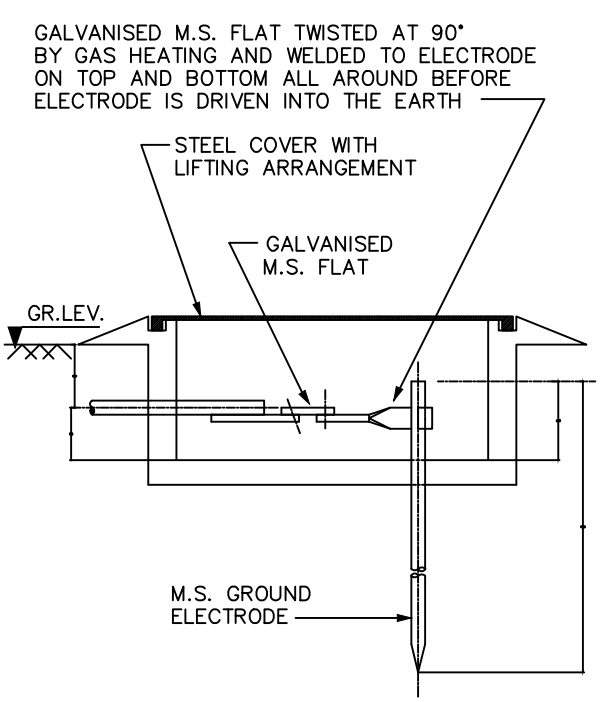
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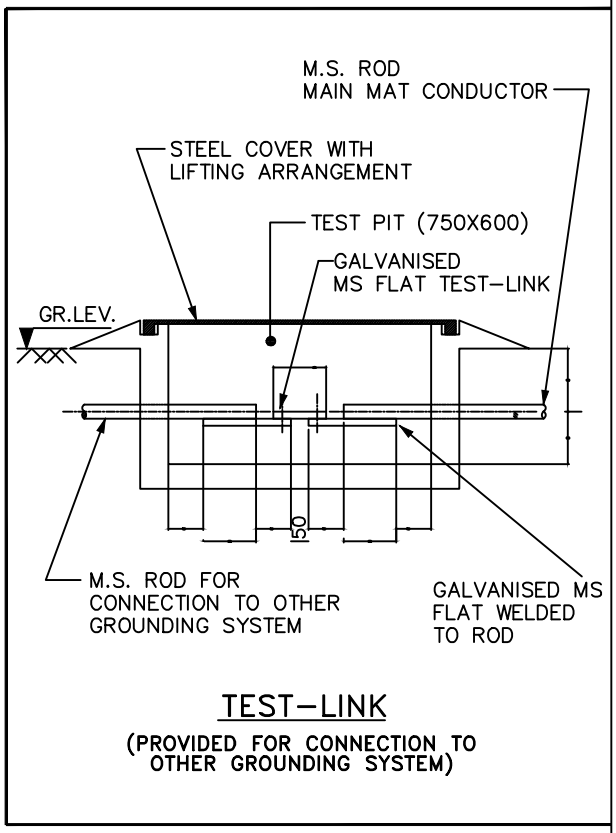
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A4_DD (9-96) [210x297]







NOTE: DIAMETER OF M.S. ROD AND SIZE OF THE GALVANISED M.S. FLAT SHALL BE SAME AS THEY ARE USED FOR MAIN GROUND GRID AND RISER PURPOSE.

FOR TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GROUNDING NOTES & DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

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9.0 Above grade, galvanized mild steel flats shall be run as main ground conductors along building steels, walls and cable trays and securely fixed to the same by welding / clamping at intervals not exceeding 1500 mm.

The ground conductors shall be interconnected between them and to the main ground grid through risers.

For steel structure building, the steel columns / beams may be utilized for grounding purpose instead of running separate ground grid conductor provided electrical continuity of bolted / welded joints are ensured and they shall be connected to station ground mat through risers.

For concrete structure building, steelwork within reinforcement concrete may be utilized for grounding conductor purpose provided electrical continuity is ensured. In such case, column steel shall be grounded at the bottom with underground station ground mat. Suitable numbers of grounding pads connected with the column steelwork shall be provided at 300mm above each floor level of the columns for equipment grounding purpose.

10.0 For substations/switchyards and transformer-yards, galvanized mild steel flats shall be run as main ground conductors along equipment foundations and mounting steel structure and securely fixed to the same by clamping at intervals not exceeding 1500 mm.The ground conductors shall be interconnected between them and to the main ground grid through risers.

11.0 All electrical equipment and assocated non-current carrying metal works, supporting structures, building/boiler columns, fence, system neutrals, lightning masts/arresters shall be connected to the plant ground system.

12.0 Two separate and distinct ground connections shall be provided for grounding of electrical equipment frameworks.

13.0 Miscellaneous devices such as junction boxes, pull boxes, push button stations, lockout switches, cable and boxes etc. shall be effectively grounded whether specifically shown or not.

14.0 Ground conductor connections above grade shall generally be made by electric arc welding. The connection shall be coated with cold galvanizing / weather resistant paints.

15.0 Bolted connection shall be made only for grounding of equipment / devices and some removable structures. The contract surfaces shall be thoroughly cleaned before connection to ensure good electrical contact.

FOR TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GROUNDING NOTES & DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

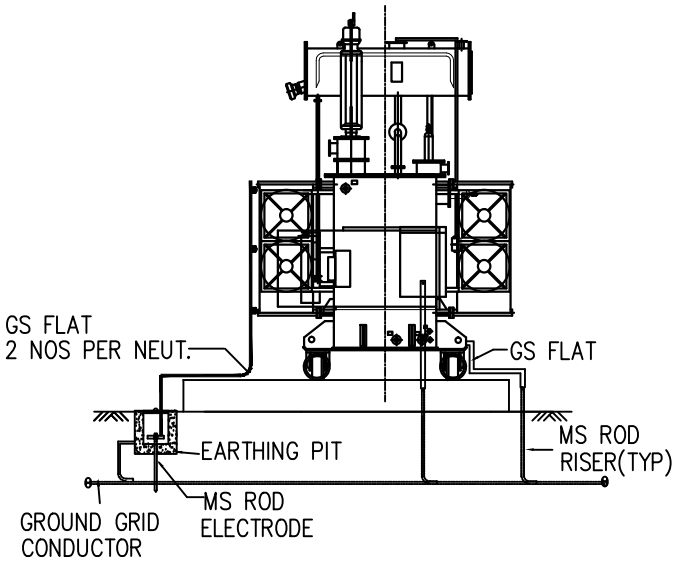
DWG. NO. 14L08-DWG-E-0600 | REV. 0

SHT.-03 OF 30

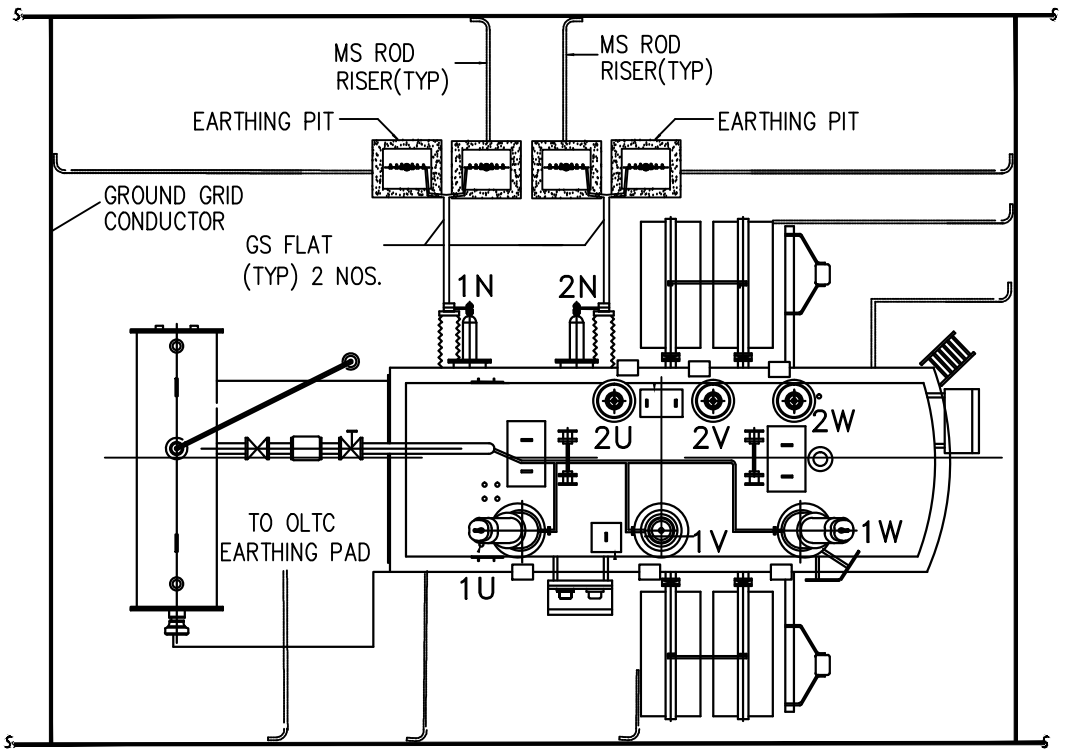
File Name 14L08-DWG-E-0600

A4_DD (9-96) [210x297]

ELEVATION



PLAN



NOTE: DISTANCE BETWEEN TWO ELECTRODES FOR THE NEUTRAL GROUNDING SHALL BE TWICE THE LENGTH OF THE ELECTRODES.

POWER TRANSFORMER GROUNDING (TYP.)

FOR TENDER ONLY

B.B	KKB	B.M	FOR TENDER ONLY	0	24.11.14
APPROVED	DRAWN	CHECKED	DESCRIPTION	REV.	DATE

GROUNDING NOTES & DETAILS
– STEEL GROUNDING CONDUCTOR

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

DWG. NO. 14L08–DWG–E–0600 | REV. 0

SHT. -30 OF 30

File Name 14L08–DWG–E–0600

A4_H (9–96) [297x210]

16.0 A continuous galvanized M.S. flat ground conductor shall be installed along the cable raceway and securely attached to each tray section, forming a solidly grounded tray system.

17.0 A G.I. wire shall be run along the metallic conduit and shall be securely tied with the same at an internal 300 mm.

Grounding connection or wire jumpers shall be installed where flexible conduit is used to connect rigid conduit to equipment.

18.0 Crane rails shall be grounded at both ends. In addition, all joints shall be bonded to provide electrical continuity.

19.0 Fence within the ground grid shall be bonded to the plant ground system at regular interval not exceeding ten (10) meters. Fence gate shall be separately grounded with flexible connection to permit movement.

20.0 For shielding, the ground conductors shall be taken right upto the top along the structure / chimney and connected directly to the lightning masts. For metallic structure / reinforced concrete structure, separate ground conductor upto top may be considered, provided electrical continuity is ensured as stated in Note 9. Further, grounding pad shall be provided at bottom & at various locations for construction to station ground grid and equipment grounding purpose.

21.0 The metallic poles used for distribution line and / or street light shall be grounded at the bottom.

22.0 Ground electrodes shall be provided at connections with generator / transformer neutrals, lightning arresters and lighting masts. Two numbers of grounding electrode each having its separate and distinct connection with neutral shall be separated by twice the length of the electrode.

FOR TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GROUNDING NOTES & DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

DWG. NO. 14L08-DWG-E-0600 | REV. 0

SHT.-04 OF 30

File Name 14L08-DWG-E-0600

A4_DD (9-96) [210x297]

23.0 Unless adequately connected to earth elsewhere, all utility and process pipelines should be bonded to a common conductor by means of earth bars or pipe clamps and connected to the earthing system at a point where the pipelines enter or leave the hazardous area except where conflicting with the requirements of cathodic protection.

24.0 Steel pipe racks in the process units and off-site areas should be grounded at every 25 m.

25.0 For grounding of Gas Insulated sub-station (GIS) equipment, Generator Isolated Phase bus duct, electronic equipment etc., recommendations of the respective manufacturer shall be strictly adhered to.

26.0 All dimensions are in millimeters (mm), unless otherwise specifically mentioned.

FOR TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GROUNDING NOTES & DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

DWG. NO. 14L08-DWG-E-0600 | REV. 0

SHT.-05 OF 30

File Name 14L08-DWG-E-0600

A4_DD (9-96) [210x297]

27.0 For ground connections, the conductor sizes shall be as listed below :

Equipment		Conductor Size & Material
a. EHV Sub-station Equipment & Structure, rail, fence riser	:	75 x 10 mm galvanized M.S. or 50 x 6 mm galvanized M.S. depending on system fault current
b. Vessels, Heat exchangers, Storage Tanks, Pipe Racks, Other Structures, Cable tray etc.	:	50 x 6 mm galvanized M.S.
c. Electrical Panel, HV Switchgear,PMCC MCC, other outdoor equipment etc.	:	50 x 6 mm galvanized M.S.
d. Main lighting Panel, Local Panel	:	35 x 6 mm galvanized M.S.
e. Lighting Panel, Emergency Lighting Panel	:	25 x 3 mm galvanized M.S.
g. Lighting fixture, switches, conduits	:	No. 16 S.W.G GI wire
h. Junction box, Power receptacle Miscellaneous small power device	:	No. 12 S.W.G GI wire
i. Motor		
* above 90 KW	:	50 x 6 mm galvanized M.S. Flat
* above 30 KW upto & including 90 KW	:	35 X 6 mm galvanized M.S. Flat
* above 5 KW upto & including 30 KW	:	25 x 3 mm galvanized M.S. Flat
* Upto & including 5 KW	:	No. 8 S.W.G GI wire

FOR TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GROUNDING NOTES & DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

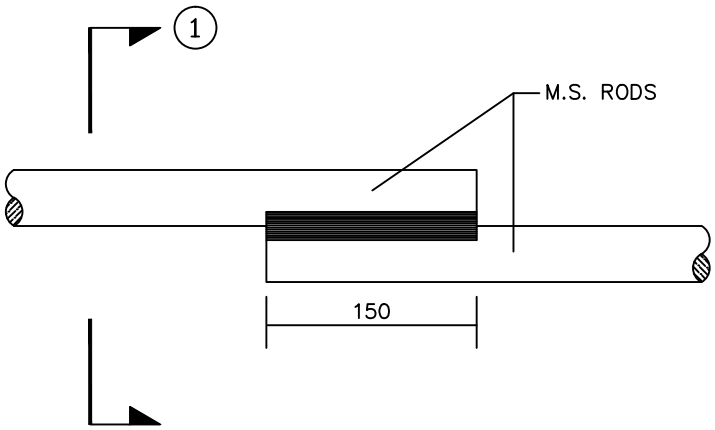
JOB NO. 14L08 | SCALE : N.T.S

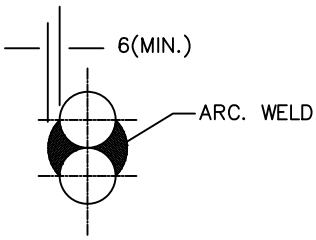
DWG. NO. 14L08-DWG-E-0600 | REV. 0

SHT.-06 OF 30

File Name 14L08-DWG-E-0600

A4_DD (9-96) [210x297]





SECTION – (1)

LAP JOINT
BETWEEN M.S. RODS

FOR TENDER ONLY

BB	KKB	BM	0	24.11.14
APPVD.	DRAWN	CHKD.	REV.	DATE

GROUNDING NOTES & DETAILS

ALUMINA UNLOADING AND TRANSPORTATION SYSTEM

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PLANT, ANGUL-759145

CONSULTANT
DEVELOPMENT CONSULTANTS PVT LTD
CONSULTING ENGINEERS

JOB NO. 14L08 | SCALE : N.T.S

DWG. NO. 14L08-DWG-E-0600 | REV. 0

SHT.-07 OF 30

File Name 14L08-DWG-E-0600

A4_DD (9-96) [210x297]

1919-55-48-00-A1-743

REFERENCE DRAWING	NO
SILOS SL 3 & SL 4 BOTTOMS (G.A FOR CIVIL WORKS)	A1 DRG - 4630551004 2-B
DETAILS OF TRESTLE LOCATIONS (BST DRG.)	NEC - 031-0-70-5K-901 SH-1
DETAILS OF BASE Ø.S. ANCHOR BOLTS ON TRESTLE FOUNDATION - BST DRG.	NEC - 031-0-70-5K-901 SH-2
PILE LAYOUT	1919-54-48-00-E-729
R/F DETAILS OF PILE CAPS SL- 1 TO SL-4	1919-55-48-00-A0-746
R/F DETAILS OF TUNNELS FOR SILOS SL- 1 TO SL-4	1919-55-48-00-A0-745

NOTES :-

1. FOR GENERAL NOTES REF. E.I.L STD. NO. 1919-A-ES-003/GEN.
2. CONCRETE WORKS SHALL CONFORM TO SPECIFICATIONS & THE GRADE SHALL BE AS FOLLOWS EXCEPT WHERE OTHERWISE NOTED :-
   a) FOR TUNNEL ———— M20 DESIGN MIX. AS PER I.S:3370. WITH 3% CICO GRADE I BY WEIGHT.
   b) FOR PILE CAP ———— M20 DESIGN MIX AS PER I.S:456 WITH 40 mm. DOWN SIZE GRADED STONE AGGREGATE.
3. REINFORCEMENTS SHALL BE OF H.Y.D BARS AS PER I.S:1786 OR I.S:1139.
4. CLEAR COVER TO REINFORCEMENT SHALL BE AS FOLLOWS :-
   a) FOR TUNNEL —— EXTERIOR FACES IN CONTACT WITH EARTH – 40 mm. & INTERIOR FACES - 25 mm.
   b) FOR PILE CAP — 100 mm. AT BOTTOM & 50 mm. AT TOP & SIDES
5. INSERT TYPES II & III AT TOP OF PILE CAPS SHALL BE FIXED IN POSITION TO AN ACCUARACY OF :-
   ± 20 mm IN HORIZONTAL DIRECTION
   ± 5 mm IN VERTICAL DIRECTION
6. WATER BARS SHALL BE JOINED BY VULCANIZING ONLY
7. CARE SHALL BE TAKEN TO GUARD AGAINST FLOATING OF THE TUNNEL DUE TO GROUND WATER PRESSURE DURING CONSTRUCTION.
8. JACK RODS FOR THE SLIP FORM SHUTTERING OF SILO WALLS SHALL BE EMBEDDED IN PILE CAP IN CONSULTATION WITH THE CONTRACTORS PRIOR TO CASTING OF PILE CAP.
9. PILE CAPS SHALL PREFERABLY BE CAST IN ONE OPERATION WITHOUT ANY CONSTRUCTION JOINT.
10. ALL ANCHOR BOLTS (EXCLUDED FROM CIVIL CONTRACTORS SCOPE OF SUPPLY) SHALL BE AS PER E.I.L STD.

SEC. 3-3

SEC. 4-4

DETAIL AT - 'A'

DETAIL AT - 'B'
(TYPICAL DET. ALL ROUND PERIPHERY OF PILE CAP)

DETAIL AT - 'C'

DETAIL AT - 'D'

DETAIL AT - 'E'

SECTION :- 7 - 7

SEC. 1-1

SEC. 2-2

SEC. 6-6

DETAIL OF PEDESTAL TYPE - 1
(ORIENTATION AS/PLAN)

SECTION :- 8 - 8

SECTION :- 5 - 5

DETAIL OF INSERTS TYPE - III
(REF. NOTE NO - 5)

DETAIL OF PEDESTAL TYPE - 2
(ORIENTATION AS/PLAN)

DETAIL OF INSERTS TYPE - II
(REF. NOTE NO - 5)

PLAN

TYPE II
20x8 NOS.INSERTS THROUGHOUT TOP SURFACE OR FILE CAP FOR SL-1
20x8 NOS.INSERTS THROUGHOUT TOP SURFACE OR FILE CAP FOR SL-2

Drg.Code: 1 0 5 3 2 0 2 9 0 2 1

No.	DATE	REVISIONS	BY	CHKD	APPD	PROJ ENGR
2	16.5.85	REVISED AS MKD.				
1	22.4.85	REVISED & RE-ISSUED FOR CONSTRUCTION				
0	28.2.85	ISSUED FOR CONSTRUCTION	S.N.C			
A	28.2.85	ISSUED FOR CO-ORDINATION	S.N.C			

EIL

ENGINEERS INDIA LIMITED
NEW DELHI - BOMBAY

NATIONAL ALUMINIUM COMPANY LIMITED
ORISSA ALUMINIUM COMPLEX - ALUMINIUM

ALUMINA HANDLING AND STORAGE
G.A OF PILE CAP & TUNNEL FOR
SILOS SL-1 & SL-2

SCALE	JOB NO.	DRAWING NO.	REV.
N.T.S	1919	1919-55-48-00-A1-743	2

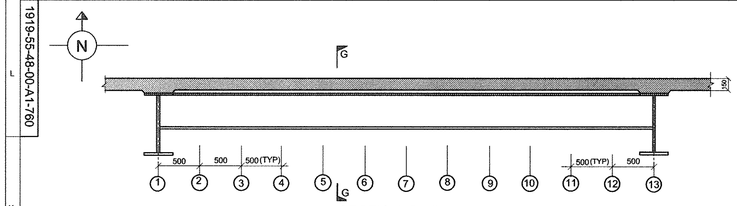
PREPARED BY :- INDFAB FCI ROAD, NALCO NAGAR, ANGUL

1919-55-48-00-A1-760

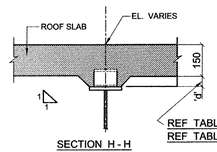
REFERENCE DRAWING	NO.
SILO SL-1,SL-2 GA & DET. OF OPENING	1919-55-48-00-AO-755
R/F DET. OF SILO ROOF (SILO SL-1 TO SL-4)	1919-55-48-00-AO-761
STEEL BEAMS SUPPORTING SILO ROOF	1919-55-48-00-D-762
DET. OF PEDESTAL & INSERTS PL. ON SL-1 TO SL-4,	NEC-031-0-70-010 SHT-1/2
GA & DET. OF OPENING (AIR INDUSTRIE DRG)-	46305510035
-SL-3 AND SL-4	

NOTES:-

1. FOR GENERAL NOTES REFER EIL STD.1919-A-ES-009-GEN
2. CONCRETE SHALL BE OF GRADE M:20 CONFORMING TO IS:456
3. REINFORCEMENT STEEL USED SHALL BE HIGH YIELD DEFORMED BARS CONFORMING TO IS: 1139 OR IS:1786.
4. ANGLE INSERTS SHOWN IN THE DRAWING SHALL BE FABRICATED FROM PLATES AS SHOWN IN THE DETAIL- (Z)



SECTION D - D



SECTION H - H
SECTION G - G
(AS DRN. & NOTED)

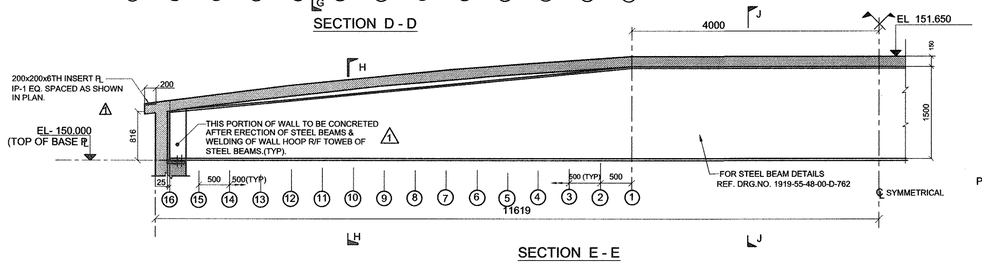
REF TABLE 'A' FOR SEC H-H
REF TABLE 'B' FOR SEC G-G

POINTS @ 500 C/C	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
d . IN MM	0	5	9	12	13	14	14	14	14	13	12	10	8	6	4	0

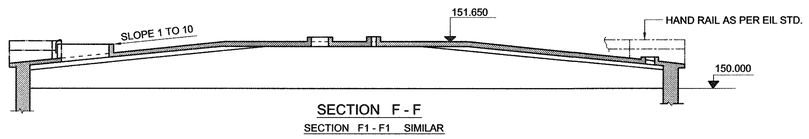
TABLE 'A'

POINTS @ 500 C/C	1	2	3	4	5	6	7	8	9	10	11	12	13
d . IN MM	13	30	45	56	64	69	71	69	64	56	45	30	13

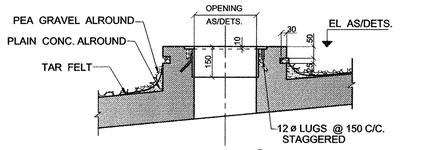
TABLE 'B'



SECTION E - E

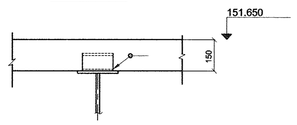


SECTION F - F
SECTION F1 - F1 SIMILAR

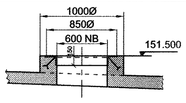


DETAIL - (Z)

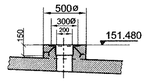
TYP. DET. OF KERB AROUND OPENINGS
AT SILO ROOF



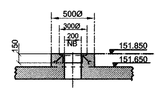
SECTION J - J



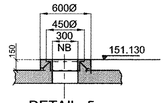
DETAIL- 1



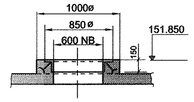
DETAIL -2



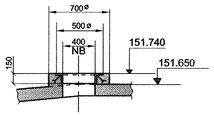
DETAIL- 4



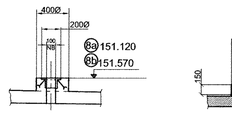
DETAIL- 5



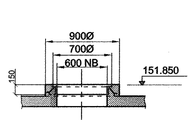
DETAIL- 6



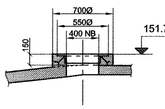
DETAIL- 7



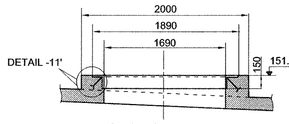
DETAIL - 8a & 8b



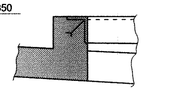
DETAIL - 9



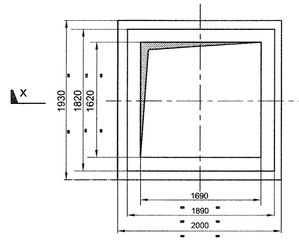
DETAIL - 3



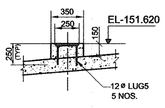
SECTION X - X



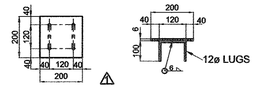
DETAIL - 11'



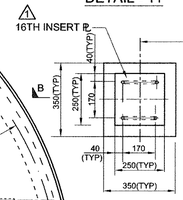
DETAIL - 11



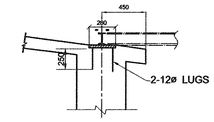
SECTION B - B



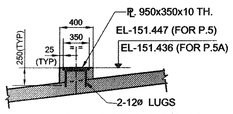
INSERT PLATE - IP-1.
(40 NOS. REQD. FOR EACH SILO)



DETAIL - A



SECTION K - K (FOR P.4)



DETAIL FOR P-5 & P-5A

Drg.Code: 1 0 5 3 2 0 3 1 0 1 1

NO.	DATE	REVISIONS	BY	CHKD	APPD	PROJ ENGR
1	30.8.85	REVISED AS MKD. ⚠	S.N.C			
0	30.5.85	ISSUED FOR CONSTRUCTION				
B	27.5.85	ISSUED FOR CO-ORDINATION				
A	03.5.85	ISSUED FOR CO-ORDINATION				

EIL

ENGINEERS INDIA LIMITED
NEW DELHI-BOMBAY

NATIONAL ALUMINIUM COMPANY LIMITED
ORISSA ALUMINIUM COMPLEX - ALUMINA

HANDLING AND STORAGE OF ALUMINA
G.A & DETAILS OF ALUMINA SILO ROOF SL-3 AND SL-4

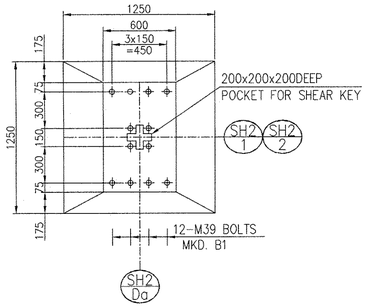
SCALE	JOB NO.	DRAWING NO.	REV
N.TS	1919	1919-55-48-00-A1-760	1

PREPARED BY INDFAB, F.C.I. ROAD,NALCONAGAR, ANGUL

PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT

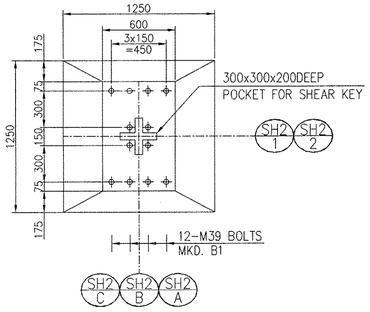
PLAN AT D–D

(FOUNDATION BOLTS AS PER EIL SPECIDICATION 7–68–0417) (SCALE 1:25)(2 NOS.)



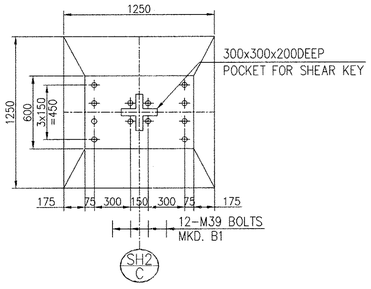
PLAN AT D1–D1

(FOUNDATION BOLTS AS PER EIL SPECIDICATION 7–68–0417) (SCALE 1:25)(6 NOS.)

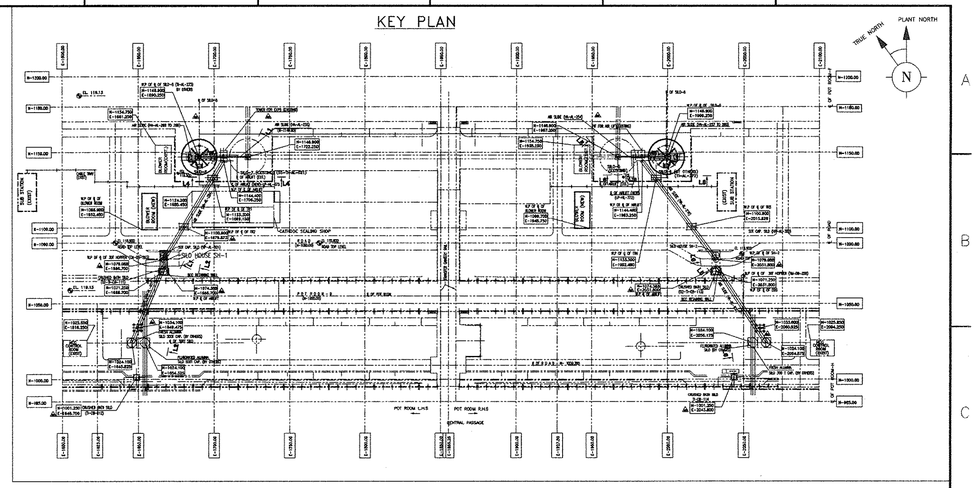


PEDESTAL MKD–P2

(FOUNDATION BOLTS AS PER EIL SPECIDICATION 7–68–0417) (SCALE 1:25)(2 NOS.)

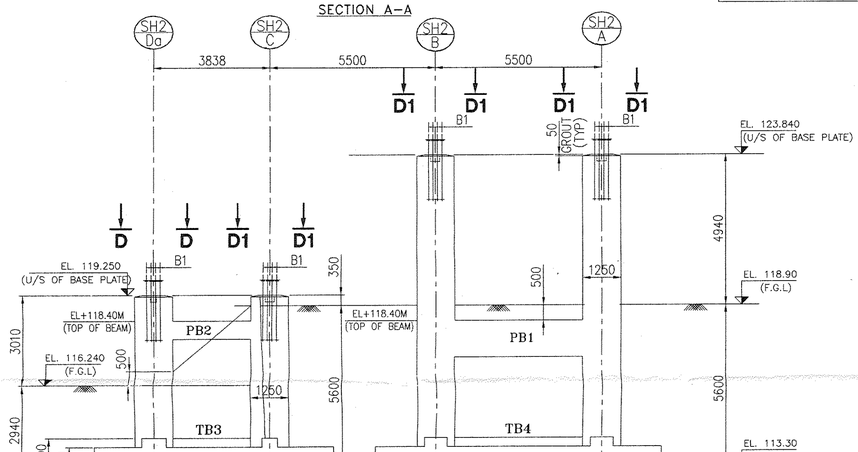


KEY PLAN



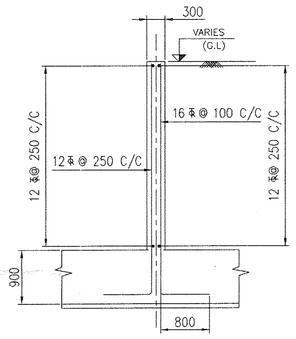
SECTION B–B AND C–C IS CANCELED

SECTION A–A



SECTION E–E

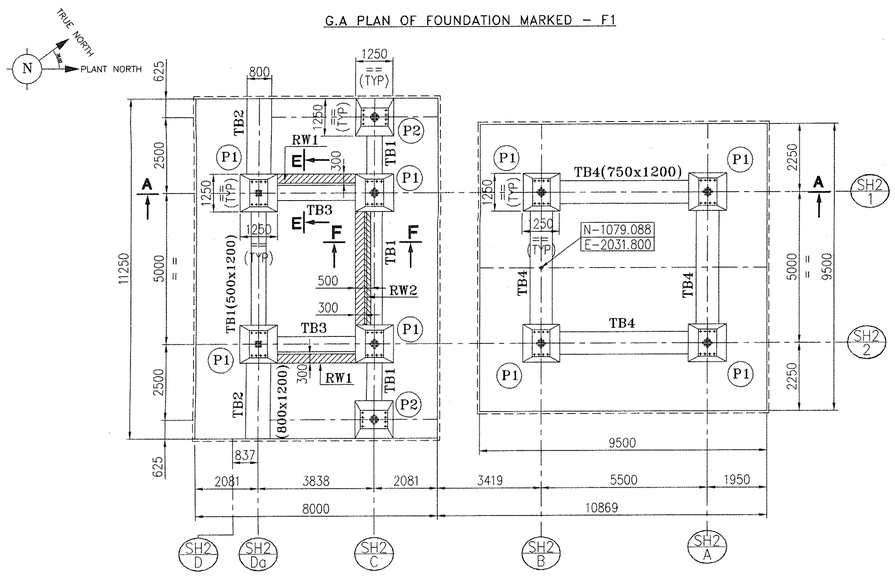
(R.C OF RETAINING WALL MKD. RW1)



NOTES :–

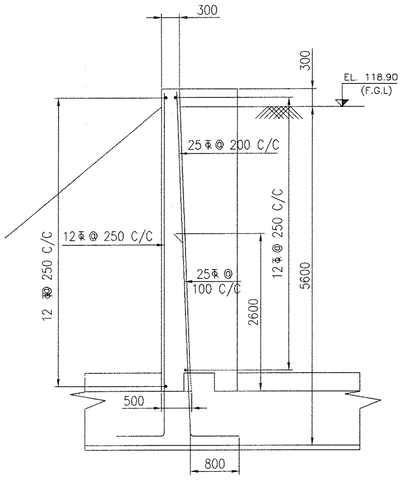
10. SUITABLE PRE–CAUTION SHALL BE TAKEN DURING EXCAVATION AS NEAR BY EXISTING FDN. IS ABOVE THE LEVEL OF SILO HOUSE FDN.
9. DEVELOPMENT LENGTH, ANCHORAGE LENGTH, HOOKS & BENDS SHALL BE AS PER IS:456–2000
8. LAPS IN REINF. BARS SHALL BE PROVIDED AT STAGGERED LOCATIONS & LAP LENGTH=50x DIA OF BAR.
7. REINFORCEMENT BARS DESIGNATED BY ϕ DENOTE HIGH YIELD STRENGTH DEFORMED BARS OF GRADE FE415 CONFORMING TO IS:1786.
6. CLEAR COVER TO MAIN REINFORCEMENTS SHALL BE 50MM. FOR FDN. TIE BEAM, 50MM.
5. FOUNDATION SHALL BE TAKEN DEEPER IN CASE THE SAID BEARING CAPACITY IS NOT ACHIEVED AT THE SHOWN DEPTH.
4. NET SAFE BEARING CAPACITY OF SOIL 20T/SQ.M
3. MUD MAT– LEAN CONCRETE (1:5:10).
2. CONCRETE GRADE FOR R.C WORK SHALL BE M20.
1. ALL DIMENSIONS ARE IN MM & LEVELS ARE IN METRES.

G.A PLAN OF FOUNDATION MARKED – F1



SECTION F–F

(R.C OF RETAINING WALL MKD. RW2)



AS BUILT

FOR DETAIL OF FDN. & STRIP BEAM MKD. SB1 & SB2 REF. DRG. NO. 1.540301

DRAWING CATEGORY (USE TICK MARK)	SPACE FOR EIL REVIEW STAMPING
A [ ] I [ ]	P. SRIDHAR / पी. श्रीधर ENGINEER / अभियन्ता EIL, ANGUL/ईआईएल-अंगुल
DOCUMENT SUBMISSION STATUS (USE TICK MARK) 1st [ ] 2nd [ ] 3rd [ ] AS BUILT [ ]	M/s L. SMIDTH MALCO–ANGL

REV.	REVISED AS PER EIL'S COMMENTS	DATE	DRN.	CHECKED	APPROVED
01		13.04.07	S.S	A.D	S.D

OWNER

NATIONAL ALUMINIUM COMPANY LIMITED.
SMELTER EXPANSION PHASE–2, ANGUL–ORISSA

CONSULTANT

इंजीनियर्स इंडिया लिमिटेड (भारत सरकार का उपक्रम) EIL ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

Rev					
Rev 5	LSI	RDY	DSV	17AUG2010	AS BUILT DRAWING
Rev 0	SS	AD	DSV	28FEB2007	Revision in zone / Description
Scale 1:100	Drawn	Chkd	Appr	Appr Date	Reference No with ◯, see legend
	DO NOT SCALE DRAWING		PC 429		Plan No

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PHASE–II EXPANSION PROJECT
ALUMINA & CRUSHED BATH HANDLING SYSTEM
SILO HOUSE–SH2 (SILO–6)
G.A OF FOUNDATION & RC. DETAIL OF RETAINING WALL
STRUCTURAL DRAWING

FLSmidth MINERALS

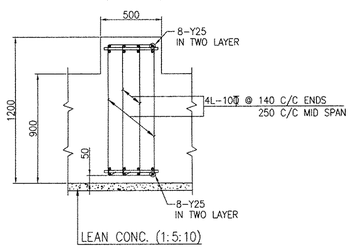
Drawing Number 1.540300 Rev 5

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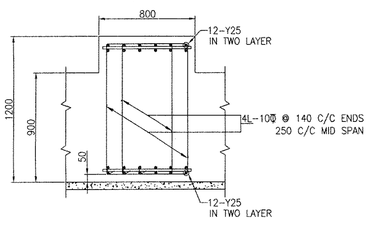
AS BUILT

PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT

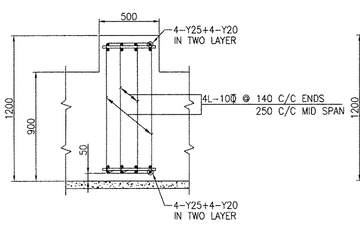
SECTION 1-1
(SCALE 1:25)



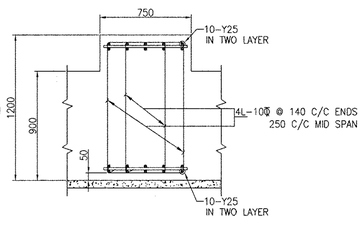
SECTION 2-2
(SCALE 1:25)



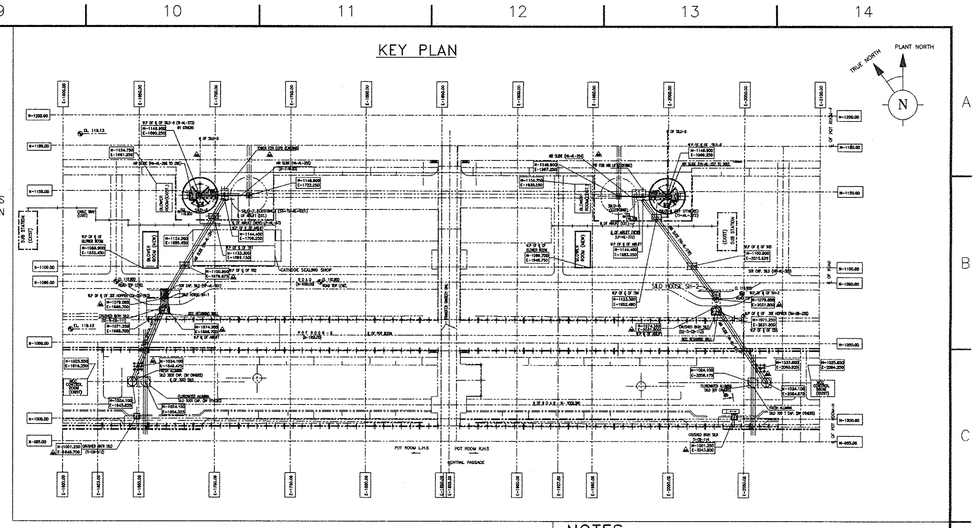
SECTION 3-3
(SCALE 1:25)



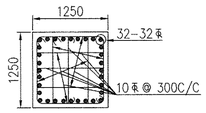
SECTION 4-4
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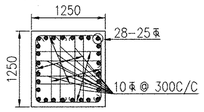
KEY PLAN



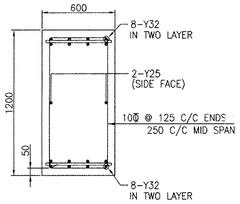
RC. DETAILS OF PDEL.-P1
(SCALE 1:50) (8 NOS.)



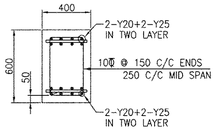
RC. DETAILS OF PDEL.-P2
(SCALE 1:50) (2 NOS.)



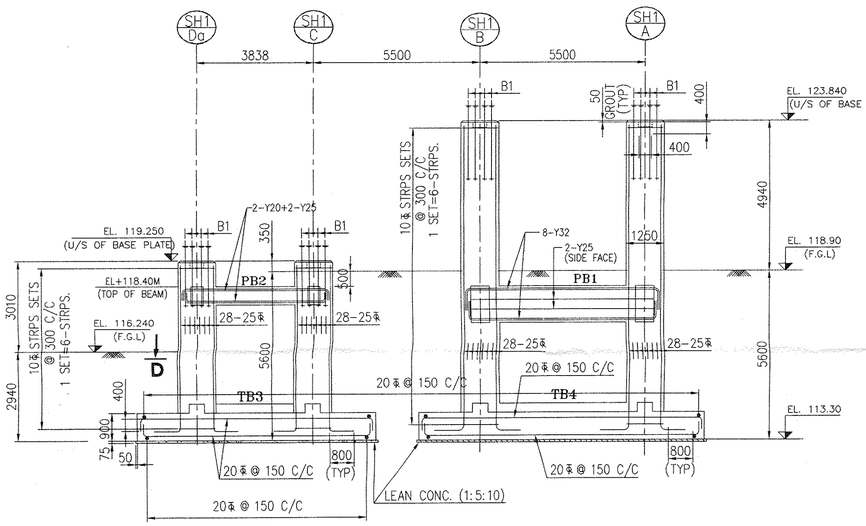
RC. DETAILS OF PB1
(SCALE 1:25)



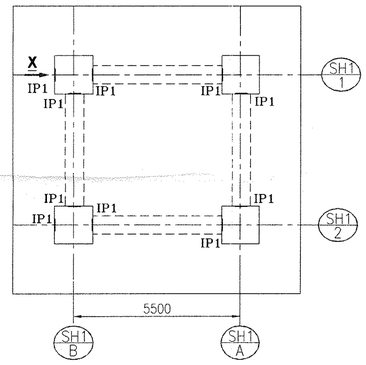
RC. DETAILS OF PB2
(SCALE 1:25)



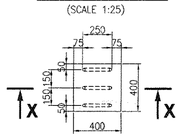
SECTION A-A



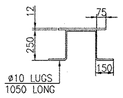
PLAN AT EL+123.79M LVL.
LOCATION OF INSERT PLATES



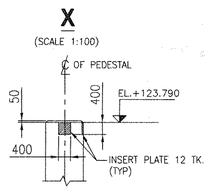
INSERT PLATE(IP1) DETAIL
EL +123.79M LVL.
(SCALE 1:25)



X - X
(SCALE 1:25)



X
(SCALE 1:100)



RCC (M20)	PCC (1:5:10)	Reinforcement (Fe415) in MT.						TOTAL (MT)
		T10	T12	T16	T20	T25	T32	
267m³	14m³	4.189	0.61	0.526	13.21	7.771	18.827	12.187

NOTES :-

(10) SUITABLE PRE-CAUTION SHALL BE TAKEN DURING EXCAVATION AS NEAR BY EXISTING FDN. IS ABOVE THE LEVEL OF SILO HOUSE FDN.

(9) DEVELOPMENT LENGTH, ANCHORAGE LENGTH, HOOKS & BENDS SHALL BE AS PER IS:456-2000

(8) LAPS IN REINF. BARS SHALL BE PROVIDED AT STAGGERED LOCATIONS & LAP LENGTH=50x DIA OF BAR.

(7) REINFORCEMENT BARS DESIGNATED BY ϕ DENOTE HIGH YIELD STRENGTH DEFORMED BARS OF GRADE FE415 CONFORMING TO IS:1786.

(6) CLEAR COVER TO MAIN REINFORCEMENTS SHALL BE 50MM. FOR RETAINING WALL

(5) FOUNDATION SHALL BE TAKEN DEEPER IN CASE THE SAID BEARING CAPACITY IS NOT ACHIEVED AT THE SHOWN DEPTH.

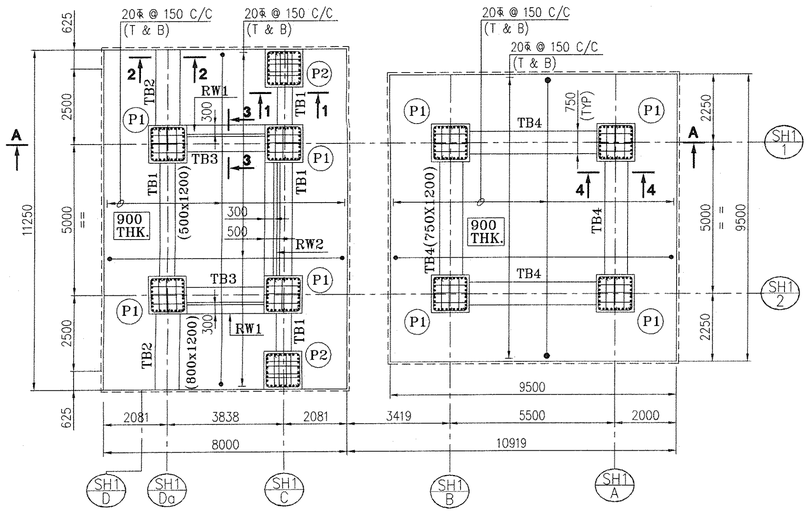
(4) NET SAFE BEARING CAPACITY OF SOIL 20T/SQ.M

(3) MUD MAT- LEAN CONCRETE (1:5:10).

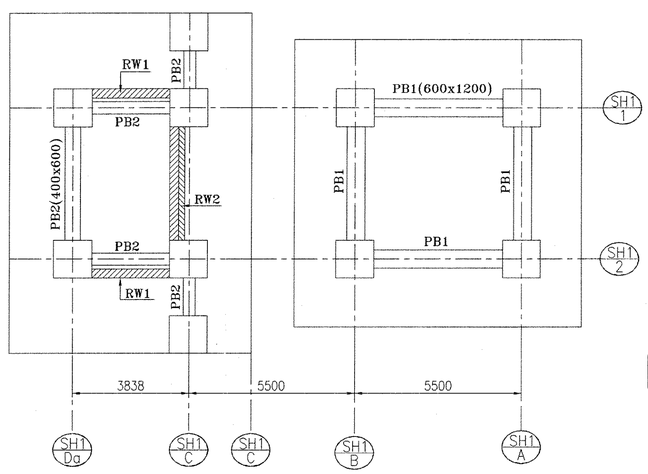
(2) CONCRETE GRADE FOR R.C WORK SHALL BE M20.

(1) ALL DIMENSIONS ARE IN MM & LEVELS ARE IN METRES.

R.C DETAIL OF FDN. MKD. F1



PLINTH BEAM LAYOUT EL+118.40M (TOP OF BEAM)



AS BUILT

FOR DETAIL OF FDN. & STRIP BEAM MKD. SB1 & SB2 REF. DRG. NO. 1.540300

DRAWING CATEGORY
(USE TICK MARK)
[A] [ ]

DOCUMENT SUBMISSION STATUS
(USE TICK MARK)
[1st.] [2nd] [3rd] [ ] AS BUILT

SPACE FOR EIL & CLIENT STAMPING

REV.	REV.	DATE	DRN.	CHECKED	APPROVED
01	REVISED AS PER EIL'S COMMENTS	16.04.07	S.S	A.D	S.D

OWNER
NATIONAL ALUMINIUM COMPANY LIMITED.
SMELTER EXPANSION PHASE-2, ANGUL-ORISSA

CONSULTANT
इंजीनियर्स इंडिया लिमिटेड (भारत एकेडमी का उद्यम)
EIL ENGINEERS INDIA LIMITED
(A Govt. of India Undertaking)

Rev 3	LSI	RDY	DSV	16AUG2010	AS BUILT DRAWING
Rev 2	SB	DMK	DSV	10MAY2007	REVISED AS PER STRUCTURAL GA.
Rev 1	SS	AD	SD	16APR2007	REVISED AS MKD
Rev 0	SS	AD	DSV	28FEB2007	Revision in zone / Description
Scale	Drawn	Chkd	Appr	Appr Date	Reference No with ◯, see legend
1:100	DO NOT SCALE DRAWING			PC 429	Plan No

NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PHASE-II EXPANSION PROJECT
ALUMINA & CRUSHED BATH HANDLING SYSTEM
SILO HOUSE-SH2 (SILO-6)
R.C DETAIL OF FDN. & STRIP BEAMS
STRUCTURAL DRAWING

FFE MINERALS
FFE MINERALS INDIA PRIVATE LTD.

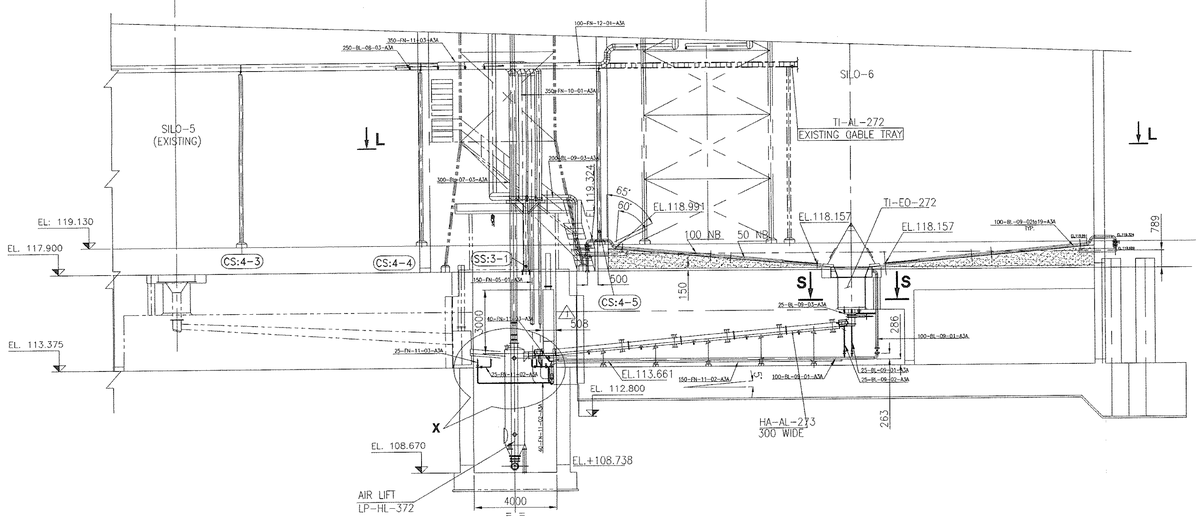
Drawing Number 1.540301

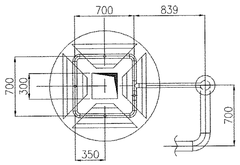
Rev 3

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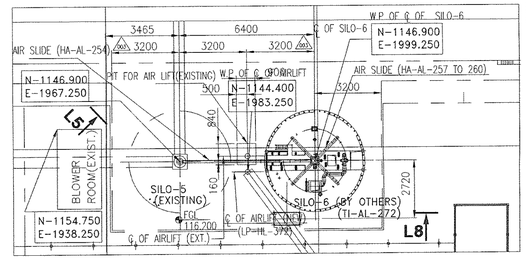
AS BUILT

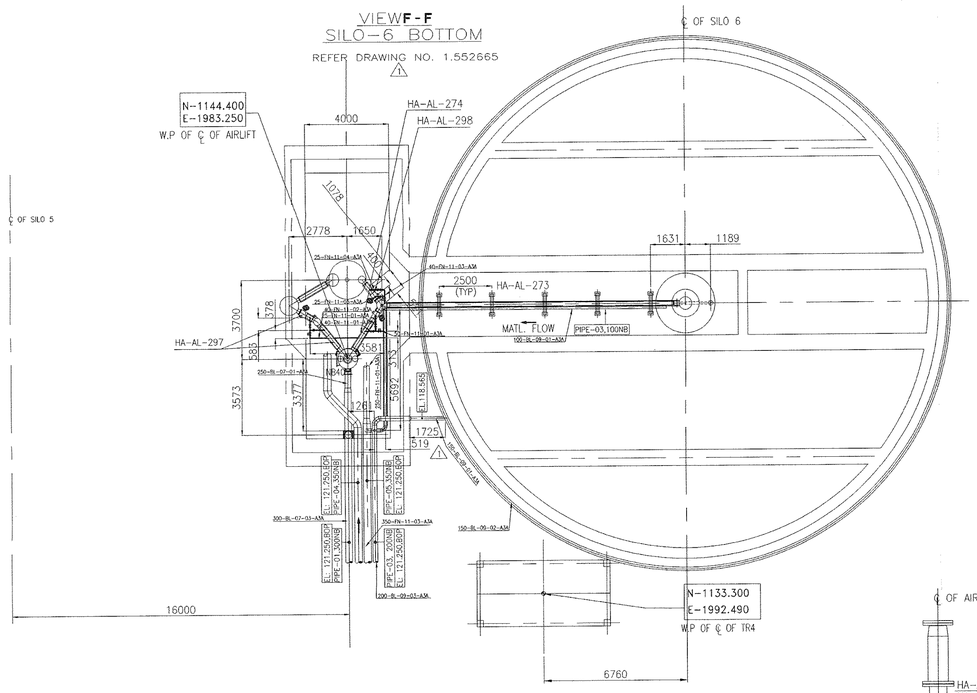
PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT



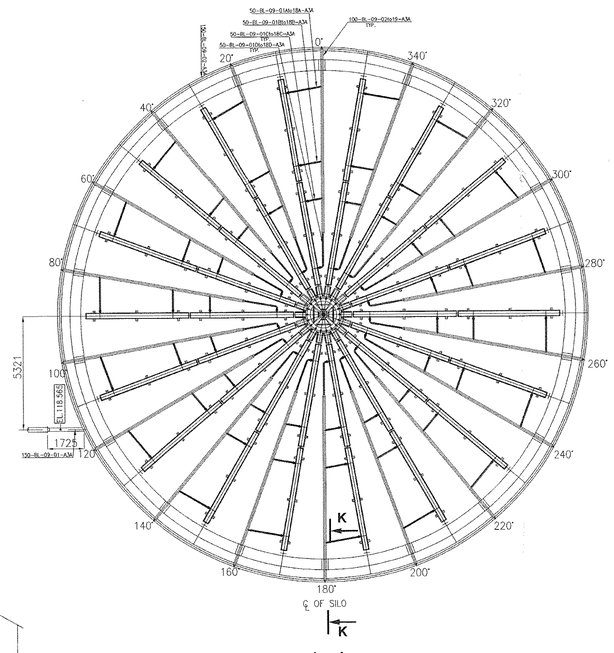


SECTION **S-S**





VIEW **L-L**

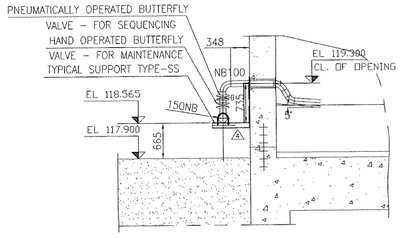


VIEW **L-L**
DETAIL OF AREATION AIR SLIDE FIXING

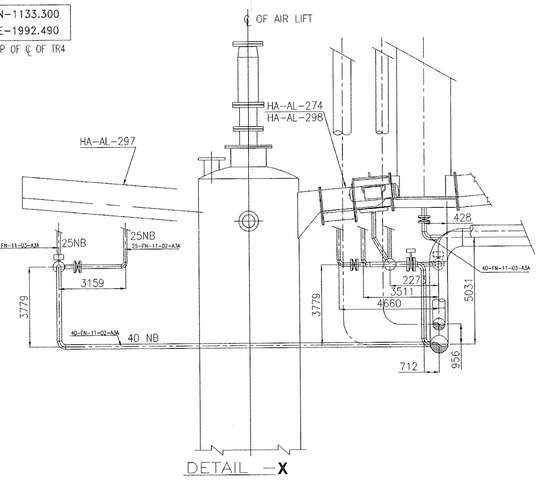
PIPE NO.	SYSTEM	AIR SLIDE/ AIR LIFT	SIZE NB
01	BL-07	AIRLIFT	300
	BL-08	LP-HL-372	250
02	BL-16	LP-HL-398	250
	BL-15	AIRLIFT	
03	BL-03	FLUIDISATION AT	200, 150, 100
	BL-04	SILO TI-AL-272 BOTTOM, CONE AIR SLIDES , CONE BOTTOM & TI-EO-272	50, 25
04	FN-01	HA-AL-254	350, 300
	FN-02	HA-AL-257 TO 260	150, 80
		TM-DB-256	100, 80
05	FN-09	HA-AL-276	350, 50,
	FN-10	HA-AL-273	150, 50, 40, 25
		HA-AL-297	150, 40, 25
		TA-DB-256A	150, 50, 40
		HA-AL-298	150, 50, 40, 25
		HA-AL-274	
06	FN-14	HA-AL-400	250 , 50
	FN-13		

AS BUILT

1. ALL DIMENSION ARE IN MM
2. READ THIS DRAWING IN CONJUNCTION WITH DRG NO.1.552661,1.552662, 1.552663, 1.552664,1.552665, 1.552666 1.552668, 1.552669



SECTION **K-K**



DETAIL **X**

DRAWING CATEGORY (USE TICK MARK): A

DOCUMENT SUBMISSION STATUS (USE TICK MARK): AS BUILT

SPACE FOR ENGG REVIEW STAMPING

REV.	REV.	DATE	DRN.	CHECKED	APPROVED
3	REVISED AS PER MOM DT. 26/10/07	26.11.07	BBA	AKB	AKB
2	GENERALLY REVISED	26.10.07	BBA	AKB	AKB
1	REVISED AS MARKED	21.06.07	BBA	RAM	AKB
0	FIRST ISSUE	05.02.07	HRS	PCH	LSS

OWNER
NATIONAL ALUMINIUM COMPANY LIMITED.
SMELTER EXPANSION PHASE-2, ANGUL-ORISSA

CONSULTANT
ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

Rev 5	ELSM	NKL	KBG	11NOV2009	REVISED AS PER SITE CONDITION △3
Rev 4	NKL	AKB	AKB	10SEP2008	PIPE NOS MENTIONED △4
Rev 3	BBA	AKB	AKB	26NOV2007	REVISED AS PER MOM
Rev 2	BBA	AKB	AKB	26OCT2007	GENERALLY REVISED
Rev 1	BBA	RAM	AKB	21JUN2007	REVISED AS MARKED △1
Rev 0	HRS	PCH	LSS	05FEB2007	Revision in zone / Description
Scale	Drawn	Chkd	Appr	Appr Date	Reference No with ◯, see legend
1:100	DO NOT SCALE DRAWING			PC 429	PDN Plan No

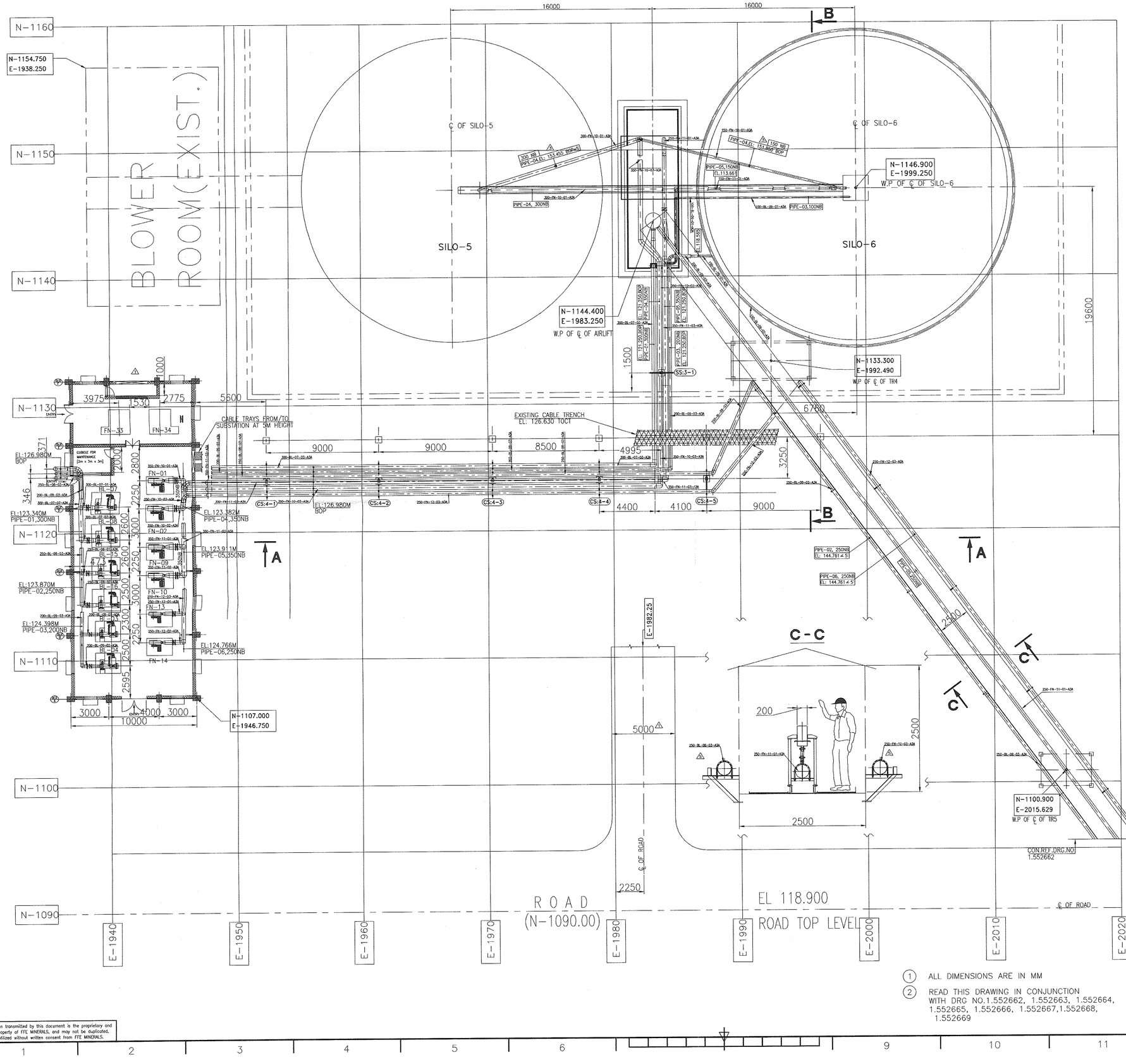
NATIONAL ALUMINIUM COMPANY LIMITED
SMELTER PHASE-2 EXPANSION ANGUL-ORISSA
ALUMINA & CRUSHED BATH HANDLING SYSTEM
SECTIONAL ELEVATION OF AIR PIPING
AT SILO AREATION SYSTEM FOR SILO-6
GENERAL ARRANGEMENT

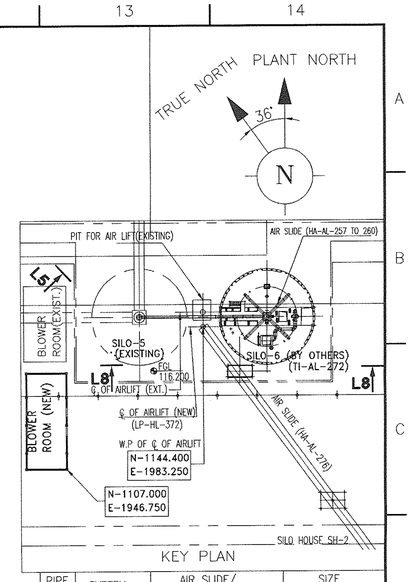
FFE MINERALS INDIA PRIVATE LTD.

Drawing Number 1.552667 Rev 5

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pl. return to us FTP (mech)





KEY PLAN

PIPE NO.	SYSTEM	AIR SLIDE/ AIR LIFT	SIZE NB
01	BL-07 BL-08	AIRLIFT LP-HL-372	300 250
02	BL-16 BL-15	LP-HL-398 AIRLIFT	250
03	BL-03 BL-04	FLUIDISATION AT SILO TI-AL-272 BOTTOM, CONE AIR SLIDES , CONE BOTTOM & TI-EO-272	200, 150, 100 50, 25
04	FN-01 FN-02	HA-AL-254 HA-AL-257 TO 260 TM-DB-256	350, 300 150, 80 100, 80
05	FN-09 FN-10	HA-AL-276 HA-AL-273 HA-AL-297 TA-DB-256A HA-AL-298 HA-AL-274	350, 50, 150, 50, 40, 25 150, 40, 25 150, 50, 40 150, 50, 40, 25
06	FN-14 FN-13	HA-AL-400	250 , 50

AS BUILT

DRAWING CATEGORY (USE TICK MARK)
[A] [ ]

DOCUMENT SUBMISSION STATUS (USE TICK MARK)
[1st.] [2nd.] [3rd.]
[✓] AS BUILT

SPACE FOR ~~EIL REVIEW~~ STAMPING

G. JAYAPRAKASH
RESIDENT MANAGER
L & T, SMIDTH MINERALS
MALCO-ANGUL-SITE

R. B. SAHU / आर. बी. साहू
SR. E. E. / वरि. अभियंता
ELECTRICAL / विद्युत

REV.	REV.	DATE	DRN.	CHECKED	APPROVED
3	REVISIED AS PER MOM DT. 26/10/07	26.11.07	BBA	AKB	AKB
2	GENERALLY REVISIED	26.10.07	BBA	AKB	AKB
1	REVISION AS MARKED	21.06.07	BBA	RAM	AKB
0	FIRST ISSUE	19.02.07	HRS	PCH	LSS

OWNER
NATIONAL ALUMINIUM COMPANY LIMITED.
SMELTER EXPANSION PHASE-2, ANGUL-ORISSA

CONSULTANT
इंजीनियर्स इंडिया लिमिटेड (भारत सरकार का उपक्रम)
EIL
ENGINEERS INDIA LIMITED
(A Govt. of India Undertaking)

Rev 5	ELSM	NKL	KBG	11NOV2009	AS BUILT DRAWING ⚠
Rev 4	BBA	AKB	AKB	10SEP2008	ALL PIPE NO. MENTIONED ⚠
Rev 3	BBA	AKB	AKB	26NOV2007	REVISIED AS PER MOM
Rev 2	BBA	AKB	AKB	26OCT2007	GENERALLY REVISIED
Rev 1	BBA	RAM	AKB	21JUN2007	REVISION AS MARKED ⚠
Rev 0	HRS	PCH	LSS	19FEB2007	Revision in zone / Description
Scale	Drawn	Chkd	Appr	Appr Date	Reference No with ◯, see legend
1:150	DO NOT SCALE DRAWING			PC 429	Plan No

NATIONAL ALUMINIUM COMPANY LIMITED,
SMELTER PHASE-2 EXPANSION, ANGUL-ORISSA.
ALUMINA&CRUSHED BATH HANDLING SYSTEM
OVERALL PLAN OF COMPRESSED AIR PIPING FOR SILO-6

GENERAL ARRANGEMENT

FFE MINERALS
FFE MINERALS INDIA PRIVATE LTD.

Drawing Number 1.552661

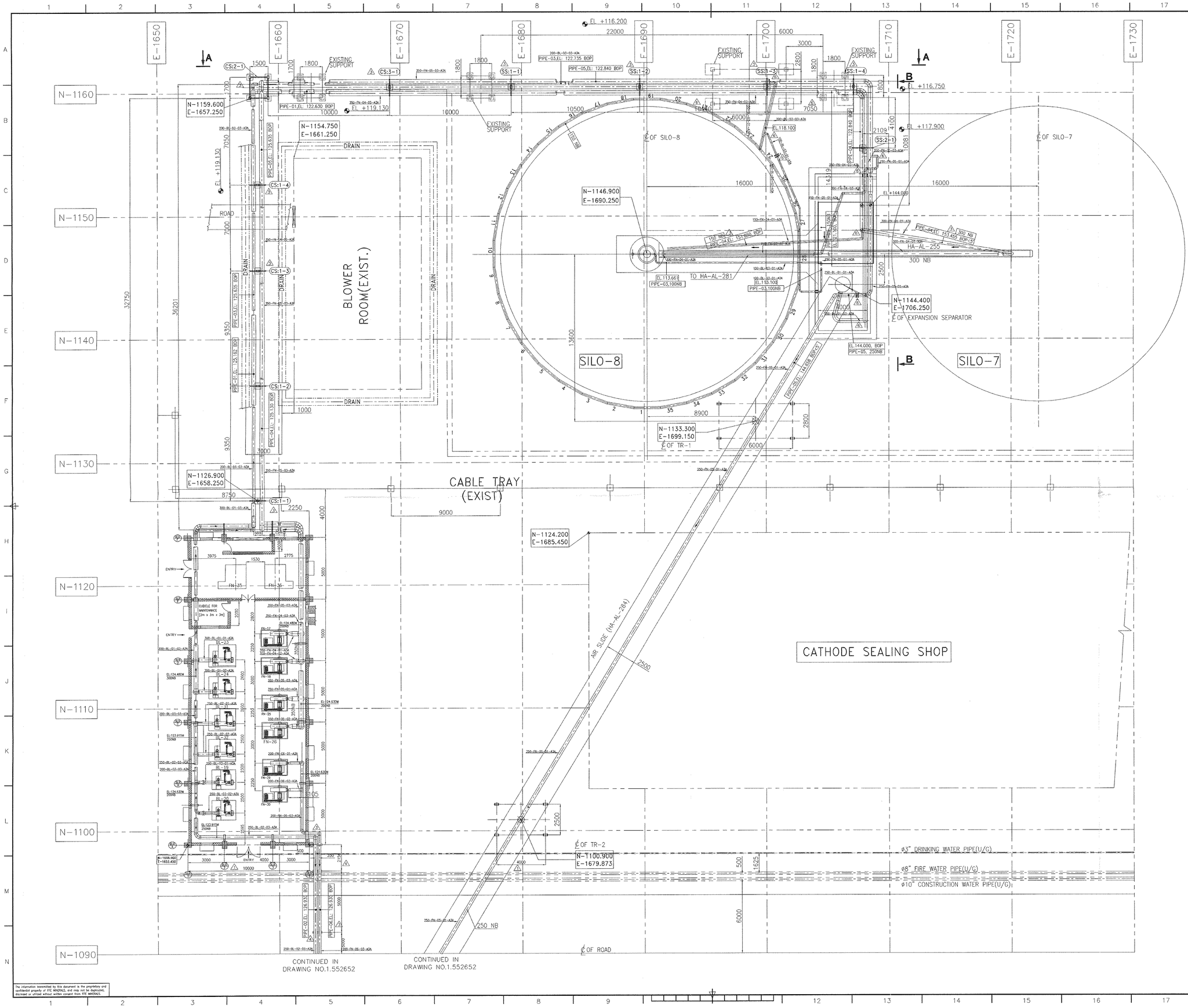
Rev 5

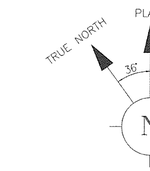
1. ALL DIMENSIONS ARE IN MM
2. READ THIS DRAWING IN CONJUNCTION WITH DRG NO.1.552662, 1.552663, 1.552664, 1.552665, 1.552666, 1.552667,1.552668, 1.552669

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pl. return to us.

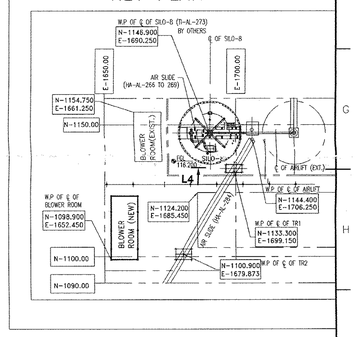
RM-DAS





PIPE NO.	SYSTEM	AIR SLIDE/ AIR LIFT	SIZE NB	REMARKS
01	BL-23 BL-24	AIRLIFT LP-HL-373	300	
02	BL-31 BL-32	AIRLIFT LP-HL-399	250	
03	BL-19 BL-20	FLUIDISATION AT SILO TI-AL-281 BOTTOM, CONE AIR SLIDES , CONE BOTTOM & TI-EO-280	200	
04	FN-17 FN-18	HA-AL-255 HA-AL-266 TO 269 TM-DB-265	350	
05	FN-25 FN-26	HA-AL-284 HA-AL-282 HA-AL-295 TA-DB-265A HA-AL-296 HA-AL-281	350	
06	FN-29 FN-30	HA-AL-401 HA-AL-286 HA-AL-299 30T HOPPER	200 ⚠	

⚠ KEY PLAN



NOTE:–

1. ALL DIMENSIONS ARE IN MM
2. READ THIS DRAWING IN CONJUNCTION WITH DRG NO.1.552652, 1.552653, 1.552654, 1.552655, 1.552656, 1.552657, 1.552658, 1.552659
3. ⚠ EIL STANDARDS TO BE FOLLOWED FOR PIPE INSTLLATION/ SUPPORTS ETC.
4. ⚠ TEST PRESSURE(COMPRESSED AIR LINE)– 1.0 kg/cm²g

AS BUILT

DRAWING CATEGORY (USE TICK MARK): [A] [ ]

DOCUMENT SUBMISSION STATUS (USE TICK MARK): [1st] [2nd] [3rd] [✓] AS BUILT

SPACE FOR EIL REVIEW STAMPING

28/5/11
G. JEYAPRAKASH
RESIDENT MANAGER
M/s. G. SMIDTH MINERALS P. LTD.
MALCO, ALWAYE, KERALA

REV.	REV.	DATE	DRN.	CHECKED	APPROVED
4	NOTE:–3 INCORPORATED AS PER EIL	12/11/07	BBA	AKB	AKB
3	REVISIONS AS MARKED	22/10/07	BBA	AKB	AKB
2	GENERAL REVISION	10/07/07	BBA	AKB	AKB
1	REVISIONS AS MARKED	03/02/07	HRS	PCH	PCH
0	FIRST ISSUE				

OWNER: NATIONAL ALUMINIUM COMPANY LIMITED.
SMELTER EXPANSION PHASE-2, ANGUL-ORISSA

CONSULTANT: इंजीनियर्स इंडिया लिमिटेड ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

Rev 6	NKL	NKL	KBG	20APR2009	AS BUILT DRAWINGS ⚠
Rev 5	NKL	AKB	AKB	17MAR2008	REVISION AS MARKED ⚠
Rev 4	BBA	AKB	AKB	27DEC2007	REVISIONS AS MARKED ⚠
Rev 3	BBA	AKB	AKB	12NOV2007	REVISIONS AS MARKED ⚠
Rev 2	BBA	AKB	AKB	23OCT2007	GENERAL REVISION
Rev 1	BBA	AKB	AKB	10JUL2007	REVISIONS AS MARKED ⚠
Rev 0	HRS	PCH	PCH	03FEB2007	Revision in zone / Description
Scale	Drawn	Chkd	Appr	Appr Date	Reference No with ◯, see legend
1:100	DO NOT SCALE DRAWING		PC 429	PDN	Plan No

NATIONAL ALUMINIUM COMPANY LIMITED.
SMELTER PHASE-2 EXPANSION, ANGUL-ORISSA.
ALUMINA & CRUSHED BATH HANDLING SYSTEM
OVERALL PLAN OF COMPRESSED AIR PIPING FOR SILO-8

GENERAL ARRANGEMENT

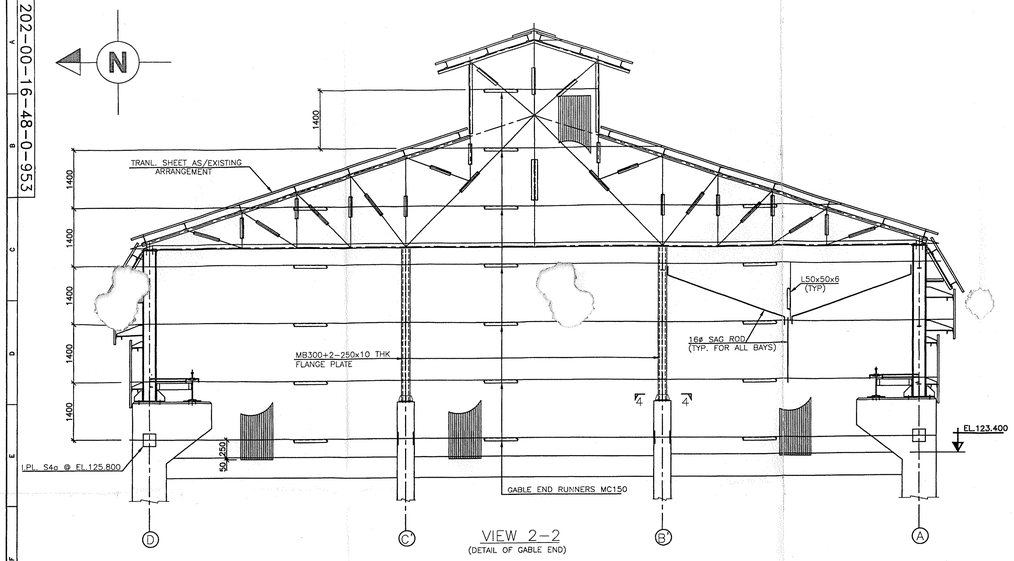
FFE MINERALS — FFE MINERALS INDIA PRIVATE LTD.

Drawing Number: 1.552651 Rev: 6

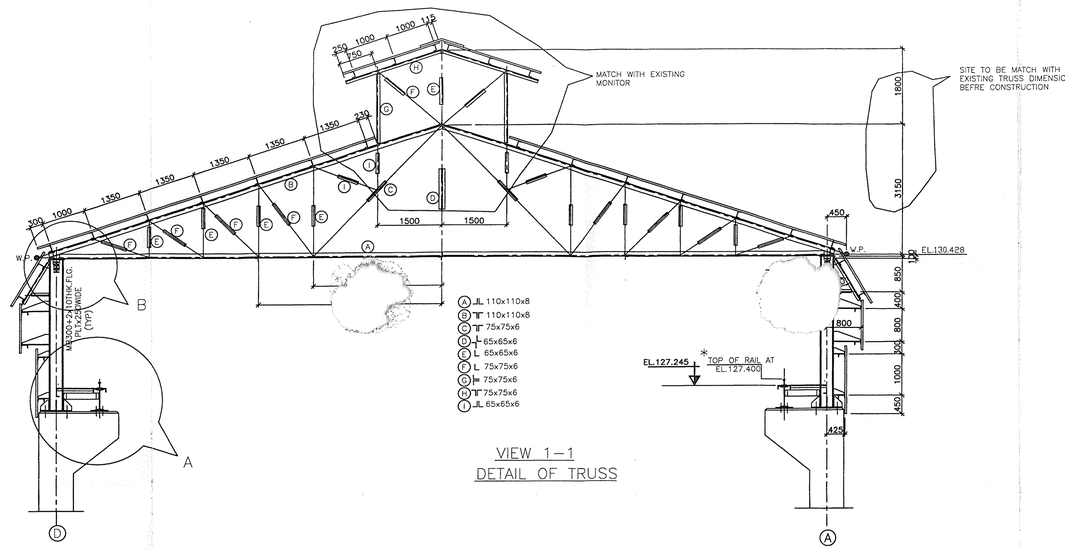
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Pl. return to us

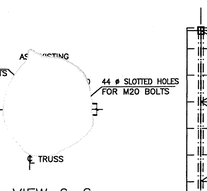
1202-00-16-48-0-953



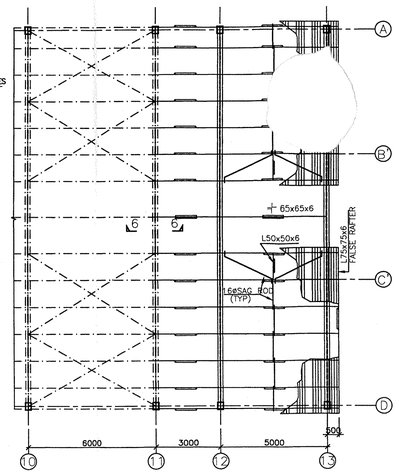
VIEW 2–2
(DETAIL OF GABLE END)



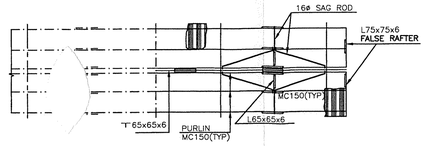
VIEW 1–1
DETAIL OF TRUSS



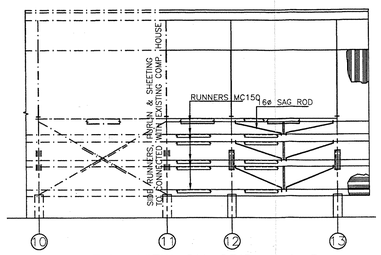
VIEW 6–6



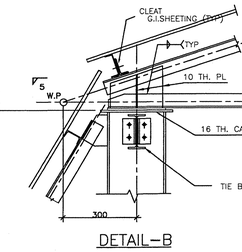
TOP CHORD PLAN



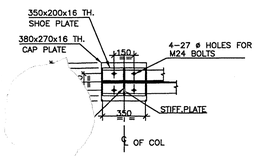
TOP OF MONITOR PLAN



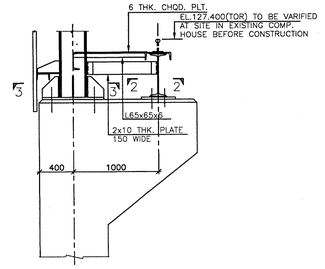
ELEVATION VIEW ON GRID–A & D



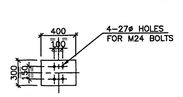
DETAIL–B



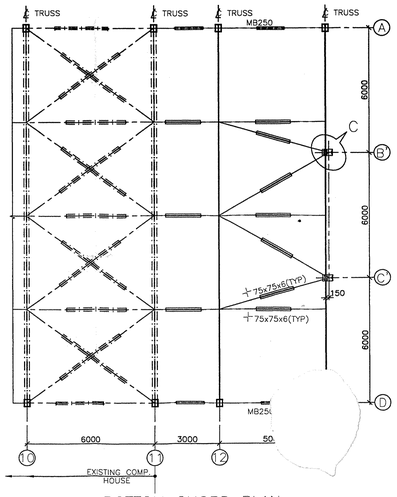
VIEW 5–5



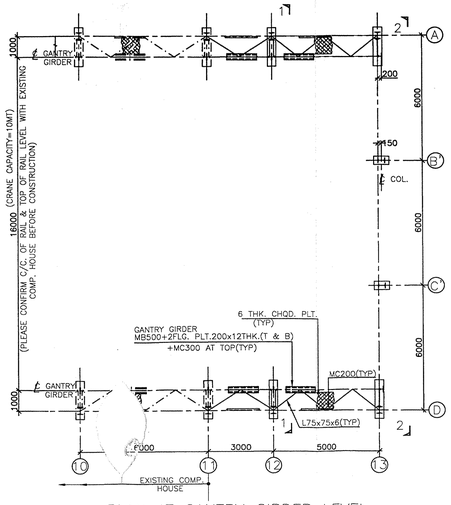
DETAIL–A



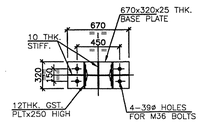
VIEW 2–2



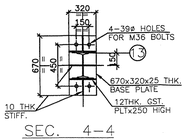
BOTTOM CHORD PLAN



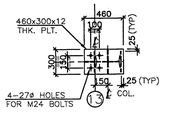
PLAN AT GANTRY GIRDER LEVEL



SEC. 3–3
DET. OF BASE PLATE
FOR 12–A, 13–A, 12–D & 13–D



SEC. 4–4



DETAIL–C
GABLE END COL. TOP PLT.

REF. DWG. NO.	REFERENCE DRAWING TITLE
1202-00-16-48-0-951	GA & R/F DET OF FDNS
1202-00-16-48-1-149	COMPRESSOR HOUSE PLAN, ELEVATION & SECTION

NOTES :-

1. ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN M.
2. FOR GENERAL NOTES REFER DRG. NO. 1202-00-16-48-4-905.

THIS DRG. SHALL BE READ IN CONJUNCTION WITH DRG. NO. 1202-00-16-48-0-951.

STRL. STEEL QUANTITIES

SECTION	QUANTITY [KG]	SECTION	QUANTITY [KG]
MB500	1400	PL 25 th.	400
MB300	1000	PL 20 th.	130
MB250	500	PL 12 th.	400
		PL 10 th.	1450
MC300	570		
MC200	400		
MC150	2800		
L 100x100x8	3000		
L 90x90x6	500		
L 75x75x6	1200		
L 65x65x6	500		
L 50x50x6	10		
		TOTAL WT.	14360

APPROVED No. 175 / LF Date ... FOR PROJECT, SMELTER

SCOPE OF WORK IN ANODE BAKING FURNACE TENDER

REV.	DATE	REVISIONS	DRN	BY	CHKD	APPD	PEMPC
0	10.10.07	ISSUED FOR CONSTRUCTION					
A	13.03.07	ISSUED FOR COMMENTS					

इंजीनियर्स इंडिया लिमिटेड (भारत सरकार का उपक्रम) ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

NATIONAL ALUM... ...MPANY LIMITED
नेशनल एल्यु... ...ो लिमिटेड

एल्युमिनियम स्मेल्टर विस्त... ...NIUM SMELTER EXPANSION परियोजना, फेज: I L अंगुल ...ROJECT, PHASE-II, ANGUL

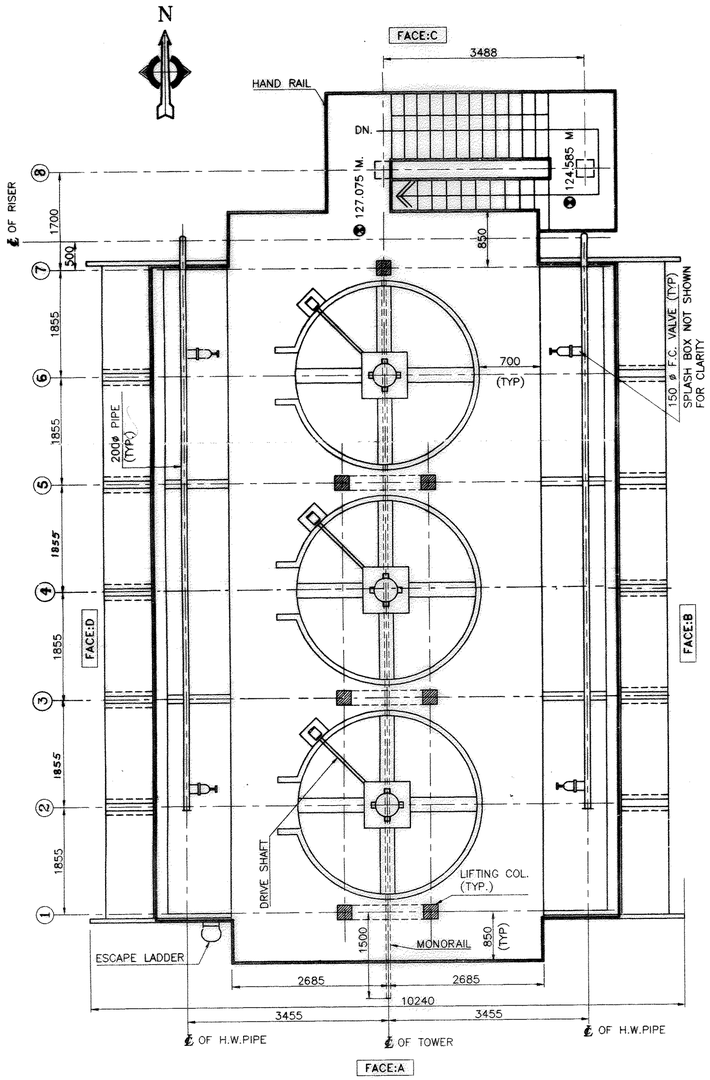
वायु संपीडक गृह
अधिसंरचना एवं गैंट्री गरडर का ब्यौरा

AIR COMPRESSOR HOUSE
DETAIL OF SUPER STR. AND GANTRY GIRDER (CAP 10T)

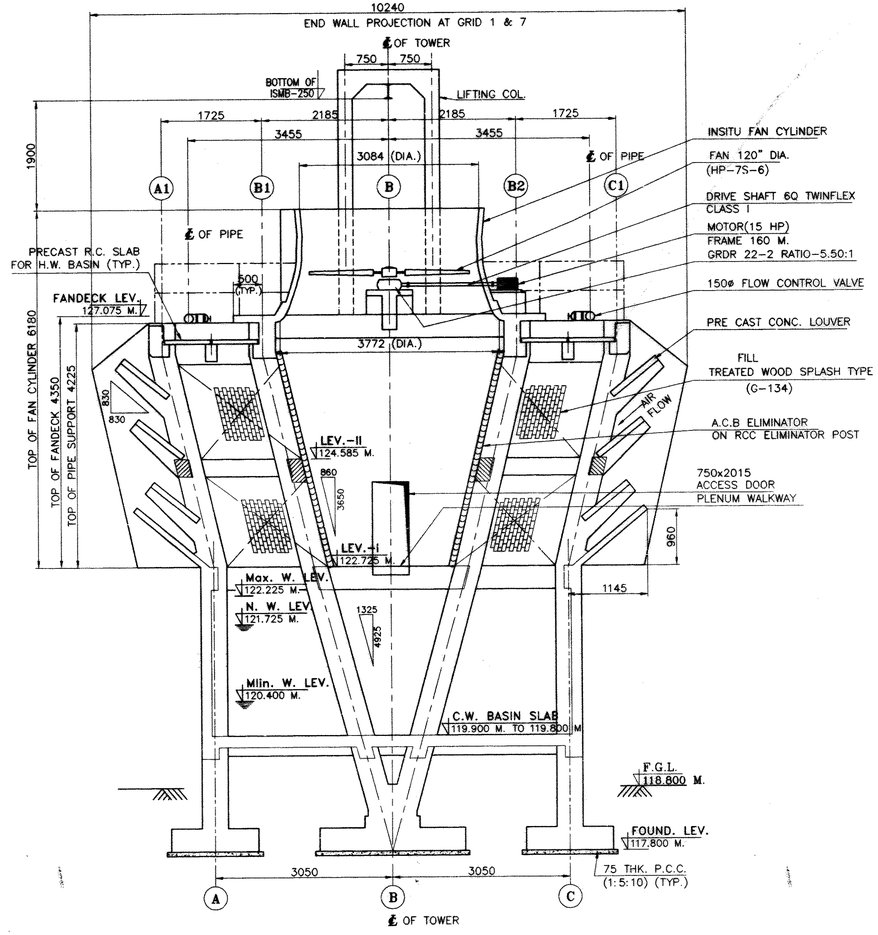
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1:100	1 2 0 2 0 0	1 6 4 8 0	9 5 3		0

1-1641-0500 REV.0 A0-1189 x 841

प्रस्तुत आरेख एवं उसमे दिये विवरण इंजीनियर्स इंडिया लिमिटेड की संपत्ति है। वे मात्र उसी लिए प्रस्तुत किये गए है और उसानुसार वे या इन्हे पूर्ण, आंशिक रूप से या संशोधित कर किसी प्रयोजन के अलावा इसका कहीं अन्य प्रयोग नहीं होना चाहिए और यह प्रयोग उसी लिए प्रस्तुत किए जाएंगे और न ही सीमित और, किसी प्रयोग



PLAN OF COOLING TOWER
AT FAN DECK LEVEL.



TRANSVERSE SECTION

DESIGN PARAMETERS	
WATER FLOW RATE PER CELL	300 CMH
HOT WATER TEMP.	45°C
COLD WATER TEMP.	35°C
WET BULB TEMP.	27°C
BHP AT MOTOR SHAFT PER CELL	10.1

NOTES : -

1. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH DRG. NO. 00-21-0017C/G/101 & G/02.
2. ALL DIMENSIONS ARE IN mm. AND LEVELS IN M.
3. FOR DETAIL OF MATERIAL OF CONSTRUCTION REFER TECHNICAL DATA SHEET.
4. FOR PIPING LAYOUT REFER DRG. NO. 00-21-0017C/G/401.

Drawing Code

4	1	3	3	4	0	0	1	0	2	1

NATIONAL ALUMINIUM COMPANY LIMITED
COOLING TOWER AND COOLING WATER TREATMENT PLANT FOR SMELTER EXPANSION PROJECT AT ANGUL, ORISSA

CONSULTANT :-
ENGINEERS INDIA LIMITED EIL JOB NO. 4375

TITLE :-
GENERAL ARRANGEMENT & SCHEMATIC VIEWS OF COOLING TOWER
COOLING TOWER MODEL : C 451 - 203 CT-III(E)

PAHARPUR COOLING TOWERS LTD.
8/1/B DIAMOND HARBOUR ROAD
CALCUTTA - 700 027

DRAWN BY	CHECKED BY			APPROVED BY
	CIVIL	TECH.	MARTG.	
Mousumi Shaw	S. Kar M.R.K.		S.V.K.	R.N. Rai

ORDER No.:- 00-21-0017C | REV. 2 | SCALE:- AS DRAWN
DWG. No.:- 00-21-0017C/G/01 | DATE:- 12.07.2000

CODE :- C 400 G

REV.	DATE	DESCRIPTION	BY	CHECKED	APPROVED
2	09.01.2001	GENERAL REVISIONS AS PER EIL'S COMMENTS	Mousumi	S. Kar S.M. S.V.K.	R.N. Rai
1	07.09.2000	GENERAL REVISIONS AS PER EIL'S COMMENTS	Mousumi	S. Kar S.M. S.V.K.	R.N. Rai

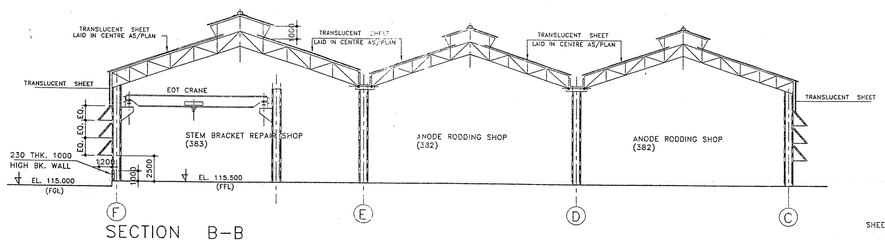
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C:\DWG\Mousumi Shaw\2000\0017C_MAL\DWG\0017cg01.dwg Wed Jan 17 13:09:35 2001 (PAHARPUR COOLING TOWERS LTD.

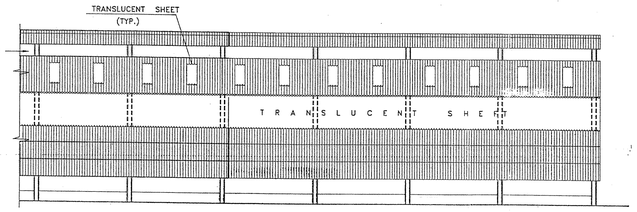
CAD FILE No:-0017CG01.DWG

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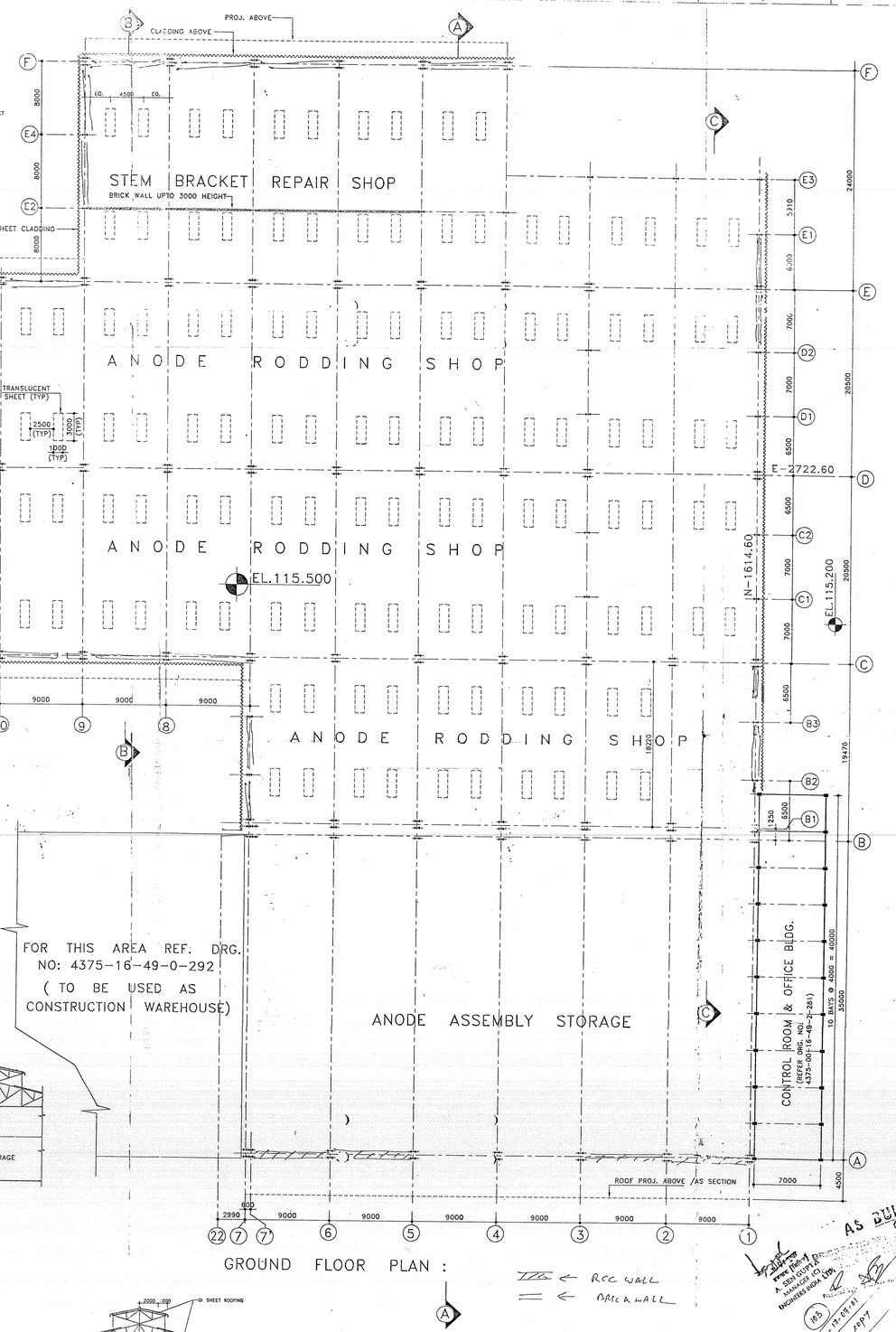
D:\ARVIND\4375\DWG\4375-08-16-49-0-283



SECTION B–B



PART WEST ELEVATION



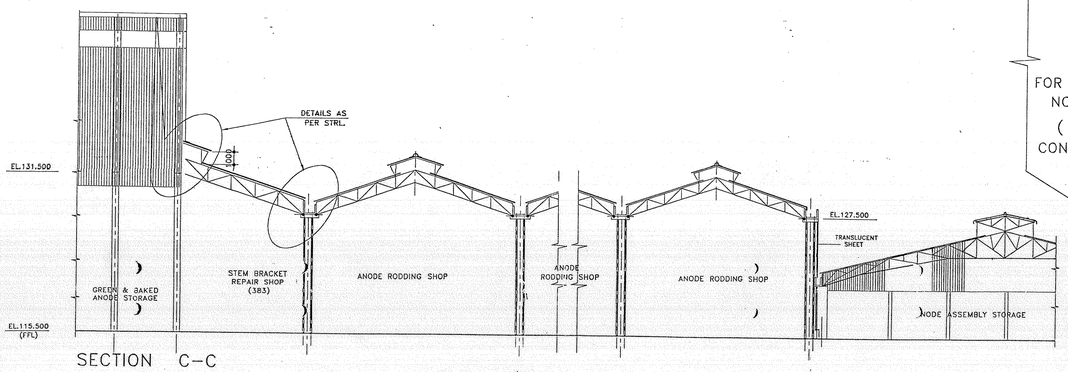
GROUND FLOOR PLAN :

FOR THIS AREA REF. DRG. NO: 4375-16-49-0-292 (TO BE USED AS CONSTRUCTION WAREHOUSE)

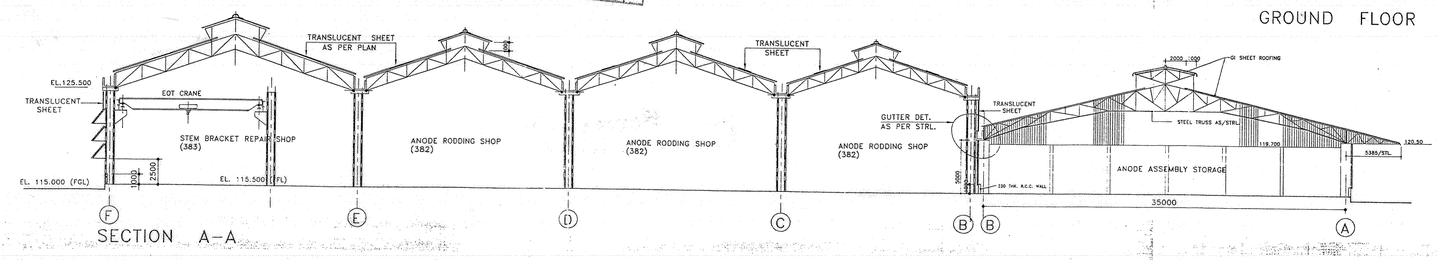
ANODE ASSEMBLY STORAGE

RCC WALL

BRICK WALL



SECTION C–C

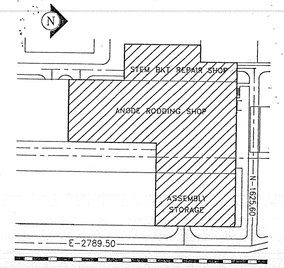


SECTION A–A

REFERENCE DRAWING	NO
GA OF ANODE RODDING & ASSEMBLY REPAIR SHOP	4375-08-16-44-3-081
ANODE ASSEMBLY RODDING SHOP	4375-08-16-44-0-082
LAYOUT & DETAILS OF COLUMNS	4375-08-16-48-1-574
G.A.& DETAILS OF SIDE SHEETING	4375-08-16-48-0-573

NOTES:

1. ALL DIMENSIONS ARE IN MM & LEVELS IN METERS.
2. 1000 WIDE PLINTH PROTECTION SHALL BE PROVIDED ALLAROUND THE BUILDING.
3. FINAL LEVELS OF THE STRL. SHALL BE AS PER MECH. EQPT./STRL. DRGS.
4. FOR RAIN WATER DISPOSAL, REFER DRG.NO 4375-09-16-49-1-306.



KEY PLAN

2 1 5 5 0 0 0 1 0 1 0

Drawing Code

CIVIL & TENDER–III

AS BUILT

TRANSLUCENT SHEET ARRANGEMENT REFINED.

No.	DATE	REVISIONS	BY	CHK'D	APP'D
1	06.07.2010	UPDATED & ISSUED FOR CONSTRUCTION	MEHTA	SDV	KAPOOR
0	14.3.2008	ISSUED FOR CONSTRUCTION	MEHTA	SDV	KAPOOR
A	18.1.2008	ISSUED FOR ENGINEERING	MEHTA	SDV	KAPOOR

ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

NATIONAL ALUMINIUM COMPANY LIMITED

SMELTER EXPANSION PROJECT

ANODE RODDING SHOP & ASSEMBLY STORAGE

PLAN, ELEVATIONS & SECTION

MICRO FILM REQUIRED	PROJ ENGR	MICRO FILM REF No.

SCALE	JOB NO.	UNIT	DEPT.	SECTN.	DWG. No.	REV.
1:200	4375	09	16	49	0283	1

EIL-501 A0-1189X841 DISTRIBUTION CODE

220/ELE/GA/A1/7454 Sh.1/4

IF IN DOUBT,PLEASE ASK

37.5 MVA,AUX.Tr.-2
220 KV/11KV

CB

1A-06

37.5 MVA,AUX.Tr.-1
220 KV/11KV

1A - 10

37.5 MVA,AUX.Tr.-3
220 KV/11KV

2A - 08

37.5 MVA,AUX.Tr.-4
220 KV/11KV

3C - 01

37.5 MVA,AUX.Tr.-5
220 KV/11KV

3C - 14

CELLULAR SWITCH GEAR - Ⅰ 11 KV BUS

CELLULAR SWITCH GEAR - Ⅱ 11 KV BUS

CELLULAR SWITCH GEAR - Ⅲ 11 KV BUS

1A-01 1A-02 1A - 03 1A-04 1A-05 1A-07 1A-08 1A-09 1A-11 1A-12 1A-13 1A - 14

2A-01 2A-02 2A-03 2A-04 2A-05 2A-06 2A-07 2A-09 2A-10 2A-11 2A-12 2A-13 2A-14 2A-15 2A-16

3C-02 3C-03 3C-04 3C-05 3C-06 3C-07 3C-08 3C-09 3C-10 3C-11 3C-12 3C-13

S/S - 10 | SPARE | S/S - 12 | CAPACITOR BANK | S/S - 20 | S/S - 15 | S/S - 16 | S/S - 22 | ST - AUX. -1 | ST - AUX. -2 1600 KVA 11 KV/433 V

S/S - 17

LT BOARD

SPARE | SPARE | SPARE | 1600 KVA 11 KV/433 V ST - AUX.-3 | SPACE CAPACIT | SPARE

LT BOARD

S/S - 25

TIE FEEDER

S/S-32 | S/S-30 | S/S-35 | SPARE TIE | FUTURE LOAD1 | FUTURE LOAD 2 | FUTURE LOAD 3 | FUTURE LOAD CAPACITY | ST - AUX. -4 11 KV/0.433KV | ST - AUX. -5 11/0.433KV

S/S-34

S/S-33 | S/S-31 | S/S-36

ACB | ACB

LT BOARD | BC | LT BOARD

S/S - 11 | S/S - 13 | S/S - 21 | S/S - 14 | S/S - 18 | S/S - 23 | S/S - 26

S/S - 24

7.5 MVA, Tr-1
11 KV/11 KV

7.5 MVA, Tr-2
11 KV/11 KV

C SPARE FOR
11 KV. COMPRESSOR

11 KV. BUS SUBSTATION - 19

11 KV. BUS SUBSTATION - 37

T/S - 1 | T/S - 2 | CONSTRUCTION POWER SUPPLY

Doc. Code : 00269009001

REV.No.	DATE	REVISION NOTE	BY.	CKD.	APPD.

DRN.	DATE 12.12.2005	S.K.BEHERA	PREPARED BY:- EAST END INFOTECH PVT. LTD. BHUBANESWAR
CKD.	20.12.05	D.K.SAHOO	NATIONAL ALUMINIUM CO LTD. SMELTER PLANT, ANGUL-759145
CKD.			TITLE:- 11 KV. DISTRIBUTION SYSTEM OF 220KV. SUBSTATION FOR SMELTER PLANT.
SCALE			DRG. No. 220/ELE/GA/A1/7454 Sh.1/4 REVISION 0

APPD.	11.01.06	S.K.PADHEE
VFD.		D.N.MOHAPATRA DATE

71037SLD

11 KV SWGR.NO. H.T-228

11 KV SUPPLY FROM 220 KV CONV. S/S 11 KV CELLULAR SWGR

11 KV FEEDER TO 11 KV SWGR. NO. HT-224 (POTLINE ANNEXE S/S NO. 710.33)

11 KV FEEDER TO 11 KV SWGR. NO. HT-222 (POTLINE S/S NO. 710.21)

11 KV FEEDER TO 11 KV SWGR. NO. HT-227 (ANODE RODDING SHOP S/S NO. 710.36)

11 KV,800 A, 50 Hz, 25 kA (1 SEC) TP BUS

BUS-37AF

BUS-37AR

SPARE TRAFO FEEDER

EXTENSION OF 11 KV SWGR (EXISTING SWBD. AT EXISTING COMPR. HOUSE S/S)

EXTENSION PNLS → EXISTING SWBD.

11 KV SUPPLY FROM EXISTING S/S NO. 71017

11 KV SUPPLY FROM EXISTING S/S NO. 71021

EXISTING SWBD. → EXTENSION PNLS

11 KV,800A, 25KA 1 SEC), 50 HZ, 3 PH.

AIR COMPRESSOR MOTOR-1 (1006 KW)

AIR COMPRESSOR MOTOR-2 (1006 KW)

AIR COMPRESSOR MOTOR-3 (1006 KW)

AIR COMPRESSOR MOTOR-4 (1006 KW)

TR-071
11/0.433KV
630KVA
+-5% TAP @2.5%
Z=6.25%
Dyn11

TR-072
11/0.433KV
1600KVA
+-5% TAP @2.5%
Z=6.25%
Dyn11

TO 63Tx

TO 51G

POWER CUM MOTOR CONTROL CENTRE(PMCC)
PMCC NO.
PC-511

415V,50Hz,2500A, 50KA (1SEC) TPN

BUS-23B

BUS-24B

AUTO-MANUAL CHANGEOVER

2500 A

SPARE

LCP-AIR COMPR # 1

LCP-AIR COMPR # 2

EOT CRANE(LIFT-COMPR HOUSE)

PDB-DC COMPR AUX

LCP-SANITARY PUMP (75-PM-1001-2C) (W)

PDB-AIR DRYER # 1

PDB-AIR DRYER # 2

TO ASB (AB-583)

TO DC SYSTEM (DC-713)

PDB-AIR DRYER # 3

PDB-AIR DRYER # 4

TO DC SYSTEM (DC-713)

SPARE

PDB-AIR COMPR AUX (LCP)

SPARE

PDB-DG AUXILIARIES

PDB-CONTROL ROOM A/C

PDB-CAFE-CT-III

LCP-AIR COMPR # 3

LCP-AIR COMPR # 4

LCP-SANITARY PUMP (75-PM-1002-2C) (W)

SPARE

SPARE

SPARE

DIESEL ENGINE GENERATOR (LOC:DG SHED)

DG-LCP/AMF PNL

750 KVA

TO 64P

TO 51G

TO 51V

TO 63P

415V EMERGENCY SWBD. NO. EB-504

415V, 1250A, 50Hz, TPN, 50kA(1sec)

SWI-253

INTERLOCK

TO PIPELINE S/S 710.33 CWG BOARD NO. EB-504

CT-III FAN MOTOR -2(I) (W)

CT-III FAN MOTOR -2(II) (W)

CT-III FAN MOTOR -2(I) (W)

LUBE OIL PUMP MOTOR-2.5 (W)

LUBE OIL PUMP MOTOR-2.5 (W)

LUBE OIL PUMP MOTOR-2.5 (W)

LUBE OIL PUMP MOTOR-2.5 (W)

TO ROBBING S/S 710.34 CWG BOARD

COOLING WATER SUPPLY PUMP (CT-III) (25-PM-1001-2C) (W)

COOLING WATER SUPPLY PUMP (CT-III) (25-PM-1002-2C) (W)

COOLING WATER SUPPLY PUMP (CT-III) (25-PM-1003-2C) (W)

EMG PDB - AIR DRYER SYSTEM

ASB NO. AB-583

415 V, 50 Hz, TPN, 400 A, 50kA (1SEC)

BUS -94B

FROM PC-511 BUS-23B

FROM PC-511 BUS-24B

FINISH PANEL I/P HOIST (CRANE) (AB-583)

PRE-STABILISATION SUB-STN MAIN I/P

TOWER PANEL I/P HOIST SPACE HEATER SUPPLY

WELDING RECEPT. NO. WB-232 (S/S NO. 710.37)

WELDING RECEPT. CT-III

WELDING RECEPT. CWG HOUSE

HOOD RAIL HEATER

WELDING RECEPT. CWG HOUSE-2

BATTERY ROOM A/C

SPARE

SPARE

DC SYSTEM DC-713

CHARGER-I

CHARGER-II

110V DC

11 KV SVGR-I

11 KV SVGR-II

415 V SVGR-I

415V SVGR-II

SPARE

SPARE

LIGHTING DISTRIBUTION BOARD (LDB) LB-581

415 V, 50 Hz, TPN, 40 kA

STREET LIGHTING CKT

SPARE

LP-HOOL CWG HOUSE-2

COMPR HOUSE-2

LP-HOOL CT-III

BATTERY ROOM

SPARE

SPARE

LTG TRANSFO. 100 KVA 433/433V +ITH +-7.5% TAPS +-2.5% Dyn11

TR-545

Drawing Code
3 1 2 8 1 0 0 4 0 1 0

AS BUILT

LEGEND :

- EARTH SWITCH
- SWITCH
- ISOLATION CABINET WITH LBS
- MCB
- H.V CIRCUIT BREAKER
- ACB
- TRANSFORMER
- TRANSFORMER MARSHALLING BOX
- CONTACTOR
- DRAW OUT FEATURE
- FUSE
- POTENTIAL TRANSFORMER
- CURRENT TRANSFORMER
- CABLE GLAND TERMINATION
- SELECTOR SWITCH
- DIODE
- RECTIFIER
- BATTERY
- (A) AMMETER
- (V) VOLTMETER
- (KWH) KILOWATT HOUR METER
- (27) UNDER VOLTAGE RELAY
- (27N) RESIDUAL VOLTAGE CHECK RELAY
- (27M) UNDER VOLTAGE RELAY FOR MOTOR TRIPPING
- (T) TIME DELAY RELAY
- (86) LOCK OUT RELAY
- (50) INSTANTANEOUS OVERCURRENT RELAY
- (51) IDMTL OVERCURRENT RELAY
- (51N) IDMTL E/F RELAY
- (50N) INSTANTANEOUS E/F RELAY
- (51G) IDMTL BACK-UP EARTH FAULT RELAY
- (51V) VOLTAGE RESTAINT OVERCURRENT RELAY
- (46) NEGATIVE PHASE SEQUENCE RELAY
- (59) OVERVOLTAGE RELAY
- (25) CHECK SYNCHRONISATION RELAY
- (95) TRIP CIRCUIT SUPERVISION RELAY

REFERENCE DRAWING	NO

No.	DATE	REVISIONS	BY	CHKD	APPD	PROJ. ENGR
1	22/6/05	REVISED AND ISSUED FOR CONSTRUCTION				
0	18/1/01	ISSUED FOR ENGINEERING	NMS	NKT	RPG	

ENGINEERS INDIA LIMITED (A Govt. of India Undertaking)

NATIONAL ALUMINIUM COMPANY LIMITED
NALCO ALUMINIUM SMELTER EXPANSION PROJECT

SINGLE LINE DIAGRAM
COMPRESSOR HOUSE-2 (EXPN.)
SUB-STATION NO. 710.37

MICRO FILM		PROJ ENGR	MICRO FILM REF No.	SCALE	JOB NO.	UNIT	DEPT.	SECTN.	DWG. No.	REV.
REQUIRED	NOT REQ.			NTS	4 3 7 5	0 0	1 6	5 0	0 0 1 0	1

EIL-301 A0-1189×841 DISTRIBUTION CODE

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Annexure – A3

SPECIAL CONDITIONS OF CONTRACT (SCC)

1.0 **GENERAL**

1.1 Special Conditions of Contract shall be read in conjunction with the General Conditions of Contract. Scope of Work, Specification of work, Drawings and any other document forming part of this contract wherever the context so requires.

1.2 Notwithstanding the sub-divisions of the document into these separate sections and volumes, every part of each shall be deemed to be supplementary to and complementary to every other part and shall be read with and into the contract so far as it may be practicable to do so.

1.3 Where any portion of the Special Conditions of Contract is repugnant to or at variance with any provisions of the General Conditions of Contract, then unless a different intention appears, the provision of the Special Conditions of Contract shall be deemed to override the provision of the General Conditions of Contract only to the extent such repugnancies or variations in the Special Conditions of Contract as are not possible of being reconciled with the provision of General Conditions of Contract.

1.4 The materials, design and workmanship shall satisfy the applicable standards, specifications, contained herein and codes referred to. Where the Technical Specifications stipulate requirements in addition to those contained in the Standard Codes and Specifications, those additional requirements shall also be satisfied.

1.5 Wherever it is mentioned in the specifications that the Contract shall perform certain work or provide certain facilities, it is understood that the Contractor shall do so at his own cost and the Contract Price shall be deemed to have included cost of such performances and provisions, so mentioned.

1.6 The Engineer may order the Contractor to suspend any work, which in the opinion of the Engineer may be subjected to damage by the prevailing weather conditions.

1.7 Unless specifically mentioned otherwise in the contract, the bidder shall quote rates for the finalised items and shall provide for the complete cost towards power, fuel, tools, tackles, equipment, construction plant, temporary work, labour materials, levies, taxes, transport, layout, repairs, rectification, maintenance till handing over, supervision, colonies, shops, establishments, services, temporary roads, revenue expenses, contingencies, overheads, profits and all incidental items not specifically mentioned but reasonably implied and necessary to complete the work according to the contract.

1.8 The decision of the Engineer-in-charge shall be final and binding on the Contractor regarding clarification of items in the schedule with respect to other sections of the contract/specifications.

1.9 CESS UNDER RE&CS ACT: BOCW, if applicable, shall be deducted by NALCO from gross bill value of contractor’s invoices.

1.10 ROYALTY CLEARANCE: As per Mines and Minerals Act of Govt. of Orissa the contractor is required to pay royalty for various types of construction materials (minor minerals) used in the work. The royalty charges shall have to be deposited in the office of Tahsildar from whose jurisdiction the minerals have been lifted. The party has to

submit Mineral usage statement with all their RA Bills and Royalty Clearance certificate from above Authority along with RA Bills / Final Bills. Final bill will be processed for payment without payment of all statutory dues by the Contractor.

1.11 The Contractor at his own cost shall make provisions for temporary works, materials and plant, lighting in and around the work area along with all labour, stores and services required for their efficient working.

1.12 The Contractor shall ensure that all the vehicles carrying equipment, consumables, cement, reinforcement, structural steel, prefabricated structures and other construction materials are duly recorded with all relevant details with the CISF authorities posted at the plant entrance gate/ material gate or any other designated security gate at site. A copy of the same has to be submitted to Engineer-in-Charge.

2.0 **PRICE:**

2.1 The offer shall be made on an F.O.R. Destination / Free Delivery at Site basis, inclusive of all costs such as taxes,duties, levies, packing and forwarding, transportation to the project site, unloading and storage of materials, MCE insurance, erection and commissioning, inspection, and testing, in accordance with the scope of work defined in the tender documents except GST. GST shall be payable extra at actuals, upon submission of a valid GST invoice by the supplier.

2.2 Price negotiation, if required, may be held with the lowest tenderer only.

2.3 Free Issue material: **There shall be NO FREE ISSUE MATERIAL for this work.**

3.0 **PRICE FIRMNESS:**

3.1 All prices quoted must remain firm and fixed till complete execution of the contract except for statutory variation in taxes & duties during contractual completion period. However, Price Variation on both supply and service portion shall be applicable as per NIT terms and conditions of PVC Clause as detailed at 29 of SCC. Any increase in taxes and duties after expiry of the completion period will be to account.

4.0 **GOODS AND SERVICES TAX (GST):**

4.1 The bidder shall indicate the HSN code of material along with the GSTIN of the invoicing location.

4.2 The bidder will be under obligation for quoting/charging correct rate of tax as prescribed under the respective Tax Laws. Further the bidder shall avail and pass on benefits of all exemptions/concessions/benefits/waiver or any other benefits of similar nature or kind available under the Tax Laws. In no case, differential Tax Claims due to wrong classification of goods and/or services or understanding of law or rules or regulations or any other reasons of similar nature shall be entertained by NALCO.

4.3 To enable NALCO to avail ITC, the bidder/ contractor shall submit any and all certificates, documents and declarations as are required by NALCO to avail of the ITC with respect to GST reimbursed by NALCO on materials sold to NALCO.

4.4 The HSN Code under which the goods/service will fall should be clearly mentioned along with the Rate at the time of submission of invoice for releasing payment.

4.5 In case, NALCO is not able to avail Input Tax Credit due to any noncompliance/default/negligence of the contractor, the same shall be recovered from the pending bills/dues (including security deposit, BG etc.).

4.6 Contractor shall be responsible to indemnify NALCO for any loss, direct or implied, accrued to NALCO on account of contractor's failure to discharge his statutory liabilities like paying taxes on time, filling appropriate returns within the prescribed time etc.

5.0 **COMPLETION PERIOD:**

The total Completion period of the project in all respect as per Technical Specifications and Scope of supply and work of our NIT shall be **26 (Twenty-Six) months** from the effective date of contract.

6.0 **EFFECTIVE DATE OF CONTRACT:**

Effective date of contract shall be the date of unqualified acceptance of the purchase orders as well as service purchase orders i.e. all contractual obligations shall commence from effective date of order. Maximum time permitted for acceptance is 15 days from the date of receipt of PO/LOI through E-Mail by NALCO**.**

7.0 **PAYMENT TERMS:**

7.1 **For Supply:**

7.1.1 10% payment shall be made against submission of basic documents like single line diagram of MCC along with GA, process flow diagram etc. as per approved billing schedule and approved by NALCO and against submission of BG for equivalent amount valid till FOT delivery (BG to enter into force on the day the corresponding payment is received by the contractor).

7.1.2 70% on pro rata basis as per approved billing schedule after delivery on FOT site basis, against dispatch document (along with inspection release order certifying clearance of goods for shipment).

7.1.3 10% payment after successful completion of commissioning against due certification by Manager-In-Charge (MIC) of NALCO. In case, the commissioning is not completed within maximum 10 months from the FOT date due to reason not attributable to the contractor, then this payment shall be released within maximum 10 months from the FOT date (notwithstanding the certification by Manager in- charge of NALCO) against submission of BG for equivalent amount valid up to the end of warranty period. However, the BG will be released upon successful completion of commissioning and against due certification by Manager-in-charge of NALCO.

7.1.4 Balance 10% payment after successful completion of PG tests and final handing over to NALCO. In case, the PG tests are not completed within maximum 16 months from the FOT date due to reason not attributable to the contractor, then this payment shall be released within maximum 16 months from the FOT date (notwithstanding the certification by Manager-in-charge of NALCO) against submission of BG for equivalent amount valid up to the end of the warranty period. However, the BG will be released upon successful completion of PG tests and final handing over to NALCO and against due certification by Manager-in-charge of NALCO.

All payments to be made directly through Bank on receipt of Invoice and relevant documents.

7.2 **For Site Work portion (i.e., unloading, storage, handling, erection, testing, commissioning and PG tests, etc. including dismantling and disposition of existing unit)**

7.2.1 80% of the basic works value along with 100% applicable taxes and duties on pro-rata basis after completion of erection of equipment at site against submission of relevant bills as per approved billing schedule on certification of Manager-In-Charge or his/her authorized representative.

7.2.2 Balance 20% of basic works value (Excluding Taxes & duties) shall be made as follows:

7.2.2.1 10% lump-sum payment shall be made after commissioning of total system and against mechanical commissioning certificate duly certified by Manager-In-Charge or his/her authorized representative.

7.2.2.2 Balance 10% lump-sum payment shall be made after final handing over of the complete system including acceptance of PG test report and clearing all liabilities duly certified by Manager-In-Charge or his/her authorized representative

7.3 **GST Payment**

7.3.1 Payment of GST is subject to reflection of the contractor's invoice in GSTR 2A/Anx-2 [GST new return of NALCO].

7.4 **NOTE:**

7.4.1 If, PG Test could not be conducted within 06 months from commissioning, for reasons not attributable to vendor, last 10% payment will be released against submission of a Bank Guarantee of equal amount valid for 12 months initially and extendable thereafter. This however, will not relieve the contractor from his obligations towards the PG Tests and any other contractual obligations.

7.4.2 All Payment can be made through e-payment mode through SBI as well as NEFT / RTGS mode through designated enabled branches. Duly filled Bank Mandate form in duplicate should be furnished with due authentication from bidder's Banker.

7.4.3 All payments are subject to submission of acceptable Contract-cum Performance Bank Guarantee (CPBG))/ Terms of CPBG mentioned elsewhere in the document.

7.4.4 Within 01 month of receipt of LOI/LOA/PO, the contractor shall submit a billing schedule/billing break up for approval of NALCO, wherever required.

7.5 **Documents to be enclosed with the Running Account (RA Bill) s:**

7.5.1 **For 80% payment for both Supply and Works portions:**

a. Tax Invoice
b. RA Bill formats available with Manager-In-Charge
c. Guarantee/Warranty Certificate (as applicable)
d. Material reconciliation certificate on Works Bill (In case of Free issue material, if any)
e. HRD Clearance in Works Bill
f. Any other document required by Manager-In-Charge or as per directive of statutory authority.

7.5.2 **Final Bill** (i.e. the last 10% of supply and works portion) shall be accompanied by :

a. Invoice
b. Completion certificate
c. Final Material reconciliation certificate on Works Bill (In case of Free issue material, if any)

d. No Claim certificate in NALCO's format
e. No dues Certificate from O&M department where project is done
f. PG Test report
g. Handing Over/Taking Over certificate
h. HRD Clearance
i. Royalty clearance certificate (wherever applicable)

Note :

(i) The final bill shall be submitted by the contractor within three months of final handing over.

8.0 **Price Reduction Schedule (PRS) For Delay in Completion of Project:**

Time is the essence of the contract and the project should be completed within the completion period mentioned in the NIT. The PRS for delay in completion of the project attributable to the contractor, shall be levied @1% of the total basic contract value per week of delay in completion or part thereof subject to maximum of 10% of total basic contract value.

9.0 **RISK & COST PURCHASE:**

9.1 NALCO also reserves the right to procure the material/equipment/services from alternate sources at the Risk & Cost of the contractor, giving 15 days' notice, if the contractor fails to execute the contract as per the terms and conditions of the Contract. This will be without prejudice to the rights of NALCO for any other action including termination.

10.0 **PRE-DISPATCH INSPECTION AND TESTING PROCEDURE:**

10.1 Pre-dispatch inspection (PDI) and testing shall be done in presence of NALCO's / Consultant's representative(s) at manufacturer's / supplier's works place prior to dispatch with 15 days of prior intimation by the supplier / Contractor. However, final inspection & testing (if any) shall be carried out at NALCO, Smelter site and the result shall be binding on the contractor on whom order shall be placed**.**

11.0 **GUARANTEE/WARRANTY**:

11.1 All the equipment and materials supplied by the Contractor shall be guaranteed against all defects in Design, Raw materials, manufacturing, Assembly, Workmanship and Performance etc. for a period of 12 (twelve) Months from the date of satisfactory completion of commissioning including the performance guarantee tests or 24 (twenty-four) Months from the date of completion of erection (Mechanical Completion), whichever is earlier.

12.0 **PERFORMANCE SECURITY / CONTRACT CUM PERFORMANCE BANK GUARANTEE (CPBG):**

12.1 The Contractor shall furnish a sum of 10% of the contract price as performance security or Contract-cum-Performance bank guarantee (**CPBG**) of 10% of Total Basic Contract value including amendment if any, in Nalco's prescribed format (**Annexure-XI**) from any Bank approved by Nalco (**Annexure-XIII**) towards guarantee/warranty of all the Equipments, materials and components against trouble free operations up to guarantee period with claim period of three months. i.e. Contract-cum-Performance

bank guarantee (**CPBG**) shall remain valid up to 03(three) months beyond the guarantee period.

12.2 The validity of CPBG initially shall be 41 (Forty-One) months considering Project completion period (26 months), Guarantee/Warranty period (12 months) plus claim period (3 Months). However, the Contractor shall be asked to extend the validity of CPBG based on the actual project execution (if required) at a later date.

12.3 **The CPBG shall be submitted within 21 days from the date of Contract/issue of LOI**. If Contractor fails to submit CPBG as mentioned above after placement of order, the equivalent amount along with a simple interest @10% per annum as penalty, applicable from the date of issue of work order till the date of submission of CPBG or submission of 1st RA bill shall be recovered from their bill(s) Subject to any deduction which Nalco is authorized to make, CPBG shall be released after satisfactory completion of guarantee/warranty period. On the breach of the contract by the contractor, CPBG shall be forfeited/encashed whether or not the Company has suffered a loss on this account and purchase order shall be rescinded. Forfeiture/encashment of CPBG does not prejudice Nalco's rights to make Risk and Cost purchases and recover damages on account of such risk and cost purchases.

12.4 The clause 19 - Security Deposit of GENERAL CONDITIONS OF CONTRACT is Not Applicable for this NIT. Also, Security Deposit wherever mentioned in GENERAL CONDITIONS OF CONTRACT shall be read as Contract-cum-Performance Bank guarantee (**CPBG**).

13.0 **FINAL HANDING OVER:**

The system shall be finally handed over to NALCO by the contractor after successful erection, commissioning, completion of PG test, handing over of As-Built drawings & documents, all type of spares, imparting Training at site to Nalco personnel as per terms and conditions of the contract.

14.0 **TERMINATION OF CONTRACT**: NALCO shall have the right to terminate the contract by giving 60 days' notice without assigning any reasons thereof. However, in the event of any breach of terms of the contract, NALCO will have right to terminate the contract by written notice to the Contractor.

15.0 **INSURANCE**: Marine cum Erection (MCE) Insurance will be arranged and borne by the contractor. Marine cum Erection (MCE) insurance is in the scope of the Supplier/contractor i.e. all the supplied equipment and materials along with the accessories shall be completely insured by the contractor till the completion of erection, commissioning at NALCO site and handing over of complete system to NALCO. **The quoted price must include the aforesaid MCE insurance charges**.

16.0 **PREFERENCE TO MAKE IN INDIA**

16.1 Preference to Make In India products (For bids < 200 Crore): Preference shall be given to Class 1 local supplier as defined in public procurement (Preference to Make in India), Order 2017 as amended from time to time and its subsequent Orders/Notifications issued by concerned Nodal Ministry for specific Goods/Products. The minimum local content to qualify as a Class- I local supplier is 50% and for class-II local supplier the minimum local content is 20%. If the bidder wants to avail the

Purchase preference, the bidder must upload a certificate (in case dealer from the OEM) regarding the percentage of the local content and the details of locations at which the local value addition is made in the format given in the Annexure XVII of the tender document along with their bid, failing which no purchase preference shall be granted. In case the bid value is more than Rs. 10.0 Crore, the declaration relating to percentage of local content shall be certified by the statutory auditor or cost auditor, if the OEM is a company and by a practicing cost accountant or a chartered accountant for OEMs other than companies as per the Public Procurement (preference to Make-in -India) order no.P-45021/2/2017-PP(BE-II) dated 16.09.2020 & subsequent amendments. Only Class-I and Class-II Local suppliers as per MII order dated 16.09.2020 will be eligible to bid. Non - Local suppliers **as per MII order dated 16.09.2020 are not eligible to participate.**

17.0 **ANTI –PROFITEERING CLAUSE (SEC 171 OF CGST ACT) (APPLICABLE FOR INDIAN BIDDERS):**

17.1 In any new Tax/Taxes is introduced on sale of goods/services, either in lieu of existing tax/ taxes or as separate tax/taxes, then the overall incidence of tax/taxes on the Vendor on account of its inputs and outputs wherever less than the incidence of existing taxes, then the vendor shall pass on to Owner, the benefits thereof by way of commensurate reduction in the basic price w.r.t Input tax benefits and reduction in Tax chargeable to 'Nalco' w.r.t Output Tax benefits in connection with goods and/or services provided.

17.2 If on the other hand, the incidence of tax/taxes is in excess of the incidence of existing tax/taxes, the Owner on submission of satisfactory proof, shall reimburse the Vendor the additional incidence of tax provided they are within the contractual completion date.

17.3 The vendor has to provide a declaration (as per Annexure XIX) along with the tender that they will abide by the requirements under Cl 171 of CGST Act,2017

18.0 **FORCE MAJEURE**: Any delay or failure to perform the contract by either party caused by acts of God or acts of Government or any direction or restriction imposed by Government of India which may affect the contract or the public enemy or contingencies like, riots etc. shall not be considered as default for the performance of the contract or give rise to any claim for damage. Within 7 days of occurrence and cessation of the event(s), the other party shall be notified. Only those events of force majeure which impedes the execution of the contract at the time of its occurrence shall be taken into cognizance.

19.0 **ARBITRATION: GCC Clause 87 Modified as detailed at ANNEXURE-A of SCC.**

20.0 **GUIDELINES FOR ELIGIBILITY OF A "*BIDDER HAVING BENEFICIARY RELATIONSHIP FROM A COUNTRY WHICH SHARES A LAND BORDER WITH INDIA*":**

All the clauses of Order No. F.No. 6/18/2019-PPD dated 23.07.2020 & OM Dtd.08.02.2021 issued by Ministry of finance (dept of Expenditure) shall be applicable against the tender. The same is available at website https://doe.gov.in/procurement-policy-divisions)

All the bidders are required to submit declaration (Ref Annexure: XVIII) as asked in the above order No. F.No. 6/18/2019-PPD dated 23.07.2020 & OM Dtd. 08.02.2021 & subsequent orders.

If the above declaration given by a bidder whose bid is accepted, is found to be false, this would be a ground for immediate rejection of bid/termination of contract and further legal action in accordance with law.

21.0 **INCOME TAX CLAUSES:**

21.1 **For supply Contracts / Purchase Orders / Supply portion of LSTK:**

NALCO, being Buyer (under Section 194Q inserted in the Income Tax Act, 1961 vide Finance Act 2021) having total sales. gross receipts, or turnover from business above Rupees Ten Crores during the last Financial Year, will deduct TDS under Section 194Q, w.e.f. 01.07.2021, at the prescribes rate of 0.1% on the purchase value of any goods, aggregate of which is exceeding the threshold limit of Rs.50 Lakhs in a Financial year.

Accordingly, Vendors/Sellers are not to collect tax at source under section 206C (1H) of the Act w.e.f. 01.07.2021, in case provisions of section are applicable to them.

The above is as per the current status and is subject to modification(s) based on amendments/notifications under Income Tax Act, 1961, from time to time.

21.2 **For Other Contracts / Orders:**

Income Tax TDS, as applicable at the prevailing rate on the gross amount billed shall be deducted from the contractor's bills.

21.3 **UNDER INCOME TAX / BILLING CLAUSES:**

Vendor / Party categorised/designated as "specified person" under Section 206AB of Income Tax Act, 1961 shall be liable for TDS at higher rate as provided under the said section, by NALCO. So, Vendors/Contractors are advised to submit self-certified copies of Income Tax return (ITR) for each of the Two Previous Years for which due date for filing of ITR has expired, along with the Invoice/Bill so as to facilitate NALCO, verify the applicability of Section 206AB.

22.0 **CRIMINAL PROCEEDINGS/ CASES**:

22.1 The bidder or its Proprietor/ Partner(s)/ Director(s) of the firm should not have been convicted by a court of Law for an offence involving moral turpitude in relation to business dealings during the past seven (7) years. The bidder shall give an affidavit to this effect. The affidavit must be affirmed before the competent judicial authority or attested by Notary Public. Bidders should upload the scanned copy of the declaration with their On - line Part - I - Bid. The original copy of the declaration should be submitted in **cover - 1 of the hard copy offer**.

22.2 The bidder has to furnish a declaration to the effect that they have not been banned or de-listed by any Government or Quasi Government agencies or PSUs of India. If they have been banned or de-listed by any Government or Quasi Government agencies or PSUs, then this fact must be clearly stated. The declaration should be in the bidder's official letterhead duly signed by the authorised signatory with official seal. Bidders should upload the scanned copy of the declaration with their On - line Part - I - Bid.

The original copy of the declaration should be submitted in **cover - 1 of the hard copy offer**.

22.3 Bidder should not be under liquidation, court receivership or similar proceeding. Bidder has to submit **certificate/ Undertaking** in this respect in his official letterhead duly signed by the authorised signatory with official seal. Bidders should upload the scanned copy of the declaration with their On- line Part - I Bid. The original copy of the declaration should be submitted in **cover - 1 of the hard copy offer**.

23.0 **TAKING OVER:** Upon successful completion of all the tests to be performed at site on equipment and systems furnished and erected by the Contractor, the Engineer shall Issue to the Contractor a taking over certificate as a proof of the final acceptance of the equipment. Such certificate shall not relieve the Contractor of any of his obligations which otherwise survive by terms and conditions of the contract after issuance of such certificate.

24.0 **REJECTION OF DEFECTIVE PLANT:** If the completed plant or any portion thereof, it is taken over under the clause 'Taking Over', be found defective or fails to fulfill the requirements of the contract, the Engineer shall give the Contractor notice setting forth particulars of such defects or failure, and the Contractor shall forth wile make the defective plant good or to make it comply with the requirements of the contract. Should he fail to do so within a reasonable time, the Purchaser may reject and, replace at the cost of the Contractor the whole or any portion of the plant as the case may be, which is defective or fails to fulfill the requirements of the Contract. Such replacement shall be carried out by the Purchaser within a reasonable time and at a reasonable price, and where reasonably possible to the same specification and under comparative condition. The Contractor's full and extreme liability under the clause shall be satisfied by the payment to the purchaser of the original contract price including charges of erection and/or supervision of erection plus the difference if any between the replacement price of the equipment including charges for erection and /or supervision of erection and the original contract price including charges for erection and / or supervision of erection in respect of such defective plant.

In the event of such rejection, NALCO shall have the right to operate any and all equipment as soon as and as long as it is in operating condition, whether or not, such equipment has been accepted as complete and satisfactory, to enable him to obtain necessary replacement, except that this shall not be construed to permit operation of any equipment which may become damaged by such operation before any required alternations or repairs and/or replacement have been made. All repairs or alternations or replacement required of the Contractor shall be made by the Contractor at such times as directed and in such manner as will cause the minimum interruption in the use of the equipment by the Purchaser. Should the Purchaser not so replace the rejected plant within a reasonable time, the Contractor's full and extreme liability under his clause will be satisfied by the repayment of all money paid by the Purchaser to him in respect of such plant.

Nothing in this clause shall be deemed to deprive the Purchaser or affect any rights under the contract which he may otherwise have in respect of such defects or deficiencies or in any way relieve the Contractor of his obligations under the contract.

25.0 **LIMITATION OF LIABILITIES:** The final payment by the Owner in pursuance of this Contract terms shall not mean release of the Contractor from all his liabilities under the Contract. The Contractor will be liable and committed under this contract to fulfill all his liabilities and responsibilities, till such time Performance Bank **Guarantee is released by the** Owner. Notwithstanding the above, the maximum liability shall be 100% of contract value and the vendor will not be liable for any indirect consequential damages/losses.

26.0 **DEDUCTION FROM CONTRACT PRICE**

26.1 All costs, damages or expenses which the Purchaser may have paid, for which under the contract Contractor is liable, may be deducted by the Purchaser from any money due or be coming due by him to the Contractor under the contract, or may be recovered by action of law or otherwise from the Contractor. Further all legal and statutory deductions will be made and the Contractor is not entitled to any reimbursement or claim what-so-ever except only a tax deduction certificate. In the event of recovery to the necessary extent becoming impossible owing to insufficiency of the Bank Guarantee (BG) and withheld amounts, the balance due to the purchaser, may be recovered in any way the Purchaser may deem fit.

27.0 **SAFETY**: The contractor shall comply with all the statutory safety provisions of NALCO and get safety clearance from the Safety Department of NALCO, CPP for all the necessary jobs and also to obtain any other statutory & environment clearances for successful completion of the contract. The contractor shall take all necessary safety measures, at their own cost, to avoid any harm or injury to their workers & staff from the equipments, facilities, etc.

28.0 **WORKMEN COMPENSATION, PERSONAL ACCIDENTAL INSURANCE, LABOUR LAWS**: All persons engaged by the contractor at NALCO site shall be adequately insured by the contractor as per the statutory norms, statutory / contingency insurance coverage i.e., third party liability, ESI and under the workmen compensation insurance policy / personal accidental insurance policy, etc. The contractor shall comply with all applicable labor laws including payment of wages, etc.

29.0 **PRICE VARIATION COMPENSATION (PVC): Applicable as Detailed at ANNEXURE-B of SCC with following .**

% of Supply Component: 83%

% of Service Component: 17%

30.0 **PAYMENT AND RECOVERY OF MOBILISATION ADVANCE**

30.1 Interest bearing recoverable Mobilisation Advance shall be paid to the Contractor (if requested by him) up to 10% of Contract Value after the following conditions have been fulfilled:

30.1.1 The formal contract has been signed between the owner and the contractor.

30.1.2 Submission of Contract cum Performance Bank Guarantee as per NIT Terms & Conditions.

30.2 Mobilisation Advance shall not be paid in less than two equal instalments. Second and subsequent instalments shall be paid after submission of utilization certificate by the contractor for the previous instalments paid for execution of this contract only and satisfactory site mobilisation by the contractor duly certified by the Engineer/Manager-In-Charge. If it is found that, the said advance has been utilized by the contractor in whole or part for any other purpose; the owner may at its discretion forthwith recall the entire advance and without prejudice to any other right or remedy available to the owner, recover the same by recourse to the Bank Guarantee(s).

30.3 The Contractor shall submit Bank Guarantee(s) for an amount equivalent to 110% of the advance amount valid up to the completion period plus one-month from any bank as per list provided in the Tender/NIT document and in the format attached in the NIT/Tender document.

30.4 The Contractor shall at the request of the owner suitably extend the validity of the Bank Guarantee(s) for such period as may be required.

30.5 The contractor may submit multiple BGs for facilitating release of BG amount equivalent to advance realized from RA bills.

30.6 The Rate of Interest shall be variable during tenure of contract. The Rate of Interest applicable on balance amount of Mobilisation Advance, applicable for the financial year shall be fixed to MCLR (1-year-tenor) of SBI declared in the month of April of that financial year plus 1%.

30.7 Recovery of Mobilisation Advance paid shall start when 15% of the work is executed or 1st Running Account (RA) bill whichever is later.

30.8 The Mobilisation Advance paid shall be recovered as stipulated above from each RA bill @ 12.5% of gross amount of RA bill in such a manner that the total advance is recovered when 80% of the contract value gets paid.

30.9 A schedule of mobilisation shall be drawn after due discussion with vendor. In the event of undue delay in mobilisation, the EIC may initiate necessary action for recovery through encashment of BG.

31.0 **SPECIAL NOTES:**

31.1 In Techno-commercial bids, the bidders should furnish a list of its Partners/Directors and a declaration that such Partners/Directors have no interest in any other bidders in respect of the same tender.

31.2 No part of the Contract nor any share or interest therein shall, in any manner or degree, be transferred, assigned or sub-let by the Contractor directly or indirectly to any person, firm or corporation whatsoever without the consent of NALCO in writing.

31.3 Drawings and samples if forwarded shall become property of the NALCO.

31.4 Complete specifications with relevant Indian/International Standards, Manufacturer's name/brand name and country of origin with catalogues and drawings if any should be sent with the offer. Offer without adequate technical specifications/information shall liable to be rejected.

31.5 NALCO reserves the right to accept any tender or to reject any or all tenders/ extend the due date for submission of offers without assigning any reasons thereof.

31.6 The tenderer has to comply with the Environmental, Social Accountability and Energy policy of NALCO.

31.7 Bidders are requested to submit their bid complete in all respect as required under pre-qualification criteria and other NIT conditions. Bid shall be evaluated based on documents submitted by bidder. During evaluation of bid, NALCO may, at its discretion, ask the bidder for clarifications on the bid. The clarifications shall be sought by portal / E-mail and the bidder has to respond/comply within the specified date mentioned in the communication. In case of noncompliance, his bid will liable to be rejected and will not be considered further. No change in prices or substance of the bid shall be sought, offered or permitted. No post bid clarification at the initiative of the bidder shall be entertained. So far as the submission of documents is concerned with regard to prequalification criteria, after submission of the bid, only related shortfall documents may be asked for and considered. For example, if the bidder has submitted a supply/ works order/contract document without its completion/performance certificate, the certificates can be asked for and considered. However, no new supply /works order/contract document shall be considered to qualify the bidder.

ANNEXURE-A of SCC

1.0 Settlement of Disputes

1.1 AMICABLE SETTLEMENT: -

If any commercial dispute, other than those where the decision of NALCO/EIC/MIC is final and binding as per the contractual terms, whatsoever arises between NALCO and the Contractor/Vendor in connection with or arising out of the Service Contract /Work Order/Purchase Order, as the case may be, including without prejudice to the generality of the foregoing, any question regarding its existence, interpretation, validity or termination, or the execution of the Contract, whether during the progress of the Contract or after its completion and whether before or after the termination, abandonment or breach of the Contract, the parties shall resolve such dispute or difference by amicable settlement. If the parties fail to resolve such dispute or difference by amicable settlement, then the dispute may be settled through Mediation by High Level Committee / Arbitration / other remedies available under the applicable laws.

1.2 Resolution of Dispute by Mediation through High Level Committee (HLC): -

If the parties fail to resolve a dispute or difference by amicable settlement, such dispute or difference, if the parties agree, may be referred to Mediation for settlement and the same shall be guided by the provisions of The Mediation Act, 2023 or any other applicable law for the time being in force & amendment thereof.

1.2.1 Invitation for Mediation: -

(i) A party shall notify the other party in writing about the dispute or difference it wishes to refer for Mediation within a period of 30 days from the date of failure to resolve the same through amicable settlement. Such notice for Mediation shall contain sufficient information relating to the dispute and the precise claim (monetary and/or declaratory) to enable the other party to be fully informed as to the nature of the dispute, amount of the monetary claim, if any, and apparent cause of action.

(ii) Upon the receipt of the notice for Mediation from a party, the other party shall intimate its stand and counter claim, if any, within a period of 30 days from the date receipt of such notice and both the claim and counter claim, if any, will be referred for Mediation.

(iii) The parties shall file their claim and counterclaim in the following format;

a. Chronology of the dispute
b. Brief of the contract
c. Brief history of the dispute
d. Issues

Sl. No.	Description of Claims / Counter claims	Claim Amount in INR	Relevant Contract Clause

e. Details of Claim(s) / Counter Claim(s)
f. Basis / Ground of claim(s) / counter claim(s) along with relevant clause of contract.

Statement of claims shall be restricted to maximum limit of 20 pages.

(iv) If no reply/response is issued within 30 days of the date of receipt of notice to refer the dispute or difference for Meditation, the Mediation shall be treated as stands failed.

1.2.2 Mediation: -

(i) Subject to the provisions of The Mediation Act, 2023 or any other applicable law, where notice for Mediation has been issued and responded to under Clause 1 .2. 1 hereinabove, the dispute or difference will be referred to a High-Level Committee (HLC) to be constituted by CMD, NALCO, for settlement through Mediation. The constitution of the HCL by the CMD, NALCO will be as per the guidelines detailed in clauses 1.2.2 (ii) to 1.2.2 (iv).

(ii) HLC will be a committee comprising of three members, who are eligible as per the clause 1.2.2 (iii). However, there will be single member HLC for disputes involving claim and counter claim (if any) up to INR. 1 crore. CMD will have authority to reconstitute an HLC filling any vacancy. The party invoking mediation shall propose names of mediators who are eligible as per clause 1.2.2 (iii) hereinbelow, for consideration by the CMD, NALCO. The number of names proposed should be twice the number of mediators in the HLC which will be formed.

(iii) The persons eligible for consideration to be members of the HLC shall be either Retired High Court Judges, or, Retired Civil Servants of Govt. of India not below the rank of Additional Secretary, or, Retired Chairman / Chairman Cum Managing Directors / Managing Directors / Directors of any Maharatna / Navratna CPSEs in India other than NALCO Ltd., who is/are registered as mediator with the Mediation Council of India, or is/are empanelled as Arbitrator with the Delhi International Arbitration Centre / Orissa High Court Arbitration Centre / IIAC / Indian Council of Arbitration.

(iv) The persons selected as a mediator / member of the HLC shall disclose in writing to the parties regarding any circumstance or potential circumstance, personal, professional, financial, or otherwise, that may constitute any conflict of interest or that is likely to give rise to justifiable doubts as to his/her independence or impartiality as a mediator. The said disclosure is required to be given by the mediators prior to the conduct of mediation. Further, during the mediation, the mediator/ member of the HLC shall, without delay, disclose to the parties in writing any conflict of interest, that has newly arisen or has come to his/her knowledge that is likely to give rise to justifiable doubts as to his independence or impartiality as a mediator/ member of the HLC.

(v) Upon disclosure under 1.2.2(iv), if either party desires to replace any member of the HLC or in the event of death/incapacity/withdrawal by any of the mediator from the HLC, then, the HLC will be reconstituted following the process as given above.

1.2.3 <u>Proceedings before HLC</u>: -

(i) On constitution of the HLC, along with the intimation regarding the constitution of the HLC, its member/s will be furnished with the information relating to the dispute and the precise claim (monetary and/or declaratory) as well as stand and counter claim of the respective parties. The HLC will convene its meeting at the earliest, but not later than 30 days of its constitution. The HLC shall be provided with all necessary inputs, clarifications etc. by both the parties. Thereafter, the HLC shall assist the parties in an independent, neutral and impartial manner in their attempt to reach an amicable settlement of their dispute. The HLC shall at all times be guided by the principles of natural justice, objectivity and fairness and protect the voluntariness, confidentiality and self-determination of the parties, and maintain the standards for professional and ethical conduct as may be specified. The HLC shall be free to decide the process and procedure to be adopted for mediation and the same shall be subject to due consent of both the parties.

(ii) In case of 3 members HLC, 2 members will constitute a valid quorum and the meeting can take place to proceed in the matter after seeking consent from the member who is not present.

(iii) The HLC shall attempt to facilitate voluntary resolution of the dispute by the parties and communicate the view of each party to the other to the extent agreed to by them,

assist them in identifying issues, advancing better understanding, clarifying priorities, exploring areas of settlement and generating options in an attempt to resolve the dispute expeditiously, emphasising that it is the responsibility of the parties to take decision regarding their claims. The HLC shall only facilitate the parties in arriving at a decision to resolve a dispute and shall not impose any settlement nor give any assurance that the mediation may result in a settlement.

(iv) The parties shall be represented by their respective authorized representatives, who will produce proper Letters of Authority before the HLC. No party shall be allowed to bring any advocate or outside consultant/advisor/agent. However, subject to the discretion of the parties, the ex-employees of parties may represent their respective organizations if they were the Manager-in-Charge/Engineer-in-Charge/Dealing Officer of the contract at the time of dispute/cause of action. Parties shall not claim any interest on claims/counter-claims from the date of notice invoking Mediation till execution of settlement agreement, if so arrived. In case, parties are unable to reach a settlement, no interest shall be claimed by either party for the period from the date of notice invoking Mediation till the date HLC submits the non-settlement report and 30 days thereafter in any further proceeding.

(v) HLC will conclude its proceedings in maximum 10 meetings, and give its recommendations within 120 days from the date fixed for the first appearance before the HLC. If required, the parties may agree to extend the period of mediation for a further maximum period of 60 days. HLC will submit draft settlement agreement containing its recommendations to both the parties on possible terms of settlement. If the parties accept the draft settlement agreement of the HLC, then the settlement agreement will be executed by both parties with all HLC members as witnesses. However, in case parties do not accept, then the HLC will submit the non-settlement report.

(vi) If, the draft Settlement Agreement shared by the HLC is acceptable to both the parties, the same will be signed within 15 days of acceptance and the same shall be authenticated by all the HLC members as witnesses. The acceptance/rejection is to be communicated by each party to other and to the HLC within 45 days of the receipt of the draft settlement agreement from HLC. After signing, the settlement agreement same shall be final and binding to both the parties and thereafter there shall be absolute bar for initiating arbitration. In case of non-agreement/non-acceptance of the draft settlement agreement, the HLC shall submit a non-settlement report to both the parties and the mediation proceedings shall stand terminated from the date of receipt of the said non-settlement report.

(vii) The venue of the HLC meeting shall be at Bhubaneswar. All the expenditure incurred towards arrangement for the venue of the mediation proceedings and fee & expenses of the HLC members and expenses incurred towards venue shall be shared by the parties equally.

1.2.4 **<u>Fees & Facilities to the Members of the HLC</u>: -** The cost of Mediation proceedings including expenses towards arranging of venue of the mediation proceedings and fee & expenses of the HLC members shall be as provided herein below:

Sl. No.	Fees/ Facility	Entitlement

1	Fees	INR 20,000 per meeting to each Mediator. In addition, each Mediator to be paid INR 10,000 for attending meeting to authenticate the settlement agreement. However maximum fee shall be INR 2,10,000 per case per Mediator.
2	Secretarial expenses	INR 10,000 lump sum.
3	Transportation in the city of the meeting	Car as per entitlement or INR 2,000 per day
4	Expenses towards Venue for meeting	Venue will be NALCO conference rooms at Bhubaneswar with fooding expenses as per actuals.
	Facilities to be provided to the out stationed member	
5	Travel from the city of residence to the city of meeting.	Economy class air tickets / first class AC train tickets/ Luxury car/ reimbursement of actual fare.
6	Transport to and from airport/railway station in the city of residence	Car as per entitlement or INR 3,000
7	Stay for out stationed members	In NALCO Guest House or in hotel to be arranged by one of the parties.

Aforesaid fees is subject to government guidelines on austerity measures, if any. All the expenditure incurred in the HLC proceedings shall be shared by the parties in equal proportions. The Parties shall maintain the account of expenditure and present to the other for the purpose of sharing on conclusion of the HLC proceedings.

1.2.5 The parties shall keep confidential all matters relating to the Mediation proceedings. Parties shall not refer or rely upon them and/or not produce them as reference / material papers / evidence in arbitration or court or any other proceedings.

1.3 <u>Arbitration</u>: -

1.3.1 If the process of mediation by HLC fails to arrive at a settlement between the parties any of the party may, within Thirty (30) days of such failure, give notice to the other party of its intention to refer the dispute/difference for arbitration indicating the precise claim amount and/or relief sought, as per the conditions as stated hereinafter provided, as to the matter in dispute/difference, and no arbitration in respect of the matter may be commenced unless such notice is given. The mechanism of settling the disputes through arbitration can be resorted to only in cases where the disputed amount (i.e. total amount of Claims including claims of interest, cost etc.) does not exceed ₹10 crores and is not below ₹50.00 Lacs including all types of interest, cost etc.. In case the disputed amount exceeds Rs. 10 Crores or less than ₹50.00 Lacs, the parties shall be within their rights to take recourse to remedies as may be available to them under the applicable laws other than arbitration. Since, mediation is a pre-condition for arbitration, any claim/dispute which has not been referred for mediation, shall not be referred for arbitration.

The parties at the time of invocation of arbitration shall submit all the details of the claims and the counter-claims including the Heads/Sub-heads of the Claims/Counter-

Claims and the documents relied upon by the parties for their respective claims and counter-claims. The parties shall not file any documents/details of the claims and counter-claims thereafter.

(The party invoking arbitration, at the time of invocation of arbitration, along with the notice, shall submit all the details of its claims including the Heads/Sub-heads of the claims and the documents relied upon by it for its claims. On receipt of notice invoking arbitration as well as the details of the claims and the documents relied upon by the claimant for its claims, within 30 days of the receipt, the other party shall give its response to the said notice, and within 60 days shall submit its counter-claims including the Heads/Sub-heads of the counter-claims and the documents relied upon by it for its counter-claims. The parties shall not file any details of the claims and counter-claims and/or documents etc. thereafter.)

The parties hereby agree that the claims/counter-claims raised by them at the time as mentioned above shall be final and binding and no further change shall be allowed in the same at any stage during arbitration under any circumstances whatsoever. Where the dispute/claim is for the payment of money, no interest shall be payable on whole or any part of the money for any period between the date on which cause of action arose and the date on which the award is made.

1.3.2 Any dispute in respect of which, a notice of intention to commence arbitration has been given in accordance with Clause 1.3.1, shall be finally settled by arbitration.

1.3.3 Any dispute referred by a party to arbitration shall be adjudicated by a Sole Arbitrator appointed by CMD, NALCO in the following manner: -

a) On receipt of a notice of intention to commence arbitration given in accordance with Clause 1.3.1, CMD, NALCO will send, within 30 days of receipt of the notice, to the party (other than NALCO) names of three persons from the panel of arbitrators of Orissa High Court Arbitration Centre and/or Delhi International Arbitration Centre and/or Indian Council of Arbitration and/or IIAC, for the said party to choose any one of them to be the Sole Arbitrator.

b) The party other than NALCO on receipt of the names as mentioned at (b) above, shall select any one of the person names to be appointed as a Sole Arbitrator and communicate his name to CMD, NALCO within thirty days of receipt of the names along with written consent for agreeing to waive the applicability of Section 12 (5) of the Arbitration and Conciliation Act, 1996, conveying its agreement for appointment of Sole Arbitrator by CMD NALCO as provided under this arbitration clause.

c) On receipt of communication as provided above, CMD, NALCO shall there upon appoint the said person as the sole Arbitrator within 30 days of receipt of the communications as mentioned at (b) above.

d) If none of the names communicated by CMD, NALCO are acceptable to the party (other than NALCO) or the said party fails to communicate such selection as provided at (b) above within the period specified, any of the parties may approach Hon'ble High Court of Orissa at Cuttack for appointment of Sole Arbitrator under Section 11 (6) of the Arbitration and Conciliation Act, 1996.

e) If the Arbitrator so appointed dies, resigns, becomes incapacitated or withdraws for any reason from the proceedings, it shall be lawful for CMD, NALCO to appoint another person in his place in the same manner as mentioned above. The person so appointed

as Sole Arbitrator shall proceed with the reference from the stage where his predecessor had left.

f) The seat and venue of arbitration shall be at Bhubaneswar. However, if the situation so warrants venue of arbitration may be at as and where required basis, and may be held at the place where the site of work is situated.

g) The fees, expenses, if any, of the Arbitrator, expenses towards venue of arbitration shall be equally shared by the parties. The fee of the Sole Arbitrator shall be as under:

h) The Arbitrators shall be paid fees as per the Fees prescribed in the Fourth Schedule of the Arbitration & Conciliation Act, 1996 and amendments, if any made thereof.

i) If after commencement of the Arbitration proceedings, the parties agree to settle the dispute mutually or refer the dispute to Conciliation, the arbitrator shall put the proceedings in abeyance until such period as requested by the parties. Where the proceedings are put in abeyance or terminated on account of mutual settlement of dispute by the parties, the fees payable to the arbitrator shall be determined as under:

a) 40% of the fees if the Pleadings are complete

b) 60% of the fees if the Hearing has commenced

c) 80% of the fees if the Hearing is concluded but the Award is yet to be passed.

j) Each party shall pay its share of arbitrator's fees in stages as under:

a) 40 % of the fees on Completion of Pleadings

b) 40% of the fees on conclusion of the Final Hearing

c) 20% at the time when arbitrator notifies the date of final award

k) The Claimant shall be responsible for making all necessary arrangements for the travel / stay of the Arbitrator including venue of arbitration, hearings. The parties shall share the expenses for the same equally.

l) The arbitration shall be conducted in the English language. Arbitration proceedings can also be conducted online, as per the discretion of the Arbitral Tribunal.

m) The Arbitrator shall give reasoned and speaking award and it shall be final and binding on the parties and any future interest as awarded by the Arbitrator shall not be more than 5% per annum simple interest.

n) Subject to the aforesaid conditions, provisions of the Arbitration and Conciliation Act, 1996 as amended by the Arbitration and Conciliation (Amendment) Act, 2015 and any statutory modification or re-enactment thereof and the rules made there under, and for the time being in force shall apply to the arbitration proceeding under this clause.

1.3.4 Notwithstanding the above, in the event of any dispute or difference relating to the interpretation and application of the provisions of commercial contract(s) between NALCO and any other Central Public Sector Enterprises (CPSEs) / Port Trusts and also between NALCO and Government Departments / Organizations or University under the Central Government (excluding disputes relating to Railways, Income Tax, Customs & Excise Departments), NALCO and State Governments/ State PSUs / Public authority / Organizations or University under any State Government, such dispute or difference shall be taken up by either party for its resolution through AMRCD as mentioned in DPE Office Memorandum No.05/0003/2019-FTS-10937 dated 14 th December, 2022 read with DPE OM No. DPE-05/0002/2023-AMRCD dated 25 th July, 2024 including further DPE OMs / clarifications and / or any amendments relating to Administrative Mechanism for Resolution of Disputes CPSEs Disputes [AMRCD]. The decision of AMRCD on the said dispute will be binding on the parties.

1.4 Notwithstanding any reference to the Mediation or Arbitration herein,

a) the parties shall continue to perform their respective obligations under the Contract unless they otherwise agree.

b) NALCO shall pay the Contractor any monies due to the Contractor.

1.5 Jurisdiction/ Governing Laws:

(a) **Jurisdiction:**

For all disputes arising of this contract, the jurisdiction shall be lie under the jurisdiction of the courts at Bhubaneswar in the State of Odisha (India) only.

(b) **Governing Laws:**

The contract shall be governed by and constructed according to the laws in force in INDIA.

ANNEXURE-B of SCC

PRICE VARIATION COMPENSATION (PVC)

1. The PVC clause shall be applicable.
2. PVC shall be applicable to both Material and Service Components of BOQ.
   a) Supply: Supply of materials for the LSTK Contracts
   b) Service: Design, Engineering, Erection & Commissioning, Testing, Training, Material Transport, Port Handling etc.
   c) % of Supply Component : 83
   d) % of Service Component : 17
3. The following methodology shall be applicable for PVC clause both for **UPWARD/DOWNWARD** variation:

3.1. **Price variation shall not be applicable for the price of items indicated in *foreign currency* in the contract**.

3.2. No price variation shall be applicable for the cost of Free Issue Materials issued by NALCO.

3.3. Minimum percentage of variation, beyond which PVC clause will be admissible, is +/- 2% of the base price, calculated in quarterly basis.

3.4. 15% of the quoted price is considered as fixed and not subject to price variation.

3.5. PVC is calculated based on indices for Material & Service Components as detailed below:

Service Component:

Base Index - AICPI-IW for the month prior to the base date.
Final Index - AICPI-IW for the month of execution.

Material Component:

Base Index - AIWPI for the month prior to the base date.
Final Index - AIWPI for the month prior to the month of delivery.

AIWPI of the applicable material group is to be applied.
Payments for each supply of materials & services would initially be made as per the base price mentioned in the contract and PVC should be submitted only quarterly, based on the above indices, provided it meets the minimum criteria of ± 2% variation as specified at Cl. 3.3 above.

3.6. For contracts where steel, cement, fuel & power are the main components, AIWPI for Steel, Cement, Fuel & Power may be applied in place of 'AIWPI for all Commodity'. 'AIWPI for all Commodity' shall be applicable for Price Variation calculation where there is no major Component of a particular material.

3.7. For Contracts involving supply of Electrical Transformers, IEEMA formula shall be used for these transformers. For other components, price variation formula with 'AIWPI for all Commodities' will be applicable.

3.8. PVC shall be applicable on both Supply of Material and Service portion. After Placement of PO, the vendor shall submit the Billing Break-up Schedule complying the

% of Supply of Material and Service portion as indicated in SCC of NIT. Price Variation will be calculated based on following formula:

3.8.1. **For Labour/Service Component**:

$$P = 0.85 \times V \times \frac{Lx}{100} \times \frac{(L1 - L0)}{L0}$$

Where,

P = Amount of Price variation

V = Value of work under consideration for PVC on pro-rata basis;

Lx = % of labour/service component to be considered for price variation.

L1 = values of corresponding labour index (AICPI – IW) as applicable for the month in which the work is executed;

L0 = values of the above mentioned labour index (AICPI-IW) is that of one month prior to the Base Date. Due date of opening of the Technical Bid is considered as the base date.

3.8.2. **For Material Component(s):**

$$P = 0.85 \times V \times \frac{Mx}{100} \times \frac{(M1 - M0)}{M0}$$

Where,

P = Amount of Price variation

V = Value of work under consideration for PVC on pro-rata basis

Mx = % of material component to be considered for price variation.

M1 = values of corresponding material index (AIWPI) as applicable for the month, prior to the month, in which the material is delivered;

M0 = values of the above-mentioned material index (AIWPI) corresponds to that of one month prior to the base date. Due date of opening of the Technical Bid is considered as the base date.

3.9. The ceiling on price variation shall not exceed the maximum limit as specified: as 15% (Fifteen percent) of the order price.

3.10. Price adjustment shall be allowed in the Contract Price for the variations in the agreed schedule and actual schedule of work, as follows:

3.10.1. When contractual “Time for Completion” of the Contract is up to eighteen (18) months and if completion of project is delayed beyond scheduled “Time for Completion” due to reasons attributable to NALCO and extension to the “Time for Completion” is granted, the extent of price adjustment, if any, shall be allowed in the Contract Price, for the upward or downward variations arising between the scheduled “Time for Completion” and actual time of completion of the respective item of work within the “Extended Time for Completion” of the Contract.

3.10.2. If completion of the project is achieved within the scheduled ‘Time for Completion’, as indicated in Contract Agreement, the price adjustment of the invoices shall be calculated on the basis of “AICPI/AIWPI Index” as explained in Cl. 3.8.

3.10.3. If completion of the project is delayed beyond scheduled “Time for Completion”, due to contractor's failure, notwithstanding the extension to the “Time for Completion” is granted, no price escalation shall be allowed in the Contract Price for the portion of work executed beyond scheduled “Time for Completion”. However, in case the indices during the extended completion time are lower, the same will also be applicable for calculating the price adjustment payable.

3.10.4. If completion of the project is delayed beyond scheduled “Time for Completion” due to reasons attributable to NALCO and extension to the “Time for Completion” is granted, price adjustment, upward or downward, if any, shall be allowed in the Contract Price, for the variations arising between the scheduled date and actual date of completion of the respective items of work within the “Extended Time for Completion” of the Contract.

3.10.5. If the completion of the project is delayed beyond scheduled “Time for Completion” due to reasons attributable to both the parties (in case of single executing agency), then the period for delay attributable to NALCO will be considered as initial delay and the price adjustment shall be applicable during this period whereas upward price variation will not be allowed for the period of delay attributable to the contractor beyond the period of initial delay.

3.10.6. For projects executed by multiple agencies and delayed beyond the scheduled “Time for Completion” due to reasons attributable to NALCO and other agencies, then the period of delay attributable to NALCO and other agency will be considered as initial delay and the price adjustment to the executing agency shall be applicable during this period whereas upward price variation will not be allowed for the period of delay attributable to the contractor beyond the period of initial delay.

3.10.7. If the delay is not attributable to either NALCO or the vendor, viz. force majeure, etc. price adjustment shall be applicable at the time of raising of the invoice as detailed below:

3.10.7.1. If force majeure is invoked before contractual completion date, then the revised Contract Period will be worked out as (Rev. Contract Period = Previous Contract Period + duration of force majeure).

3.10.7.2. PVC is applicable for the work after revocation of force majeure up to the revised Contract Period as per Cl. 3.10.2.

3.10.7.3. If force majeure is invoked after the Contractual Completion Date, PVC shall be applicable for the work done after revocation of force majeure as per Cl. 3.10.3, Cl. 3.10.4, Cl. 3.10.5 & Cl. 3.10.6.

3.11. Invoices raised beyond the contractual completion date will be processed without application of PVC. Price variation calculation will be made based on the final delay analysis.

3.12. PVC will not be applicable for any type of advance payment.

3.13. CPBG will be applicable on basic PO value/amended basic PO value (if any) and PVC clause shall not be applicable on CPBG.

3.14. PVC will not be applicable for retention amount.

3.15. If any amount is withheld due to non-compliance of supply/work as per recommendation of MIC/Authorized representative, PVC will not be applicable on release of the withheld amount. Same amount as with-held, shall be released.

3.16. PRS/LD shall be applicable on the price as varied by the operation of PVC.

3.17. Final Value of contract will be the awarded value with price variation.

MODALITY OF PRICE VARIATION COMPENSATION (PVC) CALCULATION

1. For Indigenous Tendering, one single line item in BOQ i.e. Design, Engineering, Manufacturing/Assembly, supply, Testing, Installation & Commissioning, PG Test, Training, Final Hand Over of the System" shall be published in NIT and the Vendor has to quote as Lump-sum price.
2. For Import Tendering, two-line items in BOQ i.e. Design, Engineering, Manufacturing/Assembly, supply, Testing, Installation & Commissioning, PG Test, Training, Final Hand Over of the System" for Foreign Currency and INR shall be published in NIT. The Vendor has to quote as Lump-sum price against each BOQ items in Foreign Currency and INR. PVC shall not be applicable on the BOQ line item quoted Foreign Currency and PVC shall be applicable only on the BOQ line item quoted INR.

3. The % of Supply and % of Service (or sub break-ups, wherever applicable) has been specified in Standard Terms & Conditions of NIT. A typical example for % of break-up is given below:
   a) **Single Major Component in Supply & Service**:
      i. % of Supply : 70% of the total Lump sum Price
      ii. % of Service : 30% of the total Lump sum Price
      iii. Total = 100% of the total Lump sum Price
   b) **Multiple major components in Supply and Single major component in Service**:
      i. % of Supply :
         A. % of Steel : 25 % of the total Lumpp sum Price
         B. % of Other Components: 45% of the total Lump sum Price
         C. Sub-Total % of Supply : 70% of the total Lump sum Price
      ii. % of Service : 30% of the total Lump sum Price
      iii. Total = (% of Supply +% of Service)= 100% of the total Lump sum Price

   c) **Single Major component in Supply and Multiple major components in Service**:
      i. % of Supply : 70% of the total Lump sum Price
      ii. % of Service :
         A. % of Design & Engg : 10 % of the total Lump sum Price
         B. % of Other Components: 20% of the total Lump sum Price
         C. Sub-Total % of Service : 30% of the total Lump sum Price
      iii. Total = (% of Supply +% of Service)= 100% of the total Lump sum Price

   d) **Multiple Major components in Supply and Multiple major components in Service**:
      i. % of Supply :
         A. % of Steel : 25 % of the total Lump sum Price
         B. % of Other Components: 45% of the total Lump sum Price
         C. Sub-Total % of Supply : 70% of the total Lump sum Price

      ii. % of Service :
         A. % of Design & Engg : 10 % of the total Lump sum Price
         B. % of Other Components: 20% of the total Lump sum Price
         C. Sub-Total % of Service : 30% of the total Lump sum Price
      iii. Total = (% of Supply +% of Service)= 100% of the total Lump sum Price

4. After placement of PO/LOI, the vendor has to submit Billing Break-up Schedule (BBS) as per the % indicated in the NIT for scrutinisation of NALCO. There can be multiple items for supply as well as for service. However, the % stipulated for supply as well as for service shall not change for ease of PVC calculation. The mutually agreed BBS shall be put up for approval of Competent Authority of NALCO. Accordingly, Single PO with multiple BOQ items (as approved BBS) or Separate Supply & Service POs with multiple BOQ items (as approved BBS) shall be issued for claim of intermediate RA Bills and claim of PVC.

   The vendor shall submit BBS for processing of RA Bills as per clause no: * indicated in Payment Terms.**

   If the vendor desires separate BBS for Processing of RA Bills and Processing of PVC, they shall submit separate a BBS for calculation of PVC matching the % of Supply and Service Components indicated in the NIT before processing for any RA Bills for approval of NALCO.

5. The PVC shall be calculated by the vendor for each RA Bills and to be submitted quarterly for release of the same. The vendor shall submit separate RA bills for Supply and Service components. The vendor shall submit PVC calculation sheet for each BOQ items indicating the date of supply of the material to NALCO (for Material Bills) or date of execution of work (for Service Bills). The MIC or his/her authorized representative shall verify the same with the internal documents and certify for payment.

6. Minimum percentage of variation, beyond which PVC clause will be admissible, is +/- 2% of the base price, calculated for each RA Bill.

7. Price Variation will be calculated based on following formula:

   A. <u>For Labour/Service Component</u>:

   $$Ps = 0.85 \times Vs \times \frac{Lx}{100} \times \frac{(L1 - L0)}{L0}$$

   Where,

   Ps = Amount of Price variation claimed for Service Bill

   Vs = Value of work under consideration for PVC on pro-rata basis;

   Lx = 100

   L1 = values of corresponding labour index (AICPI – IW) as applicable for the month in which the work is executed;

   L0 = values of the above mentioned labour index (AICPI-IW) is that of one month prior to the Base Date. Due date of opening of the Technical Bid is considered as the base date.

B. For Material Component(s):

$$Pm = 0.85 \times \frac{Vm}{100} \times Mx \times \frac{(M1 - M0)}{M0}$$

Where,

Pm = Amount of Price variation Claimed for Supply of Material Bill

Vm = Value of work under consideration for PVC on pro-rata basis

Mx = 100

M1 = values of corresponding material index (AIWPI) as applicable for the month, prior to the month, in which the material is delivered;

M0 = values of the above mentioned material index (AIWPI) corresponds to that of one month prior to the base date. Due date of opening of the Technical Bid is considered as the base date.

A typical example w.r.t Point 2 is given below:

3(a) Single Major Component in Supply & Service

i. **RAB-1 of Rs. 500/- for supply Materials, PV Formula shall be**

$$Pm = 0.85 \times 500 \times \frac{100}{100} \times \frac{(M1 - M0)}{M0}$$

Where,

Pm = Amount of Price variation

Vm= Value of work under consideration for PVC on pro-rata basis, i.e. Rs.500/-

(The maximum value of V shall not exceed the value mentioned in the approved BBS)

Mx = 100

M1 = values of material index (AIWPI-For all Commodities) as applicable for the month, prior to the month, in which the material is delivered;

M0 = values of the material index (AIWPI-For all Commodities) corresponds to that of one month prior to the base date. Due date of opening of the Technical Bid is considered as the base date.

ii. **RAB-2 of Rs. 200/- for rendering Service, PV Formula shall be**

$$Ps = 0.85 \times 200 \times \frac{100}{100} \times \frac{(L1 - L0)}{L0}$$

Where,

Ps = Amount of Price variation

Vs = Value of work under consideration for PVC on pro-rata basis,i.e. Rs.200/-

(The maximum value of V shall not exceed the value mentioned in the approved BBS)

Lx = 100

L1 = values of corresponding labour index (AICPI – IW) as applicable for the month in which the work is executed;

L0 = values of the above mentioned labour index (AICPI-IW) is that of one month prior to the Base Date. Due date of opening of the Technical Bid is considered as the base date.

3(b) Multiple major components in Supply and Single major component in Service

i. **RAB-1 of Rs. 500/- for supply of Steel, PV Formula shall be**

$$Pm = 0.85 \times 500 \times \frac{100}{100} \times \frac{(M1 - M0)}{M0}$$

Where,

Pm = Amount of Price variation

Vm = Value of work under consideration for PVC on pro-rata basis,i.e. Rs.500/-

(The maximum value of V shall not exceed the value mentioned in the approved BBS)

Mx = 100

M1 = values of index for Mild Steel-Long products as applicable for the month, prior to the month, in which the material is delivered;

M0 = values of index for Mild Steel-Long products (AIWPI) corresponds to that of one month prior to the base date. Due date of opening of the Technical Bid is considered as the base date.

ii. **RAB-2 of Rs. 400/- for supply of Other Materials, PV Formula shall be**

$$Pm = 0.85 \times 400 \times \frac{100}{100} \times \frac{(M1 - M0)}{M0}$$

Where,

Pm = Amount of Price variation

Vm = Value of work under consideration for PVC on pro-rata basis,i.e. Rs.400/-

(The maximum value of V shall not exceed the value mentioned in the approved BBS)

Mx = 100

M1 = values of material index (AIWPI-For all Commodities) as applicable for the month, prior to the month, in which the material is delivered;

M0 = values of the material index (AIWPI-For all Commodities) corresponds to that of one month prior to the base date. Due date of opening of the Technical Bid is considered as the base date.

iii. **RAB-3 of Rs. 200/- for rendering Service, PV Formula shall be**

$$Ps = 0.85 \times 200 \times \frac{100}{100} \times \frac{(L1 - L0)}{L0}$$

Where,

Ps = Amount of Price variation

Vs = Value of work under consideration for PVC on pro-rata basis,i.e. Rs.200/-

(The maximum value of V shall not exceed the value mentioned in the approved BBS)

Lx = 100

L1 = values of corresponding labour index (AICPI – IW) as applicable for the month in which the work is executed;

L0 = values of the above mentioned labour index (AICPI-IW) is that of one month prior to the Base Date. Due date of opening of the Technical Bid is considered as the base date.

3(c) Single Major component in Supply and Multiple major components in Service:

i. **RAB-1 of Rs. 500/- for supply of Materials, PV Formula shall be**

$$Pm = 0.85 \times 500 \times \frac{100}{100} \times \frac{(M1 - M0)}{M0}$$

Where,

Pm = Amount of Price variation

Vm = Value of work under consideration for PVC on pro-rata basis,i.e. Rs.500/-

(The maximum value of V shall not exceed the value mentioned in the approved BBS)

Mx = 100

M1 = values of material index (AIWPI-For all Commodities) as applicable for the month, prior to the month, in which the material is delivered;

M0 = values of the material index (AIWPI-For all Commodities) corresponds to that of one month prior to the base date. Due date of opening of the Technical Bid is considered as the base date.

ii. **RAB-2 of Rs. 200/- for Design & Engg, PV Formula shall be**

$$Ps = 0.85 \times 200 \times \frac{100}{100} \times \frac{(L1 - L0)}{L0}$$

Where,

Ps = Amount of Price variation

Vs = Value of work under consideration for PVC on pro-rata basis,i.e. Rs.200/-

(The maximum value of V shall not exceed the value mentioned in the approved BBS)

Lx = 100

L1 = values of corresponding labour index (AICPI – IW) as applicable for the month in which the work is executed;

L0 = values of the above mentioned labour index (AICPI-IW) is that of one month prior to the Base Date. Due date of opening of the Technical Bid is considered as the base date.

iii. **RAB-3 of Rs. 150/- for Other Service activities, PV Formula shall be**

$$Ps = 0.85 \times 150 \times \frac{100}{100} \times \frac{(L1 - L0)}{L0}$$

Where,

Ps = Amount of Price variation

Vs = Value of work under consideration for PVC on pro-rata basis,i.e. Rs.200/-

(The maximum value of V shall not exceed the value mentioned in the approved BBS)

Lx = 100

L1 = values of corresponding labour index (AICPI – IW) as applicable for the month in which the work is executed;

L0 = values of the above mentioned labour index (AICPI-IW) is that of one month prior to the Base Date. Due date of opening of the Technical Bid is considered as the base date.

Note: There are no separate indices for different service activities like Design, Engg, Erection, PG Test , Training etc available in AICPI-IW . Hence, for all service activities, only AICPI-IW to be considered for calculation.

3(d) Multiple Major components in Supply and Multiple major components in Service

i. **RAB-1 of Rs. 500/- for supply of Steel, PV Formula shall be**

$$Pm = 0.85 \times 500 \times \frac{100}{100} \times \frac{(M1 - M0)}{M0}$$

Where,

Pm = Amount of Price variation

Vm = Value of work under consideration for PVC on pro-rata basis,i.e. Rs.500/-

(The maximum value of V shall not exceed the value mentioned in the approved BBS)

Mx = 100

M1 = values of index for Mild Steel-Long products (AIWPI) as applicable for the month, prior to the month, in which the material is delivered;

M0 = values of index for Mild Steel-Long products (AIWPI) corresponds to that of one month prior to the base date. Due date of opening of the Technical Bid is considered as the base date.

ii. **RAB-2 of Rs. 400/- for supply of Other Materials, PV Formula shall be**

$$Pm = 0.85 \times 400 \times \frac{100}{100} \times \frac{(M1 - M0)}{M0}$$

Where,

Pm = Amount of Price variation

Vm = Value of work under consideration for PVC on pro-rata basis,i.e. Rs.400/-

(The maximum value of V shall not exceed the value mentioned in the approved BBS)

Mx = 100

M1 = values of material index (AIWPI-For all Commodities) as applicable for the month, prior to the month, in which the material is delivered;

M0 = values of the material index (AIWPI-For all Commodities) corresponds to that of one month prior to the base date. Due date of opening of the Technical Bid is considered as the base date.

iii. **RAB-3 of Rs. 200/- for Design & Engg, PV Formula shall be**

$$Ps = 0.85 \times 200 \times \frac{100}{100} \times \frac{(L1 - L0)}{L0}$$

Where,

Ps = Amount of Price variation

Vs = Value of work under consideration for PVC on pro-rata basis,i.e. Rs.200/-

(The maximum value of V shall not exceed the value mentioned in the approved BBS)

Lx = 100

L1 = values of corresponding labour index (AICPI – IW) as applicable for the month in which the work is executed;

L0 = values of the above mentioned labour index (AICPI-IW) is that of one month prior to the Base Date. Due date of opening of the Technical Bid is considered as the base date.

iv. **RAB-4 of Rs. 150/- for Other Service activities, PV Formula shall be**

$$Ps = 0.85 \times 150 \times \frac{100}{100} \times \frac{(L1 - L0)}{L0}$$

Where,

Ps = Amount of Price variation

Vs = Value of work under consideration for PVC on pro-rata basis,i.e. Rs.200/-

(The maximum value of V shall not exceed the value mentioned in the approved BBS)

Lx = 100

L1 = values of corresponding labour index (AICPI – IW) as applicable for the month in which the work is executed;

L0 = values of the above mentioned labour index (AICPI-IW) is that of one month prior to the Base Date. Due date of opening of the Technical Bid is considered as the base date.

Note: There are no separate indices for different service activities like Design, Engg, Erection, PG Test, Training etc. available in AICPI-IW. Hence, for all service activities, only AICPI-IW to be considered for calculation.

8. For Import Tendering, the vendor shall submit the BBS for calculation of PVC for BOQ items containing price in INR only as per the % of supply & Service indicated in NIT.

9. AIWPI for Steel shall be taken as Index for only “Mild Steel-Long products” unless other wise specified in NIT .

10. AIWPI for Cement shall be taken as Index for only “Manufacture of cement, lime and plaster” unless other wise specified in NIT .

PVC APPLICABILITY FOR THE CURRENT NIT

1. The Mode of the Tendering : Indigenous Open Two part Tendering
2. % of Supply Component : 83
3. % of Service Component : 17
4. All the relevant Clauses indicated in the NIT shall be applicable depending on case to case basis.
5. PVC shall be calculated as per the modality indicated in the “Modality of calculation of PVC” as applicable depending on case to case basis.

नालको NALCO

GENERAL CONDITIONS OF CONTRACT

NATIONAL ALUMINIUM COMPANY LIMITED
NALCO BHAWAN, P-1 NAYAPALLI,
BHUBANESWAR – 751 013

Web site: nalcoindia.com

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SECTION – 1

DEFINITIONS AND INTERPRETATION

1. DEFINITION & INTERPRETATION:

1.1 Definition:

In the contract (as hereinafter defined) the following words and expressions shall have the meanings hereby assigned to them except where the context otherwise requires.

1.1.1 The 'Owner' shall mean the National Aluminium Company Limited (NALCO), a Company incorporated under the Companies Act, 1956 having its registered office at IDCO Tower, 8th Floor, Janapath, Bhubaneswar –751007 or any other place as modified subsequently and shall include its Chairman-cum-Managing Director or other Administrative Officers authorised to deal with these presents are concerned on his behalf posted in the any of the Offices of NALCO and shall also include Owner's successors and assignees.

The Chairman-cum-Managing Director has nominated the following persons as the representative of the 'Owner' for the purpose of all contractual matters.

Smelter	-	General Manager (Smelter)	Projects
CPP	-	General Manager (CPP)	
Mines	-	General Manager (Mines)	
Alumina	-	General Manager (Alumina)	

1.1.2 The 'Tender' shall mean the tender submitted by the tenderer for acceptance by the Owner.

1.1.3. The 'Chairman-cum-Managing Director' shall mean the Chairman-cum-Managing Director of National Aluminium Co. Ltd., or his successors in office as designated by the Owner.

1.1.4. The 'Project Head' shall mean General Manager/ Deputy General Manager of the Project of National Aluminium Company Ltd., or his successor in office or his authorised representative.

1.1.5. The 'Contractor' shall mean the person or persons, firm or company whose tender has been accepted by owner and includes the contractor's legal representatives, his successors and permitted assigns.

1.1.6. The 'Sub-contractor' shall mean any person or firm or company (other than the contractor to whom any part of the work has been entrusted by the contractor, with the written consent of the owner or his representative and the legal representatives, successors and permitted assignee of such person, firm or company.

1.1.7. The 'Engineer-in-Charge' shall mean the person nominated by the Owner from time to time and shall include those who are expressly authorised by the Owner to act for and on his behalf for all function pertaining to operation of this contract. All functions pertaining to the operation of contract means all acts necessary for execution of the contract coordinating between the different agencies and final closing of the contract.

1.1.8. The 'Works' shall mean and include all works to be executed in accordance with the contract or part thereof as the case may and shall include all extras, addition, altered or substituted works as required for the purpose of the contract or as may be required to be executed by the owner/ engineer-in-charge.

1.1.9. The 'Contract' shall mean the agreement between the Owner and the contractor for the execution of the works including therein all documents such as the invitation to tender, instructions to Tenders, General Conditions of Contract, Special Conditions of Contract, Job Specifications, General Requirements, Time Schedule of Completion of Job, Drawings, Letter of Intent awarding the work, Agreed variations, if any etc.

1.1.10. The 'Contract Document' shall mean collectively the tender documents, designs, drawings specifications, agreed variations, if any and other documents constituting the tender and acceptance thereof.

1.1.11. 'Constitutional Plant' shall mean all appliances or things of whatsoever nature required in or about the execution, completion or maintenance of the works or temporary works (as hereinafter defined) but does not include materials or other things intended to form of forming part of the permanent work.

1.1.12. 'Temporary Works' shall mean all temporary works of every kind required in or about the execution, completion or maintenance of the works.

1.1.13. 'Specifications' shall mean all directions, various technical specification, provisions, and requirements, attached to the contract, which pertain to the method and manner of performing the work or works to the quantities and qualities of the work or works and the materials to be furnished under the contract for the work or works as may be amplified or modified by the Owner or the Engineer-in-charge during the performance of Contract in order to provide the unforeseen conditions or in the best interests of the work or works. It shall also include the latest edition including all addenda/ corrigenda or relevant Indian Standard Specifications and other relevant codes.

1.1.14. 'Plans' shall mean all maps, sketches, and layouts as are incorporated in the contract in order to define broadly the scope and specifications of the work or works, and all reproductions thereof.

1.1.15. 'Drawings' shall include maps, plans and tracings or prints thereof with any modifications approved in writing by the Engineer-in-Charge and such other drawings as may, from time to time, be furnished or approved in writing by the Engineer-in-charge.

1.1.16. 'Foreign consultant' shall mean a person, agency or firm including their successors and assigns, who are nonresidents of India and are responsible for supply of process Technology for expansion plant based on review of existing plant including material flow, energy balance, additional facilities and improvement on the basis of the recent experience.

1.1.17. 'Indian Consultant' shall mean a person, agency or firm including their successors and assign who are responsible for detailed engineering and construction management of the project.

1.1.18. 'Project manager' shall mean the authorised representative of the consultant posted at site. He shall be responsible for supervision of the work by the contractors as well as coordinate with different agencies within the organisation or otherwise.

1.1.19. 'Site' shall mean the lands and other places on, under in or through which the permanent works are to be carried out and any other lands or places provided by the owner for the purpose of the contract.

1.1.20. 'Notice in writing or written Notice' shall mean a notice in written, typed or printed characters sent (unless delivered personally or other wise proved to have been received) by registered post to the last known private or business address or registered office of the addressee and shall be deemed to have been received in the ordinary course of post it would have been delivered.

1.1.21. The 'Completion Certificate' shall mean the certificate to be issued by the owner or his representative when the works have been completed to his satisfaction.

1.1.22. The 'Final Certificate' in relation to the work shall mean the certificate regarding the satisfactory compliance of the various provisions of the contract to be issued by the owner or his representative after the period of liability is over.

1.1.23. 'Approved' shall mean approved in writing including subsequent written conformation of previous verbal approval and 'Approval' means approved in writing including as aforesaid.

1.1.24. The 'Period of Liability' in relation to a work means the specified period from the date of issue of completion certificate up to the date of issue of final certificate which the contractor stands responsible for rectifying all defects that may appear in the works.

1.1.25. The 'Appointing Authority' for the purpose of arbitration shall be the Chairman and managing Director or any other person so designated by him.

1.1.26. The 'Alteration Variation Order' means an order given in writing by the Engineer-in-Charge/ owner to effect additions to or deletions from or alteration in the works.

1.1.27. 'Letter of Intent' shall mean an intimation by a letter to tenderer that the tender has been accepted in accordance with the provisions contained in the letter.

1.1.28. 'Days' means a day of 24 hours from mid night irrespective of the number of hours worked in that day.

1.1.29. 'Working Day' mean any day which is not declared to be holiday or rest day by the Owner.

1.1.30. 'Week' means a period of any consecutive seven days.

1.1.31. 'Metric System': All technical documents regarding the construction of works are given in the metric system and all work in the project should be carried out accordingly to the metric system. All documents concerning the work shall also be maintained in the metric system.

1.1.32. 'Value of Contract' shall mean the sum accepted or the sum calculated in accordance with the prices accepted in tender and / or the contract rates as payable to the contractor for the entire execution and full completion of the work.

1.1.33. 'Headings and Marginal Notes' in these contract documents are given solely for facility of reference and are not part of the contract documents and are not to be taken into account in the interpretation of the provisions of the contract.

1.1.34. 'Language for Drawings & Instruction': All the drawings, titles, notes, instruction, dimensions etc. shall be in English Language.

1.1.35. 'Singular and Plural': The singular shall include the plural and vice versa wherever the context so requires.

SECTION - II

2. FACILITIES TO CONTRACTOR

2.1 Location of Sites and Access by Road:

2.1.1 Locations of Sites:

The general information about Mines Alumina, Aluminium Smelter and Captive power Plants furnished below is of indicative nature only and shall not be considered as binding in any way on the Owner and shall not govern either the scope of work or the nature of the respective rights and the obligations of the parties to such contract.

(a) Alumina Plant and Mines:

Alumina plant is on south-western side of the Panchpatmali hill near Damanjodi village in Koraput District, Orissa State. The site is situated at 12 Km from the national highway No. 43 off Semiliguda village. The Alumina Plant Site has the form of saddle between groups of low hills. The location of Red Mud Pond is in the natural basis of hills situated at a distance of 2 Km from the western side of the plant. The Bauxite mine is located at 14 Km away from the Alumina Plant Site.

(b) Smelter Plant:

Aluminium Smelter is on the Southern side of National Highway No. 42, with its approximate latitude and longitude as $20^{o}51'N$ and $85^{o}10'E$ respectively. The area, at a higher elevation in comparison with adjacent land, is not subjected to either normal or flash foods. The prevalent directions of wind are from North-West and West.

(c) Captive Power Plant:

Captive Power Plant is located at Angul, District Angul, Orissa on the south of Talcher Thermal Power Station of Orissa State Electricity Board the main plant site is about 3 Km on the north of the junction of the National Highway Nos. 42 and 23, between the villages Balaram Prasad Patna and Gotamara. The access roads to the main plant site may be taken from either of the highways.

2.1.2. Access by Road:

Contractor, if necessary, shall build other temporary access roads to the actual site of construction for his own work at his own cost. The Contractor shall be required to permit the use of the roads so constructed by him for vehicles of any other parties who may be engaged on the project site. The Contractor shall also facilitate the construction of the permanent roads should the construction thereof start while he is engaged on this work. He shall make due allowance in his tender for any inconvenience he anticipates on such account.

Non-availability of access roads, railway siding and railway wagons for the use of contractor shall in no case condone any delay in the execution of works not be the cause for any claim for compensation against the Owner.

2.2 **Water Supply:**

2.2.1. Unless other wise provided in the Contract, the Contractor shall be responsible for the arrangements to obtain supply of water necessary for the works, his labour colony, his workshops, his offices etc. All pumping installations, pipe network and distribution system will have to be carried out by the Contractor at his own cost.

2.2.2. The Owner may agree to supply water to the Contractor for use in the Owner's works on specified terms and conditions as shall be determined by the Owner, which shall be binding on the Contractors. The tenderer is however required to exercise his option to receive such water supply from Owner's main at the time of submission of his tender.

2.2.3. When the water is supplied by the Owner, the Owner's main will be within 500 metres form the site of work. The Contractor shall provide at his own cost, all necessary ferrules, pipes, fitting, couplings and tanks and temporary works required and he shall maintain all such works in satisfactory condition. The Contractor shall remove all such works and shall re-instate and make good any work disturbed, to the satisfaction of the Engineer-in-Charge.

2.2.4. In the event of the Contractor's drawing water from the Owner's main/ source, he shall not claim any compensation for interruption or failure of Owner's water supply caused due to any reasons beyond the control of the owner.

2.2.5. The water so supplied by the Owner shall be free of cost for the Constructional work only.

2.3. Power Supply:

2.3.1 Subject to availability, Owner will supply power at 400/440 V at only one point at the nearest substation, from where the contractor will make his own arrangement for temporary distribution. The point of supply will not be more than 500 Metres away from the Contractor's premises. All the works will be done as per IEA regulations and passed by the Engineer-in-Charge. The temporary line will be removed forthwith after the completion of work or if there is any hindrance caused to the other works due to the alignment of these lines, the contractor will re-route or remove the temporary lines at his own cost. The Contractor at his cost will also provide suitable electric metres, fuses, switches, etc. for purposes of payment to the Owner which should be in the custody and control of the Owner. The cost of power supply shall be payable to the owner every month. Rs. 1/- per kWh for power, which will be deducted from the running bills. The owner shall not, however, guarantee the supply of electricity and no compensation for any failure or short supply of electricity will be entertained and this does not relieve the contractor of his

responsibility for timely completion of this works as stipulated in the contract.

2.3.2 It shall be the responsibility of the contractor to provide and maintain the complete installation of the load side of the supply with due regard to safety requirement at site. All cabling, equipment, installations etc. shall comply in all respects with the latest statutory requirements and safety provisions i.e. as per and the Central/ State Electricity Acts and Rules etc. The Contractor will ensure that his equipment and Electrical wiring etc. are installed modified, maintained by a licensed Electrician/ Supervisor. A rest certificate is to be produced to the Engineer-in-Charge for his approval, before power is made available.

2.3.3 At all times, IEA regulations shall be followed failing which the Owner has a right to disconnect the power supply without any reference to the contractor. No claim shall be entertained for such disconnection by the Engineer-in-Charge. Power supply will be reconnected only after production of fresh certificate from authorised electrical supervisors.

2.3.4 The Owner is not liable for any loss or damage to the Contractor's equipment as a result of variation in voltage or frequency or interruption in power supply or other loss to the Contractor arising there from.

2.3.5 The Contractor shall ensure that the Electrical equipment installed by him are such that average power factor does not fall below 0.90 at his premises. In case power factor falls below 0.90 in any month, he will reimburse to the Owner at the penal rate determined by the Owner for all units consumed during the month.

2.3.6 The Power supply required for Contractor's colony near the plant site will be determined by the Owner and shall as per state Electricity Board's Rules and other Statutory provisions applicable for such installations from time to time. In case of power supply to Contractor's colony, the power will be made available at a single point and the Contractor shall make his own arrangement at his own cost for distribution to the occupants of the colony as per Electricity Rules & Acts. The site area and colony shall be sufficiently illuminated to avoid accidents.

2.3.7 The Contractor will have to provide and install his own light and power meters, which will be governed as per Central/ State Government Electricity Rules. The meters shall be sealed by the Owner.

2.3.8 In case of damage to any of the Owner's equipment on account of fault, intentional or unintentional on the part of the Contractor the Owner reserves the right to recover the cost of such damage from the contractor's bill. Cost of HRC Fuses replaced at the Owner's terminals due to any fault

in the Contractor's installation shall be to contractor's account at the rates decided by the Engineer-in-Charge.

2.3.9 Only motors upto 3 HP will be allowed to be started direct on line. For motors above 3 HP and up to 100 HP a suitable starting devices approved by the Engineer-in-Charge shall be provided by the Contractor For Motor s above 100 HP slipping induction motors will suitable starting devices as approved by the Engineer-in-Charge shall be provided by the Contractor.

2.3.10 The Contractor shall ensure at his cost that all electric lines and equipment and all installations are approved by the State Electricity Inspector before power can be supplied by the Owner.

2.3.11 The total requirement of power shall be indicated by the tenderer along with his tender.

2.4. Land for Contractor's Filed Office, Godown and Workshop :

2.4.1. The Owner will at his discretion and convenience and for the duration of the execution of the work may provide the land for construction of Contractor's field office, godown, workshops and assembly yard required for the execution of the contract nearer to the site.

The Contractor shall at his cost construct all these temporary buildings structures and provide suitable water supply and sanitary arrangement as approved by the Engineer-in-Charge and other inspectorates.

2.4.2. On completion of the works undertaken by the Contractor, he shall remove all temporary works erected by him and have the site cleared as directed by Engineer-in-Charge. If the Contractor fails to comply with these requirements, the Engineer-in-Charge has the right to remove any structure, such surplus, rubbish materials and depose off the same as he deems fit and get the site cleared and the contractor shall forthwith pay the amount of all expenses so incurred and shall have no claim in respect of any such surplus materials disposed as aforesaid. The Owner reserves the right to ask the Contractor at any time during the pendancy of the contract, to vacate the land by giving 7 (seven) days notice on security reasons or on national interest or otherwise. A token rent of Rs. 100/- (Rupees One hundred only) per hectare or part thereof per annum or part thereof shall be charged for the land so made available.

Land provided shall be solely on licence basis which is terminable by at any time without notice or without assigning any reasons. In the event of any such termination or the termination of the contract/completion thereof, the contractor shall forthwith vacate the premises.

2.5. Land for Residential Accommodation:

Land for residential accommodation for staff and labour may be made available at the discretion of the Engineer-in-Charge and rent for the same will be as decided by the Engineer-in-Charge according to location and the area occupied by the Contractor.

SECTION - III
GENERAL INSTRUCTIONS TO TENDERERS

3. SUBMISSION OF TENDER:

3.1. The documents issued to the tenderers shall be as follows:

(i) One complete set of tender documents as per index sheet and drawings marked 'ORIGINAL' (To be submitted along-with the quotation).

(ii) One complete set of tender documents as per index sheet marked 'TENDERER'S COPY' (To be retained by the tenderer for reference).

3.1.1. The tender documents shall be in 2 parts viz. Technical Bid and Price Bid. Technical and Price Bid should be put in separate sealed cover and marked with the tender reference and name of the work. In addition, a note on the Price Bid "Quotation do not open" is to be superscribed. Both the sealed covers are to be put in a single sealed cover. The name of the work the tender reference and date of opening are to be superscribed on this sealed envelope also.

The technical Bid shall be opened in the first instance. Clarifications, confirmations, if any, shall be obtained with regard to technical specifications. After technical specifications are firmed up, if a tenderer revises his price bid, he is required to submit justification in support of the revision made. The price bid shall be opened thereafter.

3.2. If Addenda/ Corrigenda are issued to this tender document, they must be signed, submitted along-with the tender documents. The tenderer should write clearly the revised quantities in schedule of Rates of Tender Document and should price the work based on revised quantities when amendments on quantities are issued in addenda.

3.3. Tenderers are advised to submit quotations based strictly on the terms and conditions and specifications contained in the tender documents and not stipulate any deviations. Should it however become unavoidable, deviations should be stipulated in the prescribed proforma only, contained in the proposal form. Owner reserves the right to evaluate the quotations containing deviations having financial implications, by adding the cost for such deviations are determined by Owner.

3.4. Tenders should be submitted in double sealed envelope with the name of work superscribed thereon and with the note "QUOTATION DO NOT OPEN" written prominently. The full name, postal address and telegraphic address of the tenderer shall be written on the bottom left hand corner of the sealed cover.

4.0. DOCUMENTS:

4.1.1 Bidders shall submit with his bids the particular/ documents as envisaged from Appendix (i) to (x) along with tentative construction net work/ Bar chart for completion of work taking into account various intermediate completion milestones/ component milestones and the overall completion of work under the contract.

4.1.2. Details to be submitted along with tender:

The tenders, as submitted will consist of the following:

The technical Bid and Price Bid shall be submitted as stated in para 3.1.1 Documents to be attached with price bid.

(i) Complete set of the tender document (marked ORIGINAL) as issued duly filled in by the tenderer as prescribed in different clauses of the tender document, signed and date affixed.

Documents to be attached with Technical Bid.

(ii) Earnest money in the manner specified in Clause 6 hereof.

(iii) The following proposal forms in FIVE copies

(a) Details of works of similar nature and magnitude carried out during last 5 years as per the Appendix – 1(A)
(b) Concurrent commitments of the tenderer as per the Appendix – 1(B).
(c) Details of equipments, tools and tackles proposed to be deployed for this work as per the Appendix – (II).
(d) Details of manpower proposed to be deployed for this work as per the Appendix – (III), indicating the qualification.
(e) Site organisation chart showing number of qualified engineers and supervisors etc. indicating their bio-data as per the Appendix – (IV), indicating the qualification.
(f) List of proposed sub-contractors to be deployed as per the Appendix – (V).
(g) Progress Billing as per the Appendix – (VI).
(h) Information about tenderers as per the Appendix – (VII).
(i) List of enclosures as per the Appendix – (VIII).
  a) Power of attorney
  b) Income tax & Sales tax clearance certificate.
  c) Solvency certificate from nationalised Bank
  d) Documents showing annual turnover.

(j) Exception and deviation which tenderer may desire to stipulate as per Appendix – (IX).

4.2 All pages to be initialled:

All signatures in tender documents shall be dated, as well as the pages of all sections of tender documents shall be initialled at the lower right hand corner or signed wherever required in the tender papers by the tenderer or by a person holding power of attorney authorising him to sign on behalf of the tenderer before submission of tender.

4.3. Rates to be in Figures and Words:

The tenderer shall quote in English, in figures and in words for the rates and amount tendered by him in the Schedule of Rates forming part of the documents, in such a way that interpolation is not possible. The amount of each item shall be worked out and entered and requisite total given of all items. The tendered amount for the work shall be entered in the tender and duly signed by the tenderer.

If some discrepancies are found between the rates given in works and figures or the amount shown in the tender, the following procedure shall be followed:-

a) When there is difference between the rates in figures and words, the rate which corresponds to the amount worked out by the tenderer shall be taken as correct.

b) When the rate quoted by the tenderer in figures and words tally but the amount is incorrect, the rate quoted by the tenderer shall be taken as correct.

c) When it is not possible to ascertain the correct rate by either of above methods the rate quoted in words shall be taken as correct.

4.4. Corrections and Erasures:

All corrections and alterations in the entries of tender papers shall be signed in full by the tenderer with date. No erasures or over writings are permissible.

4.5.Signature of Tenderer:

4.5.1. The tender shall contain the name, residence and place of business of person or persons making the tender and shall be signed by the tenderer with his usual signature. Partnership firms shall furnish the full names of the partners in the tender. It should be signed in the partnership's name by all the partners or by duly authorised representative followed by the name and designation of the person signing. Tender by a corporation shall be signed by an authorised representative and a power of attorney on the behalf shall accompany the tender. A copy of constitution of the firm with names of all partners shall be furnished.

4.5.2. When the tenderer signs a tender in a language other than English, the total amount tendered should in addition be written in the same language. The signature should be attested by at least one witness.

4.6 Witness: Witness and sureties shall be persons of status and property. Their name occupation and address shall be stated below their signature.

5. TRANSFER OF TENDER DOCUMENTS:

Transfer of tender document purchased by one intending tenderer to another is no permissible.

6. EARNEST MONEY:

6.1. The tenderer must pay earnest money as given in the Letter/ Notice Inviting Tenders. Tenders not accompanied with earnest money deposit will be rejected. The earnest money can be paid in cash or by crossed demand draft or fixed deposit or Bank Guarantee from any Nationalised/ Scheduled Bank or Insurance Guarantee in the prescribed proforma as indicated in the tender document in favour of National Aluminium Company Ltd.

6.2. The Bank Guarantee so furnished by the tenderer shall be only in the proforma prescribed by the Owner and valid for six months from the date of opening of the tender. No interest shall be paid by the Owner on the Earnest Money deposited by the tenderer.

7. **VALIDITY:** Tender submitted by tenderers shall remain valid for acceptance for a period of four months from the date of opening of the tender. The tenderers shall not be entitled during the said period of four months, without the consent in writing of the Owner, to revoke or cancel his tender or to vary the tender given or any term thereof. In case of tenderer revoking or canceling his tender or varying any terms in regard thereof without the consent a Owner in writing, the earnest money paid by him along-with the tender shall be forfeited.

8. ADDENDA/ CORRIGENDA:

8.1. Addenda/ Corrigenda to the tender documents may be issued prior to the date of opening of the tenders to clarify documents or to reflect modification in the design or contract terms.

8.2. The Addenda/ Corrigenda will be issued in duplicate to each person or organisation to whom a set of tender documents has been issued. Each recipient should acknowledge the receipt of the same and attach one copy of the addenda/ corrigenda along-with his offer. All addenda/ corrigenda issued shall become part of Tender Documents.

9. RIGHT OF OWNER TO ACCEPT OR REJECT TENDER:

9.1. The right to accept the tender will rest with the Owner. The Owner further does not bind himself to accept the lowest tender and reserves the authority to reject any or all the tenders received without assigning any reason whatsoever. The whole work may be split up between two or more contractors or accepted in part (not entirely) if considered expedient. The quoted rates would hold good for such eventualities. Tenders in which any of the particulars and prescribed information are missing or incomplete in any respect and / or the prescribed conditions are not

fulfilled are liable to be rejected. The decision for the owner in respect of the above shall be final and binding on the contractor.

9.2. Canvassing in connection with tenders is strictly prohibited. The submitted tenders of the tenderers who resort to canvassing are liable to rejection. Tenders containing uncalled remarks or any additional conditions are liable to be rejected.

10. THE SCHEDULE:

10.1. The work shall be executed strictly as per the Time Schedule given in Appendix –1. The period of construction given in time Schedule includes the time required for mobilisation as well as testing, rectification if any, re-testing and completion in all respects to entire satisfaction of the Engineer-in-Charge.

10.2. A joint programme of execution of the work will be prepared by the Engineer-in-Charge and contractor based on priority requirement of this project. This programme will take into account the time of completion mentioned in 19.1 above and the time allowed for the priority works by the Engineer-in-Charge.

10.3. Monthly/ weekly construction programme will be drawn up by the Engineer-in-Charge jointly with the Contractor, based on availability of work fronts and the joint construction programme as per 10.2 above. The contractor shall scrupulously adhere to these targets/ programs by deploying adequate personnel construction tools and tackles and he shall also supply himself materials of his scope of supply in good time to achieve the targets/ programmes. In all matters concerning the extents of targets set out in the weekly and monthly programmes and the degree of achievement, the decision of the Engineer-in-Charge will be final and binding on the contractor.

10.4. CONSTRUCTION SCHEDULE AND PRESENTATION:

The construction schedule shall be in the form of network of PERT CHART/ CPM or other suitable presentation for the programme of the work indicating therein the different components item of works and time required for completion of each components item wise/ month wise season wise so as to complete the work in all respects within the stipulated period. Before award of the work the contractor is also required to make the presentation to satisfy owner of their proposal for construction schedule in the form of BAR CHART and organizational resources, equipments, machinaries, manpower to be deployed for timely completion of the project.

11. **TENDERER'S RESPONSIBILITY:**

The intending tenderers shall be deemed to have visited the site and familiarised themselves thoroughly with the site conditions before submitting the tender. Non-familiarity with the site conditions will not be considered a reason either for extra claims or for not carrying out the works in strict conformity with the drawings and specifications.

12. RETIRED GOVERNMENT OR COMPANY OFFICERS:

No Engineer of Gazetted rank or other Gazetted Officer employed in Engineering or Administrative duties in an Engineering department of the State/ Central Government or of the owner is allowed to work as a contractor for a period of two years after his retirement from Government service or from the employment of the Owner without the previous permission of the Owner. The contract if awarded, is liable to be cancelled if either the contractor or any of his employees is found at any time to be such a person, who had not obtained permission of the owner as aforesaid before submission of tender or engagement in the contractor's service as the case may be.

13. **SIGNING OF THE CONTRACT:**

The successful tenderer shall be required to execute an agreement with the Owner in the proforma attached with tender document within 10 days of the receipt by him of the notification of acceptance of the tender. In the event of failure on the part of the successful tenderer to sign the agreement within the above stipulated period, the earnest money or his initial security deposit will be forfeited and the acceptance of the tender shall be considered as cancelled. No bills shall be payable unless the agreement is executed.

14. FIELD MANAGEMENTS AND CONTROLLING AUTHORITY:

14.1 The field management will be responsibility of the Project Manager posted at site by the consultant and nominated by the owner. The Project manager shall work in accordance with the directions given to him from time to time by the project head.

14.2. The Engineer-in-Charge shall only co-ordinate with the other agencies engaged to work at site, to ensure minimum disruption of work carried out by different agencies. It shall be the responsibility of the contractor to plan and execute the works strictly in accordance with site instructions and avoid hindrance to the works being executed by other agencies. The instructions of the Engineer-in-Charge shall be binding on the contractor.

15. NOTE TO SCHEDULE OF RATES:

15.1. The schedule of rates should be read in conjunction with all the other sections of the tender.

15.2. The tenderer shall be deemed to have studied the drawings, specifications and details of work to be done within time schedule and to have acquainted himself of the conditions prevailing at site.

15.3. Rates must be filled in the original tender document. If quoted in separate typed sheets, no variation in time description or specification shall be accepted. Any exceptions taken by the tenderer to the schedule of rates shall be brought out in the terms and conditions of offer.

15.4. The quantities shown against the various items are only approximate. Any increase or decrease in the quantities shall not form the basis of alternation of the rates quoted and accepted.

15.5. The owner reserves the right to interpolate the rates for such items of work falling between similar items of lower and higher magnitude.

SECTION - IV
GENERAL OBLIGATIONS

16. INTERPRETATION OF CONTRACT DOCUMENTS:

16.1. Complete documents forming the contract are to be taken as mutually explanatory. Should there by any discrepancy, inconsistency, error or omission in the contracts or any of them the matter may be referred to Engineer-in-Charge who shall give decisions and Issue to the contractor instructions directing in what manner the work is to be carried out. The decision of Engineer-in-Charge shall be final and conclusive and the contractor shall carry out work in accordance with this decision.

16.2. Works shown in the drawing but not mentioned in the specification or described in specification but not shown in the drawings shall nevertheless be deemed to be included in the same manner as if they had been specifically shown upon the drawings as well as described in the specifications.

16.3. Unless otherwise stated specifically, the 'singular' shall also mean 'plural' and vice versa wherever the context so requires words implying 'persons' shall include relevant 'corporate companies or registered association' or 'body of individuals' or 'firm of partnership' as case may be.

17. SPECIAL CONDITIONS OF CONTRACT:

17.1. Special Conditions of Contract shall be read in conjunction with the General Condition of Contract Specifications of work, drawing and any other documents forming part of this contract wherever the context so requires.

17.2. Notwithstanding the sub-divisions of the documents into the separate sections and volumes each part shall be deemed to be supplementary to complementary of every other part and shall be read with and into the contract so far as it may be practicable to do so.

17.3. In case of any discrepancy between various sections of the contract, the following order of preference shall be observed.

(1) Schedule of quantities
(2) Technical specifications
(3) Special Conditions of Contract
(4) General Conditions of Contract

17.4. Wherever it is mentioned in the specifications that the Contractor shall perform certain work or provide certain facilities it is understood that the Contractor shall do so at his cost.

17.5. The materials, design and workmanship shall satisfy the relevant Indian Standard, the job specifications contained herein and codes referred to.

Where the job specifications stipulate the requirements in addition to those contained in the standard codes and specification, these additional requirements hall also be satisfied.

18. Tenderer to Obtain his Own Information:

18.1. The tenderer shall for all purposes and whatsoever reason may be, deemed to have himself independently obtained all necessary information for the purpose of preparing his tender. The correctness of the details given in the Tender Document as guideline information to help the tenderer but to make-up the tender is not guaranteed.

18.2. The tenderer shall be deemed to have examined the tender documents, to have obtained his own information in all matters whatsoever that might influence carrying out of the works at the scheduled rates and satisfied himself to the sufficiency of his tender. Any error in description or quantity or omission therefrom shall not vitiate the contract or release the contractor from executing the work comprised in the contract according to drawings and specifications at the scheduled rates. He is deemed to know the scope, nature and magnitude of the works, the requirements of materials and labour involved etc. and as what works he has to complete in accordance with the contract document whatever be the defects, omissions or errors that may be found in the Contract Document. The contractor shall be deemed to have visited site and surroundings areas, to have satisfied himself to the nature of all existing structures, and also as to the nature and the conditions of available facilities like Railways, roadways, bridges culverts, means of transport and communications like by land, water or air and possible interruptions thereto the access to and egress from site and to have made enquiries, examined satisfied himself of the sites for obtaining sand, stones, bricks and other materials, the sites for disposal of surplus materials, the available accommodation like depots, buildings as may be necessary for executing and completing the works, to have made local independent enquiries as to the sub-soil water and variations thereof, storms, prevailing winds and climatic conditions and all other similar matters affecting the works. He is deemed to have acquainted himself his liability for payment of Government Taxes, Customs Duties and other charges.

18.3. Any neglect or failure on the part of the tenderer in obtaining necessary and reliable information or issues stated at 18.2 or any other matters affecting the contract shall not relieve him from any risks or liabilities or the entire responsibility for completion of the works at the scheduled rates and time in strict accordance with the contract documents.

18.4. Any change in layout due to site conditions or technological requirement shall be binding on the contractor and no extra claim on this account shall be entertained.

18.5. No verbal agreement or inference from conversation with any officer or employee of the Owner either before, during or after the execution of the contract agreement shall in any way affect or modify and of the terms or obligations herein contained.

19. Security Deposit:

19.1. A sum of 10% of the accepted value of the tender or actual value of the work done whichever is higher for contracts not exceeding Rs. 1 Crore, 71/2 % for the value of contracts over Rs. 1 up to Rs. 5 crores and 5%for the value of contracts over Rs. 5 crores shall have to be deposited by the person/ persons (hereinafter called as contractor) as security deposit with the owner until the expiry of defect liability period.

19.2. This may be deposited initially at 2 ½% of the value of the contract (referred as initial Security deposit) within 20 days of receipt by him of the notification of acceptance of tender and the balance will be recovered in installments through the deduction @ 10% of the gross value of the each running account bill for the contract upto Rs. 1 crore, 71/2 % for contract between Rs. 1 to Rs.5 crores and 5% for contract over Rs. 5 crores, till total security deposit is collected. No further deduction from the bills will be made on this account subject to clause 19.6 below.

19.3. Alternatively the contractor may at his option to deposit the full amount percentage as mentioned 19.1 above towards deposit within 10 days of issue of notification accepting his tender. This amount will have to be suitably enhanced to the tune of above percentage of the executed value.

19.4. The earnest money deposited with the tender shall be adjusted towards security deposit.

19.5. Contractor can furnish the initial or total security deposit amount (a) in Demand Draft or (b) through a Bank Guarantee from any Scheduled bank in the prescribed proforma.

19.6. If contractor /sub-contractor or their employees damages, breaks, deface or destroy the property belonging to the owner or other during the execution of the contract, the same shall be made good by the contractor at his own expense and in default thereof; the Engineer-in-Charge may cause the same to be made good by other agencies and recover expenses form the contractor (for which the certificate of Engineer-in-Charge shall be final).

19.7. All compensation or other sums of money payable by the contractor to the Owner or recoveries to be made under terms of this contract may be deducted from or paid by the sale of a sufficient part of his security deposit or from any sums which may be due or may become due to the contractor by the Owner on any account whatsoever. In the event of his security being reduced by reasons of any such deduction or sale, the contractor shall within ten days

thereafter make good in cash, bank drafts, any sum or sums which may have fallen short or Security deposit amount or any part thereof. No interest shall be payable by the Owner for sum deposited as security deposit.

19.8. The security deposit will be refunded after the expiry of the period of liability as stipulated in the contract.

20. Forfeiture of Security Deposit:

Whenever any claim against the Contractor for the payment of a sum of money arises out of or under the contract, the Owner shall be entitled to recover such sum by appropriating in part or whole the security deposit of the contractor, and to sell any Government securities, etc. forming whole or part of such security deposit. In the event of security being insufficient or if no security has been taken from the contractor, then the balance or the total sum recoverable as the case may be, shall be deducted from any sum then due or which at any time thereafter may become due to the contractor. The contractor shall pay to the Owner on demand any balance remaining due.

In the event of any breach by the contractor or any loss or damage occasioned to the owner which in the opinion of the owner has arises, the decision where of shall be final and binding on the contractor or in the event of the termination of the contract for any such breach, the security deposit is liable to be forfeited. The decision of forfeiture by the Owner shall be final and binding on the contractor.

21. Time of performance:

The work covered by this contract shall be commenced within twenty one days after the issue of the letter of acceptance of tender and be completed in stages on or before the dates as mentioned in the time schedule of completion of works. The contractor should bear in mind that time is the essence of the contract, unless such time be extended pursuant to the provision of clause No.22 Request for Revision of Construction time after tenders are opened will not receive consideration. The above period of twenty one days is included within the overall completion schedule, not over and above the completion time.

22. Extension of Time.

22.0. The application for extension of time is to be given to project head through the engineer –in-charge and the project head may authorise extension of time after considering the due merits.

Whenever extension of time is granted by the project head, the same shall be on the existing terms and conditions of the contract and without any additional financial liability to the Owner. The contractor in any case shall have no claim whatsoever for any type of compensation on account of any delay attributable to any one.

23. Force Majeure:

23.1 Any delays in or failure of the performance of either parties thereto shall not constitute default hereunder or give rise to any claims for damages, if any, to the extent such delays or failure of performance caused by occurrences such as acts of God or the public enemy, expropriation or confiscation of facilities by Government authority, compliance with any order or request of any Governmental authorities, acts or war rebellion, sabotage, fire, floods, explosions riots or illegal strikes, provided always that such occurrences result in impossibility of performances of the contract.

23.2 Only events of Force Majeure which impedes the execution of the contract at the time of its occurrence shall be taken into cognizance.

24. Compensation For Delay:

24.1. Time is essence of the contract. In case the contractor fails to complete the work within the stipulated period, he shall be liable to pay to the Owner as compensation, an amount equal to 1% of the value of contract per week of the delay subject to a maximum of 10% of the value of the contract. This is a genuine pre-estimate of the loss/ damage which will be suffered on account of delay /breach on the part of the contractor and he agrees to pay the said amount on demand without going in for any proof of the actual loss or damages caused by such delay/ breach.

24.2. To ensure good progress during execution of work, the contractor shall be bound in all case in which the time allowed for any work exceeds by one month to complete one-fifth of the work before one-fourth of the time allowed under the contractor has elapsed, three-eighth of the work before the half of such time has elapsed and three-fourth of the work before three–fourth of such time has elapsed. In the event of the contractor failing to comply with this condition, he shall be liable to pay as compensation for delay an amount as stipulated above. The compensation for delay so paid shall not relieve the contractor from his obligations to complete the work or from any other obligations and liabilities under this contract.

25. Failure by the Contractor to Comply with the Provisions of the Contract:

25.1. If the contractor refuses or fails to execute the work or any separate part thereof with such diligence as will ensure its completion within the time specified in the contract or extension thereof or fails to perform any of his obligation under the Contract or in any manner commits a breach of any of the provisions of the contract it shall be open to the Owner at its option by written notice to the Contractor to: -

(a) Determine the Contract: In which event the Contract shall stand terminated and shall cease to be in force and effect on and from the date appointed by the Owner on that behalf, whereupon the contractor shall stop forth with any of the contractor's work then in progress, except such work as the Owner may, in writing, requires to be done to safeguard any property or work, or

installations from damage, and the owner, for its part, may take over the work remaining unfinished by the Contractor and complete the same through fresh contractor or by other means, at the risk and cost of the Contractor, and any of his sureties if any, shall be liable to the owner for any excess cost occasioned by such work having to be so taken over and completed by the Owner over and above the cost at the rates specified in the schedule of quantities and rates.

(b) Without determining the Contract: To take over the work of the contractor or any part thereof and complete the same through a fresh contractor or by other means at the risk and cost of the Contractor. The contractor and any of his sureties are liable to the Owner for any excess cost over and above the cost at the rates specified in the schedule of quantities/ rates, occasioned by such works having been taken over and completed by the Owner. Besides, the contractor shall also be liable for any compensation accruing under clause 24.

(c) In other cases, the decision of the Owner is binding on the contractor.

25.2. In such events of clause 25.1 (a) or (b) above

(a) The whole or part of the security deposit furnished by the Contractor is liable to be forfeited without prejudice to the right of the Owner to recover from the contractor the excess cost referred to in the sub-clause aforesaid, the Owner shall also have the right of taking possession and utilizing in completing the works or any part thereof, such of materials, equipment and plants available at work site belonging to the contractor as may be necessary and the Contractor shall not be entitled for any compensation for use or damage to such materials, equipment and plant.

(b) The amount that may have become due to the Contractor on account of work already executed by him shall not be payable to him until after the expiry of six (6) calendar months reckoned from the date of termination of contract or from the taking over of the work or part thereof by the Owner as the case may be, during which period the responsibility for faulty materials or workmanship in respect of such work shall under the contract, rest exclusively with the contractor. This amount shall be subject to deduction of any amounts due from the Contractor to the Owner under the terms of the contract authorised or required to be reserved or retained by the Owner.

25.3. Before determining the contract as per clause 25.1 (a) or (b) provided in the judgement of the Owner, the default or defaults committed by the Contractor is/are curable and can be cured by the Contract if an opportunity given to him, then the Owner may issue notice in writing calling the Contractor to cure the default within such time specified in the notice.

25.4. The Owner shall also have the right to proceed or take action as per 25.1 (a) or Clause 25.1(b) above, in the event that the contractor becomes bankrupt, insolvent, compounds with his creditors, assigns the contract in favour of his

creditors or any other person or persons or being a company or a corporation goes into liquidation, provided that in the said events it shall not be necessary for the Owner to give any prior notice to the contractor.

25.5. Termination of the Contract as provided for in sub-Clause 25.1 (a) above shall not prejudice or affect their rights of the Owner which may have accrued upto the date of such termination.

26. Contractor Remains Liable to Pay Compensation if Action Not Taken Under Clause 25.

In any case in which any of the powers conferred upon the owner by clause 25 hereof shall have become exercisable and the same had not been exercised, the non-exercise thereof shall not constitute a waiver of any of the conditions hereof and such powers shall not withstanding be exercisable in the event of any further case of default by the contractor for which by any clause or clauses hereof he is declared liable to pay compensation amount to the whole of his security deposit and the liability of the contractor for past and future compensation shall remain unaffected. In the event of the Owner putting in force the powers vested in him under the proceeding clause no. 25 he may if he do so desires, take possession of all or any tools and plants, materials and stores in or upon the works of the site thereof belonging to the contractor or procured by him and intended to be used for the execution of the work or any part thereof paying or allowing for the same in account at the contract rates or in case of these not being applicable at current market rates to be certified by the Engineer-in-Charge whose certificate thereof shall be final, otherwise the Engineer-in-Charge may give notice in writing to the contractor or his clerk of the works, foremen or other authorised agent, requiring him to remove such tools, plant, materials or stores form the premises (within a time to be specified in such notice), and in the event of the contractor failing to comply with any such requisition, the Engineer-in-Charge may remove them at the contractor's expenses or sell them by auction or private sale on account of the contract and at his risk in all respects without any further notice as to the date, time or place of sale and the certificate of the Engineer-in-Charge as to the expense of any such removal and the amount of the proceeds and expenses of any such sale shall be final and conclusive against the contractor.

27. No Compensation For Alteration in or Restriction of Work:

At any time from the commencement of the work if the Owner decides for whatsoever reason, not to carryout the whole work or part thereof as specified in the tender, then owner shall give notice in writing of the fact to the contractor, who shall have no claim to any payment or compensation on whatsoever account (profit or advantage which he might have derived by executing the work in full) neither shall he have any claim for compensation by reason of any alterations having been made from the original specifications, drawings, designs and instructions which may involve any curtailment of the work as originally contemplated.

28. Change in Constitution:

When the contractor is a partnership firm the prior approval in writing from the Owner shall be obtained before any changes are made in the constitution of the firm, where the contractor is an individual or a Hindu undivided family business concern. Such approval as aforesaid shall, like wise be obtained before such contractor enters into any agreement with other parties, where under the reconstituted firm would have the right to carry out the work hereby undertaken by the contractor. In either case if prior approval is not obtained. The contractor shall be deemed to have been allotted in contravention of Clause - 34 hereof and the action and consequence shall ensure as provided in that clause.

29. Termination of Contract For Death:

If the Contractor is an individual or a proprietary concern and the individual or the proprietor dies or if the contractor is a partnership concern and one of the partners dies then, unless the Owner is satisfied that the legal representative of the individual or the proprietary concern or the surviving partners are capable of carrying out and completing contract, he (the Owner) is entitled to cancel the contract for the uncompleted part without being in any way liable for any compensation payment to the estate of the diseased contractor and/or to the surviving partners of the contractor's firm on account of the cancellation of contract. The decision of the Owner in such assessment shall be final and binding on the parties. In the event of such cancellation, the Owner shall not hold the estate of the diseased contractor and / or the surviving partners of the contractor's firm liable for any damages for non-completion of contract.

30. Members of the Owner Not individually Liable:

No Director or official or employee of the Owner shall in any way be personally bound or liable for the acts or obligations of the Owner under the contract or answerable for any default or omission in the observance or performance of the acts, matters or things which are herein contained.

31. Owner Not Bound by Personal Representation:

The Contractor shall not be entitled to any increase on the scheduled rates or any other rights or claims whatsoever by reason of any representation, explanation, statement or alleged understanding promise or guarantees given or to have been given to him by any person.

32. Contractors Office at Site:

The Contractor shall provide and maintain an office at the site for the accommodation of his agent and staff and such office shall be open at all reasonable hours to receive instructions, notices or other communications. The contractor at all time shall maintain a site instruction book and compliance of these shall be communicated to the Engineer –in-Charge from time to time and the whole document to be preserved and handed over after completion of works.

33. Contractor's Sub-ordinate Staff and their conduct :

33.1. The contractor on award of the work shall name and depute a qualified engineer having sufficient experience in carrying out work of similar nature to whom the equipment, materials if any, shall be issued and instruction for works given. The contractor shall also provide to the satisfaction of the Engineer-in-charge sufficient and qualified staff to supervise the execution of the works, competent sub-agents, foremen and leading hands including those specially qualified by previous experience to supervise the types works comprised in the contract in such manner as will ensure the best quality and expeditious working. At any time of in the opinion of the Engineer-in-Charge any additional, qualified experienced staff is considered necessary, they shall be employed by the contractor without additional charge. The contractor shall ensure to the satisfaction of the Engineer-in-Charge that sub-contractors, if any, shall provide competent and efficient supervision over the work entrusted to them.

33 .2. If any of the contractor's sub-contractor's, agents, sub-agents, assistants, foremen or any employee in the opinion of Engineer-in-Charge be guilty of any misconduct or be incompetent or insufficiently qualified or negligent in the performance of their duties or that in the opinion of the Owner Engineer-in-Charge, undesirable for administrative or any other reasons, for such or person (s) to be employed on the works, then at the directions of Engineer-in-Charge the Contractor shall at once remove such person (s) from employment with the works without the written permission of the Engineer –in-Charge. Vacancy so created shall be immediately filled at the expenses of the contractor by a qualified and competent substitute. Should the contractor be requested to repatriate any person removed from the works he shall do so and shall bear all costs in connection therewith.

33.3. The contractor shall be responsible for the proper behaviour of all the staff, foremen, workmen and others, shall exercise proper degree of control over them and in particular without prejudice to the said generality the contractor shall be bound to prohibit/ prevent any employees from trespassing or acting in any way detrimental or prejudicial to the interest of the community or the properties or the occupiers of land or properties in the neighborhood. In the event of such trespassing, the contractor shall be responsible for all consequent claims or actions for damages or injury or any other grounds whatsoever. The decision of the Engineer-in-Charge upon any matter arising under this clause shall be final.

33.4. If and when required by the Owner, all contractor's personnel entering upon the owner's premises shall be properly identified by badges of a type acceptable to the owner which must be worn at all times on Owner's premises.

33.5. It is made clear that no relationship of employer and employee is created between the owner and the contractor labourer and no claim for employment of any such labourer shall be tenable or entertained.

34. Sub-Letting Work:

34.1. No part of the contract nor any share or interest there in shall in any manner or degree be transferred, assigned or sublet by the contractor directly or indirectly to any person, firm or corporation whatsoever except as provided for in the succeeding sub-clauses without the consent in writing of the Owner.

34.2. Sub – Contracting of Works:

The Engineer-in-Charge may give written consent to sub-contract for the execution of any part of the works at the site, provided the contractor submits each individual sub-contract to the Engineer-in-Charge for approval of mode of operation and agency for the work. The contractor is advised not to enter into contract before the consent of Engineer-in-Charge.

34.3. **List of sub-contracted works to be furnished:**

At the commencement of each month, the contractor shall furnish to the Engineer-in-charge, a list of sub-contractors, persons or firms engaged by the contractor and worked at the site during the previous month with particulars like general nature of the sub-contract or works done by them.

34.4. Contractor's liability not Limited by Sub-Contractors:

Notwithstanding any sub-letting with such approval as aforesaid and notwithstanding that the Engineer-in-Charge shall have received copies of any sub-contracts, the contractors shall be and shall remain solely responsible for the quality and proper and expeditious execution of the works and the performance of all the conditions of the contract in all respects as if such sub-contract or sub-letting had not taken place, and as if such work had been done directly by the contractor.

34.5. Owner may terminate sub-contracts:

If any sub-contractor engaged upon the works at the site executes any work which in the opinion of the Engineer-in-Charge is not in accordance with the contract documents, the owner may by written notice to the contractor request him to terminate such sub-contract. The contractor upon the receipt of such notice shall terminate and dismiss the sub-contract and the sub-contractor. The owner shall have the right to remove such sub-contractor from the site if contractor fails to vacate the sub-contractor immediately.

34.6. No remedy for action taken under this clause:

For action taken by the owner under the clause shall not relieve the contractor of any of his liabilities under the contract or give rise to any right or compensation, extension of time or otherwise.

35. Power of Entry:

If the contractor shall not commence the work in the manner described in the contract documents or if he at any time in the opinion of the Engineer-in-Charge.

(i) fail to carry on the works in conformity with the contract documents or
(ii) fail to carry on the works in accordance with the contract schedule or
(iii) substantially suspend work or the works for a period of fourteen days without authority from the Engineer-in-Charge or
(iv) fail to carry on and execute the works to the satisfaction of Engineer-in-Charge or
(v) fail to supply sufficient or suitable constructional plant, temporary works, labour materials or other things or
(vi) Commit, suffer or permit any other breach of any of the provisions of the contract on his part to be performed or observed or persist in any of the above mentioned breaches of the contract for fourteen days, after notice in writing shall have been given to the contractor by the Engineer-in-Charge requiring such breach to be remedied or
(vii) If the contractor abandons the works or
(viii) If the contractor during the continuance of the contract shall become bankrupt, make any arrangement or composition with his creditors, or permit any execution to be levied or go into liquidation whether compulsory or voluntary not being merely a voluntary liquidation for the purpose of amalgamation or reconstruction then in any such case, the owner shall have the power to enter upon the works and take possession thereof and of the materials, temporary works, constructional plant, and stock thereon, and to revoke the contractor's licence to use the same, and to complete the works by his agents, other contractors, or workmen, or to relate the same upon any terms and to such other person, firm or corporation as the Owner in his absolute discretion may think proper to employ and for the purpose aforesaid to use or authorize the use of any materials, temporary works, constructional plant, and stock as aforesaid, without making payment or allowance to the contractor for the said materials other than such as may be certified in writing by the Engineer-in-Charge to be reasonable, and without making any payment or allowance to the contractor for the use of temporary said works, constructional plant and stock or being liable for any loss or damage thereto and if the Owner shall by reason or his taking possession of the work or of the works being completed by other contractor (due account being taken of any such extra work or works which may be omitted) than the amount of such excess as certified by the Engineer–in-Charge shall be deducted form any money which may be due for work done by the contractor under the contract and not paid for any deficiency shall forthwith be made good and paid to the Owner by the contractor and the Owner shall have power to sell in such manner and for such price as he may think fit all or any of the constructional plan, materials etc. constructed by or belonging to and

to recoup and retain the said deficiency or any part thereof out of the proceeds or the sale.

36. Contractor's Responsibility with other Agencies:

36.1 Without repugnance to any other condition, it shall be the responsibility of the contractor executing the work of civil construction to work in close cooperation and to coordinate in the works with the mechanical, electrical, air-conditioning and intercommunication contractors and other agencies or their authorised representatives, in providing the necessary grooves, recesses, cuts and opening etc. in wall, slabs beams and column etc. and making good the same to the desired finish as per specification, for the placement of electrical and intercommunication cables, conduits, air-conditioning inlets and outlets, grills and other equipment in the false ceiling and other partitions, the contractor before starting up the work shall in consultation, with the electrical, mechanical, inter-communication, air-conditioning contractors and other agencies prepare and put up a joint scheme, showing the necessary opening, grooves, recesses, cuts, the methods of fixing required for the works of the aforesaid, and the finishes therein, to the Engineer-in-Charge and get the approval. The contractor before finally submitting the scheme to the Engineer-in-Charge, shall have the written agreement of the other agencies. The Engineer-in-Charge, before communicating his approval to the scheme, with any required modifications shall get the final agreements of all the agencies, which shall be binding. No claim shall be entertained on account of the above.

36.2 The contractor shall conform in all respect with the provisions any statutory regulation, ordinance or bye-laws of any local or duly constituted authorities or public bodies which may be applicable from time to time to the works or any temporary works. The contractor shall keep the Owner indemnified against all penalties and liabilities of every kind, arising out of non-adherence to such statues, ordinances, laws, rules, regulations, etc.

37. Other Agencies at Site:

The contractor shall have to execute the work in such place and condition where other agencies will also be engaged for other works such as site grading, filling and leveling, electrical and mechanical engineering works etc. No claim shall be entertained due to work being executed in the above circumstances.

38. Serving of Notices:

38.1. To the Contractor:

Any notice may be served on the contractor or his duly authorised representatives at the job site or by registered mail directly to the address furnished by the contractor. Proof of issue of such notice should be conclusive of the contractor having been duly informed of the contents.

38.2. To the Owner:

Any notice to be given to the Owner under the terms of the contract shall be served by sending the same by Registered mail to or delivering the same at the respective site offices of M/s. National Aluminium Co. Ltd. addressed to the head/ site in-charge.

38.3. Rights of various Interests:

(i) The Owner reserves the right to distribute the work between more than one contractor. The contractor shall cooperate and afford the other contractors all reasonable opportunity for access to the works for the carriage and storage of materials and execution of their works.

(ii) Wherever the work being done by any department of the Owner or by the contractor employed by the Owner as per the contingent upon work covered by this contract, the respective rights and various interests involved shall be determined by the Engineer-in-Charge to secure the completion of the various portions of the work in general harmony.

40. Patents, Royalties, Rent and Excavated Material:

40.1. The contractor, if licensed under any patent covering equipment, machinery, materials or compositions of matter to be used or supplied or methods and process to be practiced or employed in the performance of this contract, agrees to pay all royalties and licence fees which may be due with respect thereto. If any equipment, machinery, materials composition matters, to be used or supplied or methods and processes to be practiced or employed the performance of this contract, is covered by a patent under which the contractor is not licensed then the contractor before supplying or using the equipment, machinery, materials, composition, method or processes shall obtain such licenses and pay such royalties and license fees as may be necessary for performance of this contract. In the event the contractor fails to pay any royalty or obtain any such license, any suit for infringement of such patents which is brought against the contractor or the Owner as a result of such failure will be defended by the contractor at his Own expense and the contractor will pay damages and costs awarded in such suit. The contractor shall promptly notify the Owner if the contractor has acquired knowledge of any plant under which a suit for infringement could be reasonably brought because of the use by the owner of any equipment, machinery, materials, process, methods, to be supplied hereunder. The contractor agrees to and does hereby grant to Owner, together with the right to extent the same to any of the subsidiaries of the Owner as irrevocable, royalty-free licence to use in country, any invention made by the contractor or his employee in or as a result of the performance of the work under the contract.

40.2. All charges on account of royalty, tollage, rent octroi terminal or sales tax and/ or other duties or any other levy on materials obtained for the work or temporary work or part thereof (excluding materials provided by the Owner) shall be borne by the contractor.

40.3. The contractor shall not set or otherwise dispose of or remove except for the purpose of this contract, the sand stone, clay, ballast, earth, rock or other substances, or materials obtained from any excavation made for the purpose of the works or any building or produce upon the sited at the time of delivery of the possession thereof, but all such substances, materials buildings and produce shall be the property of the Owner provided that contractor may with the permission of the Engineer-in-Charge, use the same for the purpose of the works by payment of cost of the same at such a rate as may be determined by the Engineer-in-Charge.

The Owner shall indemnify and save harmless the contractor from any loss on account of claims against contractor for the contributory infringement of patent rights arising out and based upon the claim that the use by the Owner of the process included in the design prepared by the Owner and used in the operation of the plant infringes on patent right. With respect of any sub-contract entered into by the contractor pursuant to the provisions on the respect to any sub-contract entered into by the contractor pursuant to the provisions of the relevant clause thereof, the contractor shall obtain from the sub contractor an undertaking to provide the Owner with the same patent protection that contractor is required to provide under the provisions of this clause.

41. Liens:

41.1. If at any time there should be evidence or any lien, claim for which the Owner might have become liable, which is chargeable to the contractor, then the Owner may pay and discharge the same and deduct the amount so paid from any amount which may be or may become due and payable to the contractor, if any lien or claim remain unsettled after all payments are made, the contractor shall refund or pay to the Owner the cost such lien or claim including all payment and reasonable expenses. Owner reserves the right to the same.

41.2. **Nothing Extra for Adverse Sub-Soil Conditions**:
The nature of sub-soil of the work site varies widely horizontally and vertically. The KI and KII values also vary widely from place to place. In addition the water bearing seems are also conspicuous with the water table at a depth of 0.75 to 3.0 metres from ground level. A number of cohesive and non-cohesive strata are available particularly everywhere. The contractor shall have to make cuts and resort to pumping with due care to avoid collapsing of sides and occurrence of 'Piping'. The Contractor shall also be careful to avoid occurrence of excessive 'heaving' by avoiding keeping the excavation proposed to atmosphere for a longer period.

41.3. Slips and falls in excavation shall be cleared by the contractor at his own cost.

Excessive heaving shall have to cut and refill with lean concrete by the contractor at his own cost. The contractor shall have to adopt under-water work in case of occurrence of piping/ quick condition without any additional cost to the Owner.

The contractor will be paid for the earthwork as per the drawing. The slopes etc. as required for the safety of the work has to be provided as per the decision of the Engineer-in-Charge at his own cost. All types of dewatering including seepage, rain water entering. The earthwork in excavation or from any other source is to be done by the contractor at his own cost till the completion of foundation upto ground level including back filling.

41.3. No Compensation in case of change of Location of site :

Change of location of site do not invalidate the contract and tenderer have no claim for any compensation for such changes.

SECTION – V
PERFORMANCE OF WORK

42. **Execution of Works**:
All the work shall be executed in strict conformity with the provisions of the contract documents explanatory detailed drawings, specifications and instructions by the Engineer-in-Charge whether mentioned in the contract or not. The contractor shall be responsible for ensuring that works are executed in the most substantial, proper and workman like manner using the quality materials and labour, through out the job Completion in strict accordance with the specifications and to the entire satisfaction of the Engineer-in-Charge.

43. **Coordination and inspection of Works**:
The coordination and inspection of the day-to-day work under the contract shall be the responsibility of the Engineer-in-Charge or his authorised representative. A work order book will be maintained by the contractor for each sector in which the aforesaid written instructions will be entered. These will be signed by the contractor or his authorised representative by way of acknowledgement within 12 hours.

44. Works in Monsoon and Dewatering:

44.1 The execution of work may entail working in the monsoon also. The contractor must maintain a minimum labour force as may be required for the job. And plan execute the construction and erection according to the prescribed schedule. No extra will be considered for such work in monsoon.

44.2 During monsoon and other period, it shall be the responsibility of the contractor to keep the construction work site free from water at his own cost.

45. Work on Sundays and Holidays:
For carrying out works on Sundays and holidays, the contractor will to keep Engineer-in-Charge or his representative at least two days in advance and obtain permission in writing. The contractor shall observe all labour laws and other statutory rules and regulations in force. In case of any violation of such laws, rules and regulations, consequence if any, including the cost thereto shall be exclusively borne by the contractor and the Owner shall have no liability whatsoever on his account.

46. General Conditions of Construction and Erection Work:

46.1 The working time at the time of work is 48 hours per week. Overtime work is permitted in case of need and the owner will not compensate the same. Shift-working at 2 or 3 shifts per day will become necessary and the contractor should take this aspect into consideration for formulating his rates for quotation. No extra claims will be entertained by the Owner on this account.

46.2 The contractor must arrange for the placement of workers in such a way that the delayed completion of the work or any part thereof or for any reason whatsoever will not affect their proper employment. The Owner will not entertain any claim for old time payment whatsoever.

46.3 The contractor shall submit to the Engineer-in-Charge reports at regular intervals regarding the state and progress of work. The contract shall provide display boards showing progress and labour strength at work site, as directed by the Engineer-in-Charge.

46.4 The site of work will be released progressively in stages and no claim for any compensation or damages will be tenable for non-release of the entire site at a time.

47. Drawings to be supplied by Owner:

47.1 The drawings attached with tender are only for the general guidance to the contractor to enable him to visualise the type of work contemplated. The contractor will be deemed to have studied the drawings and formed an idea about the total work involved.

47.2 In the Course the progress of work detailed working drawings on the basis of which actual execution of the work has to proceed, shall be furnished in stages. The contractor shall be deemed to have gone through the drawings supplied to him thoroughly and carefully, in conjunction will all other connected drawings and discrepancies if any, shall be brought to the notice of the Engineer-in-Charge, before actually carrying out the works.

47.3 Copies of all detailed working drawings relating to the works shall be kept at the contractor's office on the site and shall be made available to the Engineer-in-Charge at any time during the contract period. The drawings and other documents issued shall be returned to the Owner on completion of the works.

48. **Drawings to be supplied by the Contractor**:

48.1 The drawings/data which are to be furnished by the contractor are enumerated in the special conditions of contract and shall be furnished within the specified time.

48.2 Where approval of drawings for manufacture/construction/fabrication has been specified it shall be contractor's resposibility to have these drawings prepared as pe r the directions of Engineer-in-Charge and get them approved before proceeding with manufacture/construction/fabriction works as the case may be. Any changes that may have become necessary in these drawings during the execution of the work shall have to be carried out by the contractor to the satisfaction of Engineer-in-Charge at no extra cost. All final approved drawings shall bear the certification stamp duly signed by both the contractor and the Engineer-in-Charge as indicated below.

"Certified true for …….
(Name of work)

Agreement No ……

Signed
(**Contractor**) (**Engineer-in-Charge**)

48.3 A period of 3 weeks from the date of receipt shall be required for approval of drawings by the Engineer-in-Charge.

48.4 As built drawing showing all Corrections, adjustments etc. shall be furnished by the Contractor in five copies and one transparent to record purposes to the owner.

49 Setting Out Works:

49.1 The Engineer-in-Charge shall furnish to the contractor with only the four corners of the work site that is plant boundary limits, and a level bench mark only. The contractor shall set out the works, provide an efficient staff for the purpose and shall be solely responsible for the accuracy of such setting out.

49.2 The contractor shall provide, fix and be responsible for the maintenance of all stacks, templates, level marks, profiles and other similar things and shall take all necessary precautions to prevent their removal or disturbance. He shall be responsible for their consequences arising of such removals, disturbances corrections thereon and for their efficient and timely reinstatement. The contractor shall also be responsible for the maintenance of all existing survey marks, boundary marks, distance marks and centre line marks, either existing or supplied and fixed by the contractor. The work shall be set out to the satisfation of the Engineer-in-Charge. The approval thereon or jointing with the contractor by the Engineer-in-Charge in setting out the work, shall not relive the contractor of any of his responsibilities.

49.3 Before beginning the work the contractor shall at his own cost, provide all necessary reference and level posts-pegs, bamboos, flags, ranging rods, strings, and other materials for proper layout of the work in accordance with the scheme for bearing marks acceptable to the Engineer-in-Charge. The centre, longitudinal, face and cross lines shall be marked by means of small masonry pillars. Each pillar shall have distinct mark at the centre to eable the theodolite to be set over it. No work shall be started until all these points arechecked and approved by Engineer-in-Charge in writing, but such approval shall not relieve the contractor of any of his responsibilities. The contractor shall also provide all labour, materials and other facilities as necessary, for the proper checking or layout and inspection of the points during construction.

49.4 Pillars bearing geodetic marks located at the sites of units of works under construction should be protected and faced by the contractor.

49.5 On completion of work, the contractor must submit the geodetic documents according to which the work was carried out.

50. Responsibility for Level and Alignment:

50.1 The contractor shall be entirely and exclusively responsible for the horizontal and vertical alignment, the level and correctness of every part of the work shall rectify effectually any errors or imperfections therein. Such rectification shall be carried out by the contractor at his own cost, when instructions are issued to that effect by the Engineer-in-Charge.

50.2 Lighting, Watch & Ward:

The contractor shall in connection with works provide and maintain at his own cost all lightings, guards, fencing and watch and ward and the security of the entire work in progress in cluding all the machineries, materials shall be the responsibility of the contractor till taken over by the owner by way of the written taking over certificate.

51. Materials to be Supplied by Contractor :

51.1 The contractor shall procure and provide the whole of the materials required for the construction including M.S. Rods, Cement and other building materials, tools, tackles, construction plant and equipment for the completion and maintenance of the work except the materials which will be issued by the Owner and shall make his own arrangement for procuring such materials and for the transport thereof. The owner may give necessary recommendation to the respective authorities, if so desired by the contractor, but assumes no further responsibility of any nature. The owner will insist on the procurement of materials which has the approval of Indian Standards Institution having ISI stamp and/or which are supplied by reputed suppliers borne on DGS & D list.

51.2 The contractor shall properly store all materials either issued to him or brought by him to the worksite to prevent damages due to rain, wind, direct exposure to sun etc. as also from theft, pilferage, etc. for proper and speedy execution of his works. The contractor shall maintain sufficient stocks of all meterials required by him.

51.3 No material shall be despatched from the contractor's stores before obtaining the approval in writing of the Engineer-in-Charge.

51.4 All plants, tools and other materials brought by the contractor to the site must be declared at the time of bringing the same to the site.

52. Stores Supplied by the Owner:

52.1 If the specification of the work provides for the use of any material other than Steel & Cement of special description to be supplied from the Owner's stores or it is required that the contractor shall use certain stores to be provided by

the Engineer-in-Charge, such materials and stores, and price to be charged therefore as hereinafter mentioned being so far as practicable for the convinience of the contractor, but no so as in way to control the meaning or effect of the contract, the contract shall be bound to purchase and shall be supplied much materials and stores as are from time to time required to be used by him for the purpose of the contract only. The sums due from the contractor for the value of materials supplied by the Owner will be recovered from the Running Account Bill on the basis of actual consumption of materials (after taking into account any wastage allowance as may be provided for in the contract). The contractor should raise requisite copies of indents in a proforma as prescribed by the Engineer-in-Charge and no claim whatsoever will be entertained by the Engineer-in-Charge on this account. After completion of the works, the contractor is required to account as per relevant clauses in this document, for the full quantity of materials supplied to him.

52.2The value of the stores/materials as may be supplied to the contractor by the Owner will be debited to the contractor's account at the rates shown in the schedule of materials and if they are not entered in the schedule, they will be debited at cost price, which for the purpose of thecontract shall include the cost of carriage and all other expenses whatsoever such as normal storage supervision charges which shall have been incurred in obtaining the same at the Owner's stores. All materials so supplied to the contractor shall remain the obsolute property of the Owner and shall not be removed on any account from the site of the work and shall be at all times open for inspection to the Engineer-in-Charge. Any such materials remaining unused at the time of the completion or termination of the contract shall be returned to the Owner's stores or at a place as directed by the Engineer-in-Charge in perfectly good condition at contractor's cost.

52.3 Steel & Cement:

52.3.1 If the specification of the work provides for the use of steel or cement such items of steel and cement to the extent required as per the specification of the works, shall be supplied at Owner's stores by the Owner for utilisation in the work on non-chargable basis from time to time depending upon the progress of the work. The tender rates shall be exclusive of the cost of steel and cement to be supplied as per the specification of the work, However, in case of flats and chequeuered plates the same have to be procured by the contractor at his own cost.

52.3.2 Such materials of steel and cement shall be issued only for permanent works and not for making other temporary works etc. Contractor shall bear all cost including lifting and loading carting from issue points to work site/contractor stores, custody and handling etc. and return of surplus serviceable/unserviceable materials to owner's store or other places to be designed by owner and no separate payment for such expenditure shall be made.

52.3.3 Items of steel as per specification of the work as mentioned above shall be supplied in the available length only. No claim on account of supply of non-standard length shall be entertained. Steel materials shall be issued on actual weight basis.

52.3.4 Cement as mentioned above will be supplied to the contractor a receive from the manufacturer/stockist. The theoretical weight of each bag of cement supplied will be considered as 50 Kg.

52.3.5 Scraps & Surplus Material:

The Contractor shall return all the surplus/unutilised as well as the scraps and wastages out of the materials supplied to him to the Owner's stores in a perfectly good condition at the contractor's cost. However, the following scraps allowances are permissible.

		Unaccountable	Accountable
(i)	Cement	3%	Nil
(ii)	Reinforcement Steel	½%	2.5%
(iii)	Steel structural (Plates & Sections)	½%	4.5%
(iv)	M.S. Plates for fabrication of Pipes	½%	As per cutting diagrams approved by Engineer-in-Charge before cutting and fabrication.

52.3.6 Return of unutilised/surplus materials and scrap/wastage:

In respect of any utilised/surplus quantities of cement and steel supplied by not accounted for and or returned by the contractor shall pay to the Owner amounts at the penal rate of twice the SAIL, Bhubaneswar Stock-yard rate of that particular section of steel and cement as the case may be as on the date of accountability. If the Contractor fails to return the scraps/wastage generated as per the above percentage, recovery of such scrap/wastage shall be made at the rate of Rs. 7000/- per tonne.

The charging of penal rate shall be without the prejudice to the other remedies or action available to the owner against the contractor including any criminal action.

52.3.7. **Accounting for Materials:**

Every month the Contractor shall submit a statement for all the materials supplied to him by the owner in the proforma prescribed by the Engineer-in-Charge.

52.3.8 On completion of the work, the Contractor shall submit material appropriation statement for the materials supplied to him by the Owner.

52.3.9 All materials supplied to the contractor shall remain the absolute property of the all times and title therein shall not pass to the contractor at any time. The possession of the materials in the hands of the contractor is only for the

purpose of incorporating the same in the Owner's work. The material supplied shall not be removed by the contractor on any account from the site of work and shall be at all times open for inspection by the Engineer-in-Charge or owners reprsentative. The contractor shall not use the materials supplied to him for any purpose or work other than the work, which the said materials are supplied.

53. **Conditions for issue of Materials:**

(i) Materials specified as to be issued by the Owner will be supplied to the contractor by the Owner from his stores. It shall be the responsibility of the contractor to take delivery of the materials and arrange for its loading, transport and unloading at the site work at his own cost. The material shall be issued during the working hours of his Stores and as pe the rules of the Owner framed from time to time.

(ii) The contractor shall bear all incidental charges for the storage and safe custody of materials at site after these have been issued to him.

(iii) The contractor shall construct suitable godown at the site of work for storing the materials safe against damage by rain, dampness, fire, theft, etc. He shall also employ necessary watch and ward establishment for the purpose.

(iv) Materials specified as to be issued by the Owner shall be issued in standard sizes as obtained from the manufacturers.

(v) It shall be duty of the contractor to inspect the materials supplied to his at the time of taking delivery and satisfy himself that they are in good condition. After the materials have been delivered by the Owner, it shall be the responsility of the contractor to keep them in good condition and if the materials are damaged or lost, at any time, they shall be repaired and.or replaced by him at his own cost according to the directions of the Engineer-in-Charge.

(vi) The Owner shall not be liable for delay in supply or non-supply of any materials, which the Owner has unertaken to supply where such failure or delay is due to natural calamities, act of enemies, transport and procurement difficulties and any circumstances beyond the control of the Owner. In no case, the contractor shall be entitled to claim any compensation or loss suffered by him on his account.

(vii) It shall be the responsibility of the contractor to arrange in time all materials required for the works other than those to be supplied by the Owner. If however in the opinion of the Engineer-in-Charge the execution of the work. Is likely to be delayed due to the contractor's inability's to make arrangements for supply of materials which normally he has to arrange for, the Engineer-in-Charge shall have the right at his own discretion to issue such materials if available with the Owner or procure the materials from the market or elswhere. The contractor will be bound to take such materials at the rates decided by the Engineer-in-Charge. This however, does not in anyway absolve the contractor from responsibility of making arrangement for the supply of such materials in part or in full, should such a situation occur nor shall this constitute a reason for the delay in the exectution of the work.

(viii) Non of the materials supplied to the contractor will be utilised by the contractor for manufacturing item which can be obtained as supplied from standard manufacturer in finished form unless approved by Engineer-in-Charge in writing.

(ix) The contractor shall, if desired by the Engineer-in-Charge, be required to execute an indemnity bond in the prescribed form for safe custody, usage and accounting of all materials issued by the Owner.

(x) The contractor shall furnish to Engineer-in-Charge sufficiently in advance a statement showing his requirements of the quantities of the materials to be supplied by the Owner and the time when the same will be required by him for the works, so as to enable the Engineer-in-Charge to make necessary arrangement for procurement and supply of material.

(xi) Account of the materials to be issued by the Owner shall be maintained by the contractor indicating the daily receipt, consumption and balance in hand in a manner prescribed by the Enginner-in-Charge. All connected papers requisitions, issues returns etc. shall be always available for inspection in the contractor's office at site.

(xii) The contractor should see that only the required quantities of materials are got issued. The contractor shall not be entitled to cartage and incidential charges for returning the surplus materials, if any, to the stores, place of issue or to the place as directed by the Engineer-in-Charge.

(xiii) Materials/equipment supplied by Owner shall not be utilised for any other purpose (s) than issued for.

(xiv) The owner may issue the material in phases at his discretion keeping in view the programmes of the work.

(xv) In case of free issue of materials, the contractor shall submit an indemnity bond in the prescribed format for 80% (eighty) value of the materials and a bank guarantee for 20% (twenty) of the value of the materials. The indemnity bond and bank guarantee shall be valid till the material acount is totally settled.

54. **Return of Surplus:**

Notwithstanding anything contained to the contrary in any or all the clauses of this contract where any materials for the execution of the contract are procured with the assistance of the Owner either by issue from Owner's stock or purchases made under orders, or permits or licences issued by government the contractor shall hold the said materials as trustee for the owner and use such materials economically and solely for the purpose of the contract and not dispose them off without the permission of the Owner and return, if required by the project head all surplus or unserviceable materials that may be left with him after the completion of the contract or at its termination for any reason whatsoever on his being paid or credited such price as the Project head shall determine having due regard so the condition of the materials. The price allowed to the contractor however, shall not exceed the amount charged to him excluding the storage charges, if any. The decision of the project head shall be final and conclusive in such matter. In the event of breach of the aforesaid conditions, the contractor shall, in the terms of the licences, or permits and/ or

for criminal breach of trust, be liable to compensate the Owner at double rate or any higher, in the event of those materials at the time having higher rate or not being available in the market, then any other rate to be determined by the project head and his decision shall be final and conclusive.

55. **Materials Obtained From Dismantling:**
If the contractor in the course of execution of the work is called upon to dismantle any part for reasons other than those stipulated in clauses 57 and 65 hereunder, the materials obtained in the work of dismantling etc. will be considered as the Owner's property and will be disposed off to the best advantage of the Owner.

56. **Articles of Value Found:**
All gold silver and other materials of any descriptions, precious stones, coins, treasures, relics, antiques and other similar things which shall be found, in, under or upon the site, shall be property of the Owner and the contractor shall duly preserve the same to the satisfaction of the Engineer-in-Charge and shall from time to time delivery the same to such person or persons indicated by the Owner.

57. **Inspection of Works:**

57.1 The Engineer-in-Charge will have full power and authority to inspect the works in progress at any time wherever the premises/ workshops situated, of the Contractor, person, firm or corporation where works in connection with the contract may be or where materials are being or intended to be supplied.. The contractor shall afford or procure every facility and assistance to Engineer-in-Charge carry out such inspection. The contractor shall, at all time during the usual working hours and at all other times at which reasonable notice of the intention of the Engineer-in-Charge or his representative to visit the works shall have been given to the contractor, either himself be present to receive orders and instructions or have a responsible agent duly accredited in writing be present for the purpose. Orders given to the contractor's agent shall be considered to have the same force as if they had been given to the contractor himself.

57.2 The contractor shall give not less than seven days notice in writing to the Engineer-in-Charge before covering up or otherwise placing beyond reach of inspection and measurement any work in order that the same may be inspected and measured. In the event of failure of above the same shall be uncovered and all facilities made available again at contractor's expense for carrying out such measurement or inspection.

57.3 The contractor is to provide at all times during the progress of the work and maintenance period proper means at access with ladders gangways etc. and the necessary attendance to move and adopt as directed for inspection or measurement of the works by the Engineer-in-Charge.

58. **Assistance to the Engineer:**
The Contractor shall make available to the Engineer-in-Charge free of cost all necessary instructions and assistance in checking of settling out of works and

in the checking of any works made by the contractor for the purpose 0f setting out and taking measurements of work.

59. **Discrepancies between instructions:**
Should any discrepancy arise between the various instructions furnished to the contractor or his agents or staff or if any doubt arises on the meaning or implementation of any such instructions or should there be any difference of opinion on the issues, the contractor shall refer the matter immediately in writing to the Engineer-in-Charge whose decisions thereon shall be final and conclusive. No claim on losses alleged to have been caused by such discrepancies between instructions, doubts or misunderstanding shall in any event be admissible.

60. **Alterations in Specifications and Designs and Extra Works:**

(a) The Project Head shall have power to make any alterations, in omission from additions to or substitutions, for the schedule of rates, the original specifications, drawings and instructions that may appear to him to be necessary or advisable during the progress of the work, and the contractor shall be bound to carry out such altered/ extra/ new items of work in accordance with any instructions which may be given to him in writing signed by the Project Head and such alterations, omissions, additions or substitutions shall not invalidate the contract and any altered, additional or substituted work which the contractor may be directed to do in the manner above specified as part of the work shall be carried out by the contractor on the same conditions in all respects on which he agreed to do the main work. The time of completion of work may be extended for the part of the particular job at the discretion of the Project Head for any such alterations, additions, or substitutions of the work, as he may consider as just and reasonable. The rates for such additional, altered or substituted work under the clause shall be worked out in accordance with the following provisions:-

(b) If the rates for the additional, altered or substituted work are specified in the contract for the work, the contractor is bound to carry out the additional, altered or substituted work at the same rates as are specified in the contract.

(c) If the rates for the additional, altered or substituted work are not specifically provided in the contract for the work, the rates will be derived from rates for similar class of work as are specified in the contract for the work. The opinion of the Project head as to whether or not the rates can be reasonably so derived from the items in this contract will be final and binding on the contractor.

(d) If the rates for the additional, altered or substituted work can not be determined in the manner specified in sub-clause (a) & (b) above, then the contractor shall within 7 days of the date of receipt of order to carry out

the work, inform the Project Head of the rate which it is his intention to charge for such class of work, supported by analysis of the rate or rates claimed, and the project Head shall determine the rate or rates on the basis of the prevailing market rates of materials plus labour cost including equipment hire charge at schedule of hourly/ daily rates plus 15% to cover contractor's supervisions overhead and profit and pay to the contractor accordingly. The opinion of the Project Head to current market rates of the materials and the quantum of labour and equipment involved per unit of measurement will be final and binding on the contractor. The schedule of hourly/ daily rates shall be as enclosed.

61. **Action Where no Specification is issued:**
In case of any class of work for which there is no such specification supplied by the Owner as is mentioned in the tender document such work shall be carried out in accordance with the Indian Standard Specifications. If the Indian Standard Specifications do not cover the same, the work should carried out as per standard Engineer in Practice subject to the approval of the Engineer-in-Charge.

62 **Abnormal Rates:**
The contractor is expected to quote the rate for each item after careful analysis of cost involved for the satisfactory performance and completion of item work considering all specifications and conditions of contract. This will avoid loss of profit or gain in case ofcurtailment or change in specification for any other item. In case the rate quoted by the tenderer for any item are usually high or unusually low it will be sufficient cause of the rejection of the tender unless the Owner is convinced about the reasonableness of the analysis for such rate furnished by the tenderer (on demand) after scrutiny.

63. Tests For Quality Works:

63.1 All materials and workmanship shall be of the respective kinds described in the contract documents and in accordance with the instructions of the Engineer-in-Charge and shall be subjected from time to time to such tests at contractor's cost as the Engineer-in-Charge may direct at the place of manufacture or fabrication or at the site or at all or any such places. The contractor shall provide assistance, instruments, machines, labour and materials as are required for examining, measuring and testing any workmanship as may be selected and required by the Engineer-in-Charge.

63.2 All the tests that will be necessary in connection with the execution of the work as decided by Engineer-in-Charge shall be carried out at the field testing laboratory of this Owner if available by paying the charges as decided by the Owner from time to time. In case of non-availability of testing facilities with the Owner, the required laboratory as directed by Engineer-in-Charge.

63.3 If any tests are required to be carried out in connection with the work or materials or workmanship not supplied by the contractor, such tests shall be

carried out by the contractor as per the instructions of Engineer-in-Charge and cost of such tests shall be reimbursed by the Owner.

64. Samples:

The contractor shall furnish to the Engineer-in-Charge for approval when request or if required by the specifications, adequate samples of all materials and finished to be used in the work. Such samples shall be submitted before the work is commenced and in sample time to permit tests and examinations thereof. All materials furnished and finishes applied in actual work shall be fully equal to the approved samples.

65 Liabilities for Defect, Imperfections etc. and Rectifications Thereof:

If it shall appear to the Engineer-in-Charge that any work has been executed with unsound, imperfect or unskilled workmanship, or with materials of any inferior description, or that any matrials or articles provided by the contractor for the execution of work are unsound or of quality inferior to that contracted for, or otherwise not in accordance with the contract, the contractor shall on demand in writing from the Engineer-in-Charge or his authorised representative specifying the work, materials or articles complained of, notwithstanding that the same may have been inadvertently passed, certified and paid for, forthwith rectify or remove and reconstruct that work so specified and provide other proper and suitable materials or articles at his own charge and cost, and in the event of failure to do so within a period to be specified by the Engineer-in-Charge in his demand aforesaid, the Engineer-in-charge may on expiry of notice period rectify or remove, and re-execute the work or remove and replace with others, the materials or articles complained of as the case may be at the risk and expense in all respects of the contract. The decision of the Engineer-in-Charge as to any question arising under this clause shall be final and conclusive.

66. Suspension of Works:

(i) Subject to the provision of sub para (ii) of this clause, the contractor shall if orderded in writing by the Engineer-in-Charge., or his representative, temporarily suspend the works or any part thereof such period and such time as so orderded and shall not, after receiving such written orders, proceeds with the work therein, orderded to be suspended until he shall have received a written order to proceed therewith. The contractor shall not be entitled to claim compesation for any loss or damage sustained by him by reason of temporary suspension of the works aforesaid. An extension of time for completion, corresponding with the delay caused by any such suspension of the works as aforesaid will be granted to the contractor should be apply for the same provided that the suspension was not consequent to any default or failure on the part of the contractor.

(ii) In case of suspension of entire work, orderded in writing by the Enginner-in-Charge, for a period of more than two months, the contractor shall have the option to terminate contract.

67. Possession Prior to Completion:

The Engineer-in-Charge shall have the right to take possession of or any completed or partially completed work or part of the work. Such possession or use shall not be deemed to be an acceptance of any work completed in accordance with the contract. If such prior possession or use by the Engineer-in-Charge delay the progress of work, equitable adjustment in the time of completion will be made and the contract agreement shall be deemed to be modified accordingly.

68 Twelve months Period of Liability from the Date of Issue of Completion Certificate:

68.1 The contractor shall gurantee the installation/work for a period of 12 months from the date of completion of work as certified by the Engineer-in-Charge which is indicated in the completion certificate. Any damage or defect that may arise though remained undeiscovered at the time of issue of completion certificate, connected in any way with the equipment or materials supplied by him or in the workmanship shall be rectified or replaced by the contractor at his own expenses as deemed necessary by the Engineer-in-Charge or in default the Engineer-in-Charge may cause the same to be made good by other agency and deduct expenses (of which the certificate or Engineer-in-Charge shall be final) from any sums that may be then or at any time thereafter become due to the contractor or from his security deposit, or the proceeds of sale thereof or of a sufficient portion thereof.

68.2 If the contractor feels that any variation in work or in quality of materials or proportions would be beneficial or necessary to fulfil the guarantees called for, he shall bring this in writing to the notice of the Engineer-in-Charge.

68.3 Care of works:

From the commencement of completion of the work, the contractor shall take full responsibility for the care of all works including all temporary works and in case any damage, loss or injury shall happen to the work or to any part thereof or to any temporary works from any cause whatsoever, shall at his own cost repair and make good the same so that on completion the work shall be in good order and in conformity in every respects with the requirements of the contract and the Engineer-in-Charge's Instructions.

68.4 Defects Prior to Taking Over:

If at any time before the work is taken over, the Engineer-in-Charge shall:

(a) Decide that any work done or materials used by the contractor or any sub-contractor is defective or not in accordance with the contract, or that the works or any portion therof are defective, or do not fulfil the requirements of contract (allsuch matter, being hereinafter, called 'Defects' in this clause) and (b) as soon as reasonably practicable gives to the contractor notice in writing of the said decision specifying particulars of the defects claimed to exist or to have occurred then the contractor shall at his own expenses and with all speed make good the defects so specified.

In case contractor shall fail to do so, the Owner may take, at the cost of contractor, such steps as may in all circumstances be reasonable to make good such defects. The expenditure so incurred by the owner be recovered from the amount due to the contractor. The decision of the Engineer-in-Charge with regard to the amount to be recovered from the contractor will be final and binding on the contractor. As soon as the works have been completed in accordance with the contract (except minor respects that do not affect their use for the purpose for which they are intended and except for maintenance thereof provided in clause 68.1 of General Conditions of Contract) and have passed the tests on completion, the Engineer-in-Charge shall issue a certificate (hereinafter called completion certificate) in which he shall certify the date on which the works have been so completed and have passed the said tests and the Owner shall be deemed to have taken over the works on the date so certified. If the works have been divided into various groups in the contract, the Owner shall be entitled to take over any group or groups before the other or others.

68.5 Defect After Taking Over:

In order that the contractor could obtain a completion certificate he shall make good with all possible speed, any defect arising from the defective materials supplied by the contractor or that may have been notices or developed, after the works or group of the works has been taken over, the period allowed, for carrying our such work will be normally one month. If any defect be not remedied within a reasonable time, the owner may proceed to do the work at contractor's Risk and expenses and deduct from the final bill such amount as may be decided by the Owner.

If by reason of any default on the part of the contractor a completion certificate has not been issued in respect of every portion of the works within one month after date fixed by the contract for the completion of the works, the Owner shall be a liberty to use the work or any portion therof in respect of which a completion certificate has not been issued, provided that the works or the portion thereof so used as aforesaid shall be afforded reasonable opportunity for completion of these works for the issue of completion certificate.

68.6 Guarantee/Transfer of Guarantee:

For works like water-proofing, acid & alkali resisting materials, pre-construction soil treatment against termite or any other specialized works etc. the contractor shall invariable engage sub-contractors who are specialists in the field and firms or repute and such a sub-conractor shall furnish guarantees for their workmanship to the Owner, through the contractor. In case such a sub-contractor/firm is not prepared to furnish a guarantee to the owner, the contractor shall give that guarantee to the Owner directly.

SECTION – VI
CERTIFICATE AND PAYMENT

69. SCHEDULE OF RATE AND PAYMENTS:

69.1 **Contractor's Remuneration:**

The price to be paid by the Owner to the contractor for the whole of the work done and for the performance of all the obligations undertaken by the contractor under the contract document shall be ascertained by the application of the respective schedule of rates (the inclusive nature of which is more particularly defined by way of application but not of limitation, with clause No. 69.2) and payment to be made accordingly to the work actually executed and approved by the Engineer-in-Charge. The sum so ascertained shall(exception only as and to the extent expressly provided here in) constitute the sole and inclusive of remunaeration of the contractor under the contract and no further or other payment whatsoever shall be or become due or payable to the contractor under the contract.

69.2 Schedule of Rates to the Inclusive:

The prices/rates quoted by the contractor shall remain firm till the issue of final certificate and shall not be subject to escalation. Schedule of rates shall be deemed to include and cover all costs, expenses and liabilities of every description and all risks of every kind to be taken in executing, completion and handing over the work to the Owner by the contractor. The contractor shall be deemed to have known the nature, scope, magnitude and the extent of the works and materials required though the contract document may not fully and precisely furnish them. Hr shall make such provision in the schedule of rates as he may consider necessary to cover the cost of such items of work and materials as may be reasonable and necessary to completer the work. The opinion of the Engineer-in-Charge as to the items of work which are necessary and reasonable for completion of work shall be final and binding on the contractor although the same may not be shown on or described specifically in contract documents.

Generality of this present provision shall not be deemed to cut down or limited in any way because in certain cases it may and in other cases it may not expressly stated that the contractor shall do or perform a work or supply articles or perform with services at his own cost or without addition of payment or without extra charge or works to the same effect or that it may be stated or not stated that the same are included in and covered by the schedule of rates.

69.3 Schedule of rates to cover Cconstructional Plant, Materials. Labours etc.:

Without in any way limiting the provision of other subclauses the schedule of rates shall be deemed to include the cover the cost of all constructional plant, temporary works (except as provided for herein), pumps, materials, labour, insurance, fuel, stores, and appliances to be supplied by the contractor and all other matters in connection with each items in the schedule of quantities and

the execution of the works or any portion thereof finished complete in every respect and maintained as shown or described in the contract documents or as may be orderded in writing during the continuance of the contract.

69.4 Schedule of Rates to cover Royalties, Rents and Claims:

The schedule of rates shall be deemed to include and cover the cost of all royalties and fees for the articles, processes, protected by letters, patent or otherwise incorporated in or used in connection with the works, also all royalties, rents, and other payments in. connection with obtaining materials of whatsoever kind for the works and shall include an indemnity to the owner which the contractor hereby gives against all actions, proceedings, claims, damages, costs and expenses arising from the incorporation in or use on the works of any such articles, processes or charges if levied on materials, equipment or machinery to be brought to site for use on work, shll be borne by the contractor.

69.5 Schedule of Rates to cover taxes and duties:

No exemption or reduction of custom duties, excise duties, sales tax, quay or any port duties, transport charges, stamp duties or Central or State Government or Local Body (or from any other body) or Municipal Taxes or duties, taxes or charges whatsoever will be granted or obtained and all expenses of which shall be deemed to be included in and covered by the schedule of rates. The contractor shall be obtain and pay for all permits or other privileges necessary to complete the work.

69.6 Schedule of Rates to cover Risk of Delay:

The schedule of rates shall be deemed to include and cover the risk of all responsibilities of delay and interference with the contractor's conduct of work which occur from any cause including orders of the owner in the exercise of his powers and on account of extension of time granted due to various and for all other possible or probable causes of delay.

69.7 Schedule of Rates cannot be altered:

For work under unit rate basis no alteration will be allowed in the schedule of rates by reasons of works or any part of them being modified, altered, extended, diminished or omitted. The schedule of rates is of fully inclusive rates which have been fixed by the contractor and agreed to by the Owner and cannot be altered.

69.7.1 The schedule of rates to cover for working in operating plant. Contractor's rates shall be deemed to include taking into account that he has to work in operating plant and shall take sufficient care in moving the plants, equipments and materials from one place to another, so that they do not cause any damage to any person or to the property of the owner or to thirty party including over head and underground cable/pipe lines. In the event of such damages including eventual loss of production and operation of the plant or services in any plant or establishment as estimated by the owner or ascertained or by the

third party shall be borne by the contractor. Since the work is to be executed for the expansion of the plant, the rate of the contractor shall also deem to include all interference/obstruction/interruption for which no compensation shall be paid to be contractor.

70. Procedure For Measurement/ Billing of Work in Progress:

70.1 All measurements shall be in metric system. All the works in progress will be jointly measured by the representative of the Engineer-in-Charge and the contractor's authorised agent progressively. Such measurements will be got recorded in the measurement book by the Engineer-in-Charge or his authorised representative and signed in token of acceptance by the contractor or his authorised representative.

For the purpose of taking joint measurement the contractor's representative shall be bound to be present whenever required by the Engineer-in-Charge. If, however, he absents for any reason whatsoever the measurements will be taken by the Engineer-in-Charge or his representative and this will be deemed to be correct and binding on the contractor.

70.2 Billing:

The contractor will submit a bill in approved proforma in accordance with the contract terms and the agreed billing schedules in quintuplicate to the Engineer-in-Charge giving abstract and detailed measurement for the various items executed during a month, before the expiry of the first week of the succeeding month. The Engineer-in-Charge shall take or cause to be taken the requisite measurements for the purpose of having the same verified and the claim as far as admissible, adjusted, if possible, before the expiry of 10 days form presentation of the bill.

70.2.1 The bill shall be submitted by the contractor in computerised formats approved by the owner. The bills along-with floppies containing measurement of work, particulars of materials, recoveries etc. have to be submitted to the owner.

70.2.2 For lump-sum contracts, the payment will be according to agreed billing schedule. No adjustment shall be allowed in lump-sum prices for any variations in the quantities, specifications etc. shall take or a cause to be taken the requisite measurement for the purposes of having the same verified and the claim as far as admissible, adjusted, if possible, before the expiry of 10 days from presentation of the bill.

70.3 Secured Advance on Materials:

In case of tenders for completed items of works, contractor may be allowed "Secured Advance" on the security of materials brought to site for execution of the contracted items of work to the extent of 75% of the value of materials which go into the completed works as assessed by the Engineer-in-Charge provided that the materials are of an imperishable nature and that formal

agreement is drawn up with the contractor under which the Owner secures a lien on the materials and is safe guarded against losses due to the contractor postponing the execution of the work or to the improper storage &/or misuse of the materials and against the expenses entitled for their proper watch and safe custody. Recoveries of advances so made would not be postponed until the whole of the work entrusted to the contractor is completed. They should be adjusted from his running account bills for work done as the materials are used, the necessary deductions being made whenever the items of work in which they are used and billed for.

70.4 **Dispute in Mode of Measurement:**
In case of any dispute as to the made of measurement not covered by the contract to be adopted for any item of work, mode of measurement as per latest Indian Standard Specifications shall be followed.

70.5 Rounding of Amounts:
In calculating the amount of each item due to the contractor in every certificate prepared for payment, sum of less than 50 paisa shall be omitted and the total amount on each certificates shall be rounded off to the nearest, i.e. sum of less than 0.50.p shall be omitted and sums of 0.50p and more upto one rupee shall be reckoned as one rupee.

71. LUMPSUMS IN TENDER:
For the item in tender where it includes lumpsum in respect of parts of work, the contractor shall be entitled to payment in respect of the items at the same as are payable under this contract for such items, or if the part of the work in question is not, in the opinion of the Engineer-in-Charge capable of measurement, or determination, the Owner may at his discretion pay the lump-sum amount entered in the tender or a percentage thereof and the certificate in writing of the Engineer-in-Charge shall be final and conclusive against the contractor with regards to any sum payable to him, under the provisions of this clause.

72. RUNNING ACCOUNT PAYMENTS TO BE REGARDED AS ADVANCE:
All Running Account Payment shall be regarded as Payments by way of advance against the final payment only and not as payment for work actually done and completed, and shall not preclude the requiring of bad, unsound and imperfect or unskilled work to be removed and taken away and reconstructed or re-erected or be considered as an admission of the due Performance of the contract, or any part thereof, in this respect, or of the accruing of any claim by the contractor, nor shall it, conclude, determine or affect in any way the powers of the Owner under these conditions or any of them as to the final settlement and adjustments of the accounts or otherwise, or in any other way vary or affect the contract. The final bill shall be submitted by the contractor within one month from the sate of physical completion of the work, otherwise,

the Engineer-in-Charge's certificate of the measurement and of total amount payable for the work accordingly shall be final and binding on all parties.

73. NOTICE OF CLAIMS FOR ADDITIONAL PAYMENT:

Should the contractor consider that he is entitled to any extra payment or compensation or to make any claims whatsoever in respect of the works arising under the terms of this contract he shall forthwith give notice in writing to the Engineer-in-Charge that he claims extra payment within ten days from the ordering of any work or happening of any event upon which the contractor bases such claims and such notice shall contain full particulars of the nature of such claims with necessary particulars as above within the time above specified shall be an absolute waiver thereof. No omission by the Owner to reject any such claim and no delay in dealing therewith shall be waiver by the Owner of any right in respect thereof.

74. PAYMENT OF CONTRACTOR'S BILL:

No payment shall be made for works estimated to cost less that Rs. 10,000/- till the whole of the work shall have been completed and a certificate of completion given. But in case of works estimated to cost more that Rs. 10,000/- the contractor, on submitting the bill thereof be entitled to receive a monthly payment proportionate to the part thereof approved and passed by the Engineer-in-Charge, whose certificate of such approval and passing of the sum so payable be final and conclusive against the contractor. This payment will be made after making necessary deductions as stipulated elsewhere in the contract document for materials, security deposit etc. or any statutory recoveries.

Payment due to the contractor shall be made by the Owner, by Crossed Account Payee Cheque forwarding the same to registered office or the notified office of the contractor. In no case will owner be responsible if the Cheque is mislaid or misappropriated by un-authorised person/ persons. In all cases, the contractor shall present his bill duly pre-receipted on proper revenue stamp.

All payment shall be made in Indian Currency.

75. Receipt For Payment:

Receipt for payment made on account of work when executed by a firm, must be signed by a person holding due power of attorney in this respect on behalf of the contractor, except when the contractors are described in their tender as limited company in which case the receipts must be signed in the name of the company by one of its principal officers or by some other persons having authority to give effectual receipt for the company.

76. Completion Certificate:

76.1. Application for completion certificate:

When the contractor fulfils his obligation under clause 69.4 he shall be eligible to apply for completion certificate in respect of the work by submitting the completion documents along with such application for completion certificate.

The Owner or his representative shall normally issue to the contractor the completion certificate within one month after receiving an application therefor from the contractors after verifying from the completion documents and satisfying himself that the work has been completed in accordance with and as set out in the construction and erection drawings, and the contract documents.

The contractor, after obtaining the completion certificate, is eligible to present the final bill for the work executed by him under the terms of contract.

76.2. Completion Certificate:

Within one month of the completion of work in all respects, the contractor, shall be furnished with a certificate by the owner or his representative of such completion but no completion certificate shall be given not shall the work be deemed to have executed until all, scaffolding, surplus materials and rubbish is cleared off the site completely not until the work shall have been measured by the Engineer-in-Charge, whole measurement shall be binding and conclusive. The work will not be considered as complete and taken over by the owner, until all the temporary work, labour and staff colonies etc. constructed are removed and work site cleared to the satisfaction of the Engineer-in-Charge.

If the contractor shall fail to comply with the requirements of this clause on or before the date fixed for the completion of the work, the Engineer-in-Charge may at the expenses of contractor remove such scaffolding, surplus materials and rubbish and dispose off the same as he thinks fit and clean off such dirt as aforesaid, and the contractor shall forthwith pay the amount for all expenses so incurred and shall have no claim in respect of any such scaffolding or surplus materials as aforesaid except for any sum actually realized by the sale thereof.

Completion Certificate shall be in 3 parts as follows:

(1) Physical/ Mechanical Completion work.
(2) Satisfactory completion of commissioning of equipment with load.
(3) Satisfactory completion of guarantee.

The contractor shall clearly indicate the 3 dates separately.

76.3. Completion Documents:

For the purpose of Clause 76 the following documents will be deemed to form the completion documents:

(i) The technical documents according to which the work was carried out.

(ii) Three sets of construction drawings showing therein the modification and corrections made during the course of execution and signed by the Engineer-in-Charge.

(iii) Completion Certificate for embedded and covered –up works.

(iv) Certificate of final levels as set out for various works.

(v) Certificate of tests performed for various works.

(vi) Material appropriation statement to the materials issued by the owner for the works and list of surplus materials returned to the owner's store duly supported by necessary documents.

(vii) Physical/ Mechanical Completion work.

(viii) Satisfactory completion of commissioning of equipment with load.

(ix) Satisfactory completion of guarantee.

The Contractor shall clearly indicate the 3 dates separately.

77. Final Decision And Final Certificate:

Upon the expiration of the period of liability and subject to the Engineer-in-Charge being satisfied that the works have been duly maintained by the contractor during monsoon or such period as herein provided in clause 68.1 and that the contractor has in all respect duly made up all subsidence and performed all his obligations under the contract, the Engineer-in-Charge shall (without prejudice to the right of the Owner to retain the provisions of relevant clause hereof) otherwise give a certificate, herein referred to as the final certificate, to the effect and the contractor shall not be considered to have fulfilled the whole of his obligations under the contract until Final Certificate shall have been given by the Engineer-in-Charge notwithstanding any previous entry upon the work and taking possession, working or using of the same or any part thereof by the Owner.

78. Certificate And Payments No Evidence of Completion:

Except the final certificate no other certificate or payment against a certificate or on general account shall be taken to be an admission by the Owner of the due performance of the contract of any part thereof or of occupancy or validity of any claim by the Contractor.

SECTION – VII

TAXES AND INSURANCE

79. TAXES, DUTIES, OCTROI ETC.

79.1. The Contractor shall defray all charges, such as rent, toll local taxes excise duty, other payments and compensations, if any, in connection with the procurement and handling of materials, fabrication and execution of works or any method or process connected with the works or Temporary works.

Sales Tax or any other tax on materials required for the works as also Tax on works contract shall be payable by the Contractor and the Owner will not entertain any claim whatsoever in this regard.

79.2. Notwithstanding anything contained elsewhere in the contract, the owner shall deduct at source from the payments due to the contractor, the taxes as required under Section -13–AA of the Orissa Sales Tax Act or as amended from time to time or under any other statue. The amounts so deducted shall be deposited by the Owner with the Sales Tax authorities as per Law. It is for the contractor to deal with the Sales Tax authorities directly in respect of any claim or refund relating to the above deductions and the owner shall not be liable or responsible for any claims or payments or reimbursement in this regard.

80. INSURANCE:

Contractor shall at his own expense carry and maintain insurance with reputed insurance companies to the satisfaction of the Owner as follows:

80.1 Employees State Insurance Act:

The contractor agrees to and does hereby accept full and exclusive liability for compliance with all obligations imposed by the Employees State Insurance Act., 1948, and the contractor further agrees to defend, indemnify and hold Owner harmless form any liability of penalty which may be imposed by the Central, State or Local authority by the reason of any asserted violation by contractor or Sub-contractor of the Employee's State Insurance Act, 1948 and also from all claims, suits or proceeding that may be brought against the Owner arising under, growing out of or by reasons of the work provided for by this contract whether brought by employees of the contractor, by third parties or by Central or State Government authority or any political sub-division thereof.

The contractor agrees to fill in with the Employees State Insurance Corporation, the Declaration Forms and all forms which may be required in respect of the contractor's or sub-contractor's employees, whose aggregate remuneration is Rs. 560.00 per month or less and who are employed in the work provided for or those covered by ESI from time to time under the Agreement. The contractor shall deduct and secure the agreement of the sub-contractor to deduct the employee's contribution as per the first schedule of the Employee's State Insurance Act from wages and affix the employee's

contribution cards at wages payments intervals. The contractor shall remit and secure the agreement of the sub-contractor to remit to the State Bank of India, Employees State Insurance Corporation Account, the employee's contribution as required by the Act. The contractor agrees to maintain all cards and records as required under the Act in respect of employees and payments and the contractor shall secure the agreement of the sub-contractor to maintain such records. Any expenses incurred for the contributions, making contributions or maintaining records shall be to the contractor's or sub-contractor's account.

The Owner shall retain such sum as may be necessary from the total contract value until the contractor shall furnish satisfactory proof that all contribution as required by the Employees State Insurance Act, 1984, have been paid. This will be pending on the contractor when the Employees State Insurance Act is extended to the place of work.

80.2 Workmen Compensation and Employees Liability Insurance:

Insurance shall be affected for all the contractor's employees engaged in the performance of this contract. If any of the work is subject, the contractor shall require the sub-contractor to provide workmen's compensation and employer's liability insurance for the latter's employees if such employees are not covered under the contractor insurance.

80.3 Any other insurance required under Law or Regulations or by Owner:

Contractor shall also carry and maintain any and all other insurance, which he may be required under any law or regulation from time to time. He shall also carry and maintain any other insurance, which may be required by the Owner.

80.4 Accident or Injury to workmen:

The owner shall not be liable for or in respect of any damages or compensation payable at law in respect or in consequence of any accident or injury to any workman or other person in the Employment of the contractor or any sub-contractor save and except and accident or injury resulting from any act or default of the Owner, his agents or servants and the contractor shall indemnify and keep indemnified the Owner against all such damages and compensation (save and except as aforesaid) and against all claims, demands, proceeding, costs, charges and expenses, whatsoever in respect or in relation thereto.

80.5 Transit Insurance:

In respect of all items to be transported by the Contractor to the site of work, the cost of transit insurance should be borne by the contractor and the quoted price shall be inclusive of this cost.

81 DAMAGE TO PROPERTY OR TO ANY PERSON OR ANY THIRD PARTY:

81.1 Contractor's rate shall deem to include taking into account that he has to work in operating plant and shall take sufficient care in moving the plants, equipment and materials from one place to another so that they do not cause

any damage to any person or to the property of the Owner or to a third party including over head and underground cables, pipelines. In the event of such damages including eventual loss of production and operation of the plants or services in any plant or establishment as estimated by the Owner or ascertained or by the third party shall be borne by the Contractor.

81.2 Contractor shall also be responsible for making good to the satisfaction of the Owner any loss or any damage to all structures and properties belonging to the Owner or being executed or procured or being procured by owner or by other agency within the premises of all the work or Owner. If such loss or damages is due to fault and or the negligence or willful acts or omission of the contractors, his employees, agents, representatives or sub-contractors.

81.3 The contractor shall indemnify and keep the owner harmless of all claims for damages to property other than owner's property arising under or by reason of this contract if such claims result from the fault and/ or negligence or willful acts or omission of the contractor, agents, representative or sub-contractor.

82 DEMURRAGE DUES:

The contractor shall pay demurrage charges incurred by the Owner because of the contractor's failure to load or unload any goods or materials within the time allowed by the Railway and/ or Transport Agency for such loading or unloading as charges incurred by the contractor within the permissible time as also charges due on consignments booked by or to him. In case the contractor fails to pay these charges, these charges shall be deducted from any sums, which may be due or become due to the contractor in terms of this contract and/ or any other contract.

SECTION – VIII
LABOUR LAWS AND ARBITRATION

83 LABOURER LAWS:

Contractor shall comply with any and all laws, ordinances, regulations and decision of courts (which shall be deemed to be a part of this Agreement) concerning the health, sanitary arrangements, wages, welfare, safety and employment of any and all of his workers upon the Project or any portion thereof and shall exclusively bear the consequences of failure to comply therewith Contractor shall Indemnify and hold Engineer and Owner harmless from any claims, fines or penalties which may be made against Engineer or Owner as result of Contractor's failure to fulfil these obligations.

Without limiting the generality of the foregoing, Contractor shall fully comply with.

The contractor shall obtain clearance from the Labour Department regarding the compliance of the labour laws on 6 monthly basis and submit to the owner for record.

(i) No labour below the age of 18 (eighteen) years shall be employed on the work.

(ii) The contractor shall not pay less than what is provided under law to labourers engaged by him on the work.

(iii) The contractor shall at his expense comply with all labour laws and keep the Owner indemnified in respect thereof .

(iv) The contractor shall pay equal wages for men and women in accordance with applicable labour laws.

(v) If the contractor is covered under the contractor labour (Regulation and Abolition) Act, he shall obtain a licence from licensing authority (i.e. office of the labour commissioner) by payment of necessary prescribed fee and the deposit, if any, before starting the work under the contract.

(vi) The Contractor shall employ labour in sufficient numbers either directly or through sub-contractors to maintain the required rate of progress and of quality to ensure workmanship of the degree specified in the Contract and to satisfaction of the Engineer-in-Charge. The contractor shall not employ in connection with the works any person who has not completed his 18 (eighteen) years of age.

(vii) The Contractor shall furnish to the Engineer-in-Charge the distribution return of the number and description, by trades of the work people

employed on the works. The Contractor shall also submit on the 4th and 19th of every month to the Engineer-in-Charge a true statement showing in respect of the second half of the preceding month and the first half of the current month (1) the accidents that occurred during the said fortnight showing the circumstance-under which they happened and the extent of damage and injury caused by them and (2) the number of female workers who have been allowed Maternity benefit as provided in the Maternity Benefit Act 1961 or Rules made thereunder and the amount paid to them.

(viii) The contractor shall comply with the provisions of the payment of Wages Act 1936, Minimum Wages Act 1938, Employees Liability Act 1928. Workmen's Compensation Act, 1923, Industrial Dispute Act 1947, the Maternity Benefit Act 1961, Employees Provident Fund Act, 1952 and Contract Labour regulation and abolition Act 1937, Employment of Children Act 1938 or any modifications thereof or any other law relating thereto and rules made thereunder from time to time.

(ix) The Engineer-in-Charge shall on a report having been made by an Inspecting Officer as defined in Contract Labour (Regulation and Abolition) Act 1970 have the power to deduct from the moneys due to the Contractor any sum required or estimated to be required for making good the loss suffered by a worker or Workers by reason of non-fulfillment of the Conditions of the Contractor for the benefit of workers, non-payment of wages or of deductions made from his or their wages which are not justified by the terms of the Contract or non-observance of the said regulations.

(x) The Contractor shall indemnify the Owner against any payments to be made under and for the observance of the provisions of the aforesaid Acts without prejudice to his right to obtain indemnity from his sub-contractors. In the event of the contractor committing a default or breach of any of the provisions of the aforesaid Acts as amended from time to time, of furnishing any information or submitting or filling any Form/Register/Slip under the provisions of these Acts which is materially incorrect then on the report of the inspecting Officers the Contractor shall without prejudice to any other liability pay to the owner a sum not exceeding Rs. 50.00 as liquidated damages for every default, breach of furnishing, making submitting, filling materially incorrect statement as may be fixed by the Engineer-in-Charge and in the event of the contractor's default continuing in this respect the liquidated damages may be enhanced to Rs. 50.00 per day of default subject to a maximum of one percent of the estimated cost of the works put to tender. The Engineer-in-Charge shall deduct such amount from bills or security deposit of the Contractor and credit the same to the welfare fund constituted under these acts. The decision of the Engineer-in-Charge in this respect shall be final and binding.

84 **Implementation Of Apprentices Act 1961:**

The contractor shall comply with the provisions of the Apprentices Act 1961 and the Rules and orders issued thereunder from time to time. If he fails to do so, his failure will be a breach of the contract and the Engineer-in-Charge may, at his discretion, cancel the contract. The contractor shall also be liable for any pecuniary liability arising of any violation by him of the provisions of the Act.

85 Contractor to Indemnify the Owner:

85.1 The contractor shall indemnify the Owner and every member, Officer and employee of the owner, also the Engineer-in-Charge and his staff against all actions, proceedings, claims, demands costs and expenses whatsoever arising out of or in connection with the matter referred to in clause 81 and elsewhere and all actions, proceedings, claims demands costs and expenses which may be made against the Owner for or in respect of or arising out of any failure by the contractor in the performance of his obligations under the contract. The Owner shall not be liable for or in respect of any demand or compensation payable by law in respect or in consequence of any accident or injury to any workman or other person in the employment of the contractor or his sub-contractor and contractor shall indemnify and keep indemnified the Owner against all such damage and compensation and against all claims, damages, proceedings, costs, charges and expenses whatsoever thereof or in relation thereto.

85.2 Payment of Claims and Damages:

Should the Owner have to pay any money in respect of such claims or demands as aforesaid the amount so paid and the cost incurred by the Owner shall be charged to and paid by the Contractor and the contractor shall not be at liberty to dispute or question the right of the Owner to make such payments notwithstanding the same may have been made without his consent or authority or in law or otherwise to the contrary.

85.3 In every case in which by virtue of the provisions of section 12, sub-section (i) of workmen's compensation Act, 1923 or other applicable provision of Workman Compensation act or any other act, the Owner is obliged to pay compensation to workman employed by the contractor in execution of the works, the Owner will recover from the contractor the amount of the compensation so paid, and without prejudice to the rights of Owner under section 12, sub-section (2) of the said act. Owner shall be at liberty to recover such amount or any part thereof by deducting it from the security deposit or from any sum due to the contractor whether under this contract or otherwise. The Owner shall not be bound to contest any claim made under section 12 sub-section (I) of the said Act except on the written request of the contractor and upon his giving to the Owner full security for all costs for which the Owner might become liable in consequence of contesting such claims.

86. Health and Sanitary Arrangements For Workers:

86.1 In respect of all labour directly or indirectly employed in the works for the performance the contractor's part of this agreement, the contractor shall comply with or cause to be complied with all the rules and regulations of the local sanitary and other authorities or as framed by the Owner from time to time for the protection of health and sanitary arrangements for all workers.

86.2 The contractor shall provide in the labour colony all amenities such as Electricity, water and other sanitary and health arrangements. The Contractor shall also provide necessary surface transportation to the place of work and back to the colony for their personnel accommodated in the labour colony.

87. Arbitration:

All disputes or differences whatsoever which shall at any time arise between the parties hereto touching or concerning the works or the execution or maintenance thereof of the contract or the rights touching or concerning the works or the execution or maintenance thereof of this contract or the construction meaning operation or effect thereof or to the rights or liabilities of the parties or arising out of or in relation thereto whether during or after completion of the contract or whether before or after determination, fore closure or breach of the contract (other than those in respect of which the decision of any person is by the contract expressed to be final and binding shall after written notice by either party to the contract to the other of them and to the Appointing Authority hereinafter mentioned be referred for adjudication to a sole Arbitrator to be appointed as hereinafter provided.

For the purpose of appointing the sole Arbitrator referred to above, the Appointing Authority will send within thirty days of receipt of the notice, to the contractor a panel of three names of persons.

The contractor shall on receipt of the names as referred selected any one of the person names to be appointed as a sole Arbitrator and communicate his name to the Appointing Authority within thirty days of receipt of the names. The appointing Authority shall there upon without any delay appoint the said person as the sole Arbitrator. If the contractor fails to communicate such selection as provided above within the period specified, the Appointing Authority shall make the selection and appoint the selected person as the sole Arbitrator.

If the Arbitrator so appointed is unable or unwilling to act or resigns his appointment or vacate his office due to any reason whatsoever sole Arbitrators shall be appointed as aforesaid. The work under the contract shall, however continue during the arbitration proceedings.

The Arbitrator shall be deemed to have entered on the reference on the date he issues notices to both the parties fixing the date of the first hearing.

The Arbitrator may, from time to time, with the consent of the parties, enlarge the time for making and publishing the award.

The Arbitrator shall give a separate award in respect of each dispute or difference and shall give a reasoned and speaking award/ awards.

The venue of arbitration shall be at Bhubaneswar. However, if the situation so warrants, it may, as and when required, be held at the place where the site of work is situated.

The fees, if any, of the Arbitrator shall, if required to be paid before the award is made and published be paid half and half by each of the parties. The costs of the reference and of the award including the fees, if any of the Arbitrator shall be in the discretion of the Arbitrator who may direct to and by whom and in what manner, such costs or any part thereof shall be paid may fix or settle the amount of costs to be so paid.

The award of the arbitrator shall be final and binding on both the parties.

Subject to aforesaid, the provisions of the Arbitration Act 1940 or any statutory modification or re-enactment thereof and the rules made thereunder, and for the time being in force shall apply to the arbitration proceeding under this clause.

For Public Sector Enterprises guidelines as per the circular of BPE No. 15/9/86-BPE (FIN) dated 30.03.89 as amended time to time will be followed.

88. Jurisdiction/ Governing Laws:

(a) Jurisdiction:

For all disputes arising of this contract, the jurisdiction shall be lie under the jurisdiction of direct courts in the respective areas in the State of ORISSA (India) only.

(b) Governing Laws:

The contract shall be governed by and constructed according to the laws in force in INDIA.

SECTION – IX
SAFETY CODE

89. GENERAL:

Contractor shall adhere to safe construction practice and guard against hazardous and unsafe working conditions and shall comply with Owner's safety rules as set forth herein. Prior to start of construction, contractor will be furnished copies of Owner's 'Safety Code' for information and guidance, if it has been prepared.

90. SAFETY REGULATIONS:

90.1. In respect of all labour, directly or indirectly employed in the work for the performance of contractor's part of this agreement, the contractor shall at his own expense arrange for all the safety provisions as per (i) Safety codes of CPWD & Indian Standards Instructions (ii) The electricity Act, (iii) The Mines Act, and (iv) Regulations. Rules and orders made thereunder and such other acts as applicable.

90.2. The contractor shall observe and abide by all fire and safety regulations of the Owner. Before starting construction work, contractor shall consult Owner's Safety Engineer or Engineer-in-Charge and must make good to the satisfaction of the Owner any loss or damage due to fire to any portion of the work done under this contract or to any of the Owner's existing property.

91. First Aid and Industrial Injuries:

(i) Contractor shall maintain first aid facilities for his employees and those of his subcontractors.

(ii)Contractors shall make outside arrangements for ambulance service and for treatment of industrial injuries. Name of those providing these services shall be furnished to Owner prior to start of constructions and their telephone numbers shall be prominently posted in Contractor's field office.

(iii)All critical industrial injuries shall be reported promptly to owner, and a copy of Contractor's report covering each personal injury requiring the attention of a physical shall be furnished to the Owner.

92. General Rules:

Smoking within the Battery Areas, rank farm, or dock limits in strictly prohibited. Violators of the "No Smoking" rules shall be discharged immediately".

93. Contractor's Barricades:

(i) Contractor shall erect and maintain barricades required in connection with his operation to guard or protect.

(a) Excavations.
(b) Hosting Areas.
(c) Areas adjudged hazardous by Contractor's or Owner's Inspectors.
(d) Owner's existing property subject to damage by Contractor's operation.
(e) Rail road unloading spots.

(ii) Contractor's employees and those of his sub-contractors shall become acquainted with Owner's barricading practice and shall respect the provisions thereof.

(iii) Barricades and hazardous areas adjacent to but not located in normal routes of travel shall be marked by red flasher lanterns at nights.

94. Scaffolding:

(i) Suitable scaffoldings should be provided for workmen for all works that cannot safety be done from the ground or from solid construction except such short period works as can be done safely from ladders. When a ladder is used a Mazdoor shall be engaged for holding the ladder and if the ladder is used for carrying materials as well, suitable footholds and handholds shall be provided on the ladder and the ladder shall be given an inclination not steeper than 1 in 4 (1 horizontal and 4 vertical).

(ii) Scaffolding or staging more than 4 metres above the ground or floor swing on suspended from an overhead support or erected with stationary support shall have a guard rail properly attached, bolted, braced and otherwise retarded at least one metre high above the floor or platform of such scaffolding or staging and extending along with entire length of the outside and ends thereof with only such openings as may be necessary for the delivery of materials. Such scaffolding or staging shall be so fastened as to prevent it from swaying from the building or structure.

(iii) Working platform, gangways and stairways should be so constructed that they should not sag unduly or unequally and if the height of the platform of gangway or the stairway is more than 4 metres above ground level or floor level, they should closely boarded, should have adequate width and should be suitable fastened as described in (ii) above.

(iv) Every opening in the floor of a building or in a working platform be provided with suitable means to prevent the fall of persons or materials by providing suitable fencing or railing whose minimum height shall be 1 metre.

(v) Safe means of access shall be provided to all working platforms and other working places. Every ladder shall be security fixed. No portable single ladder shall be over 9 metres in length. The width between the side rails in run ladder shall in no case be less than 30 cm. For ladder upto and including 3 metres in length; for longer ladders this width should be

increase at least 15 mm for each additional metre of length. Uniform step spacing shall not exceed 30 cms. Adequate precautions shall be taken to prevent danger from electrical equipment. No materials on any of the sites of work shall be so stacked or placed as to cause danger or inconvenience to any person or public. The contractor shall also provide all necessary fencing and lights to protect the workers and staff from accidents, and shall be bound to bear the expenses of defence of every suit, action or other proceedings of law that may be brought by any person for injury sustained owing to neglect of the above precautions and to pay any damages and cost which may be awarded in any such suit or action or proceedings to any such person or which may with the consent of the contractor be paid to compromise any claim by any such person.

95. Excavation and Trenching:

All trenches 1.2 metres or more in depth, shall at all times be supplied with at least one ladder for each 50 M length or fraction thereof.

Ladder shall be extended from bottom of the trench to at least 1 metre above the surface of the ground. The sides of the trenches which are 1.5 metres in depth shall be stepped back to give suitable slope, or securely held by timber bracing, so as to avoid the danger of sides to collapse. The excavated materials shall not be placed within 1.5 metres of the edge of the trench or half of the trench width whichever is more. Cutting shall be done from top to bottom. Under no circumstances undermining or under-cutting shall be done.

96. General Safety:

(i) Before any demolition work is commenced and also during the process of the demolition work.

(a) All roads and open areas adjacent to the work site shall either be closed or suitably protected.

(b) No electric cable or apparatus which is liable to be a source of danger shall remain electrically charged.

(c) All practical steps shall be taken to prevent danger to persons employed from risk of fire or explosion or flooding. No floor, roof or other part of the building shall be so overloaded with debris or materials as to render it unsafe.

(ii) All necessary personal safety equipment as considered adequate by the Engineer-in-Charge, should be kept available for the use of the persons employed at the site and maintained condition suitable for immediate use and the contractor should take adequate steps to ensure proper use of equipment by persons concerned as outlined below:

(a) Workers employed on mixing asphalt materials, cement and lime mortars shall be provided with protective footwear and protective gloves.
(b) Those engaged in white washing and mixing or stacking of cements bags or any materials which are injurious to the eyes shall be provided with protective goggles.
(c) Those engaged in welding and cutting works, shall be provided with protective face and eye –shields, hand gloves etc.
(d) Stonebreakers shall be provided with protective goggle and protective clothing and seated at sufficiently safe intervals.
(e) When workers are employed in sewers and manholes which are in use, the contractor shall ensure that the manhole cover are opened and are ventilated at least for an hour before the workers are allowed to get into the manholes, and the manholes so opened shall be cordoned off with suitable railing and provided with warning signals or board to prevent accident to the public.
(f) The contractor shall not employ men below the age of 18 years and women on the work of painting with products containing lead in any form. Wherever men above the age of 18 years are employed on the work of lead painting, the following precautions should be taken:

(1) No paint containing lead or lead products shall be used except in the form paste or readymade paint.

(2) Suitable facemasks should be supplied for use by the workers when paint is applied in the form of spray or a surface having lead paint dry rubbed and scrapped.

(3) Overalls shall be supplied by the Contractor to the workmen and adequate facilities shall be provided to enable the working painters to wash them on cessation of work.

(iii) When the work is done near any place where there is a risk of drowning all necessary safety equipment shall be provided and kept ready for use and all necessary steps taken for prompt rescue of any person in danger and adequate provision should be made for prompt first aid treatment of all injuries likely to be sustained during the course of the work.

(iv) Use of hoisting machines and tackles including their attachments anchorage and supports shall conform to the following standard or conditions:

(a) These shall be of good mechanical construction, sound materials and adequate strength and free from patent defect and shall be kept in good working order.
(b) Every rope used in hoisting or lowering materials or as means of suspension shall be of durable quality and adequate strength and free from patent defects.

(c) Every crane driver or hoisting appliance operator shall be properly qualified and no person under the age of 21 years should be in charge of any hoisting machine including any scaffolding which or give signals to the operator.

(d) In case of every hoisting machine and of every chain ring hook, shackle swivel and pulley block used in hoisting or lowering or as means of suspension, the safe working load shall be ascertained by adequate means. Every hoisting machine and all gear referred to above shall be marked with the safe working load and the conditions under which it is applicable shall be clearly indicated. No part of any machine or any gear referred to above in this paragraph shall be loaded beyond the safe working load except for the purpose of testing.

(e) In case of department machines, the safe working load shall be notified by the Engineer-in-Charge. As regards contractor's machines, the contractor shall notify the safe working load of the machine to the Engineer-in-Charge, whenever he brings any machinery to site of work and get it verified by the Engineer-in-Charge.

(v) Motors, gears, transmission lines, electric wiring and other dangerous parts of hoisting appliances should be provided with efficient safe-guards. Hoisting appliances should be provided with such means as to reduce to the minimum the accidental descent of the load, adequate precaution should be taken to reduce to the minimum the risk of any part or parts of a suspended load becoming accidentally displaced. When workers are employed on electrical installations, which are already energized, insulating mats, wearing apparel such as gloves sleeves and boots as may be necessary should be provided. The workers shall not wear any rings, watches and carry keys or other materials, which are good conductors or electricity.

(vi) All scaffolding, ladders and other safety devices mentioned or described herein shall be maintained in safe conditions and no scaffoldings, ladder or equipment shall be altered or removed while it is in use. Adequate washing facilities should be provided at or near places of works.

(vii) These safety provisions should be brought to the notice of all concerned by displaying on a notice board at a prominent place at the work spot. The person responsible for compliance of the safety code shall be named therein by the contractor.

(viii) The ensure effective enforcement of the rules and regulations relating to safety precautions, the arrangements made by the contractor shall be open to inspection by the welfare officer Engineer-in-Charge or safety Engineer of the Administration or their representatives.

(ix) Notwithstanding the above clauses there is nothing in these to exempt the contractor from the operations of any other Act or rules in force in the Republic of India. The works throughout, including any temporary works, shall be carried out in such a manner as n9ot to interfere in any way whatsoever with the traffic on any roads or footpaths at the site or in vicinity thereto or any existing works whether the property of the Administrations or of a third party.

97. Care in handling Inflammable gas:

The Contractor has to ensure all precautionary measures and exercise utmost care in handling the inflammable gas cylinder/ inflammable liquids/ paints etc. as required under the law and/ or as advised by the fire authorities of the Owner.

98. Temporary Combustible Structures:

Temporary combustible structures will not be built near or around work site.

99. Precautions Against Fire:

The Contractor will have to provide Fire Extinguisher/ Fire Buckets and drums at work site as recommended by Engineer-in-Charge. They will have to ensure all precautionary measures and exercise utmost care in handling the inflammable gas cylinders/ inflammable liquid/ paints etc. as advised by Engineer-in-Charge. Temporary combustible structures will not be build near or around the work-site.

100. Explosives:

Explosives shall not be stored or used on the works or on the site by the contractor without the permission of the Engineer-in-Charge in writing and then only in the manner and to the extent to which such permission is given. When explosives are required for the works they shall be stored in a special magazine to be provided at the cost of the contractor in accordance with the Explosive Rules. The contractor shall obtain the necessary licence for the storage and the use of explosives and all operations in which or for which explosives are employed shall be at sole risk and responsibility of the contractor and the contractor shall indemnify the owner against any loss or damage resulting directly or indirectly therefrom.

101. Mines Act:

101.1 Safety Code: The contractor shall at his own expense arrange for the safety provisions as required by the Engineer-in-Charge in respect of all labour directly employed for performance of the works and shall provide all facilities in connection therewith. In case the Contractor fails to make arrangements and provides necessary facilities as aforesaid. The Engineer-in-Charge shall be entitled to do so and recover the costs thereof from the Contractor.

101.2 Failure to comply with Safety code or the provisions relating to report on accidents and to grant of maternity benefits to female worker shall make the Contractor liable to pay Company liquidated damages an amount not exceeding Rs. 50/- for each default or materially incorrect statement. The decision of the Engineer-in-Charge in such matters based on reports from the Inspecting Officer or from representatives of Engineer-in-Charge shall be final and binding and deductions for recovery of such liquidated damages may be made from any amount payable to the Contractor from all the provisions of the Mines Act 1952 or any statutory modification's or re-enactment thereof the time being in force and any Rules and Regulations made thereunder in respect of all the

persons employed by him under this contractor and shall indemnify the Owner from and against any claim under the Mines Act or the rules and regulations framed thereunder by or on behalf of and persons employed by him or otherwise.

102. Preservation of Peace:

The Contractor shall taken requisite precautions and use his best endeavors to prevent any riotous or unlawful behaviour by or amongst his workmen and other employed on the works and for the preservation of peace and protection of the inhabitants and Security of property in the neighborhood of the work. In the event of the Owner requiring the maintenance of a special Police force at or in the vicinity of the site during the tenure of works, the expenses thereof shall be borne by the Contractor and if paid by the Owner shall be recoverable from the Contractor.

103. Outbreak of Infectious Diseases:

The Contractor shall remove from his camp such labour and their families as refuse protective inoculation and vaccination when called upon to do so by the Engineer-in-Charge's Representative. Should Cholera, Plague or other infectious diseases break out the Contractor shall burn the huts, bedding clothes and other belonging of or used by the infected parties and promptly erect new huts on healthy sites as required by the Engineer-in-Charge failing which within the time specified in the Engineer's requisition, the work may be done by the Owner and the cost thereof recovered from the Contractor.

104. Treatment of Contractor's Staff in Company's Hospital:

The Contractor and his staff, other than labourers and their families requiring medical aid from the Owner's hospitals and dispensaries will be treated as private patients and charged accordingly. The contractor's labourers and their families will be granted from treatment in the Owner's hospitals and dispensaries where no other hospitals or dispensaries are available provided the contractor pays the cost of medicines dressing and money accordingly to the normal scale as also additional charges if any for special examination e.g. X- Ray etc.

105. Use of Intoxicants:

The sale of dent spirits or other intoxicating beverages upon the work in any of the buildings, encampments or tenements owned, occupied by or within the control of Contractor or any of his employee is forbidden and the contractor shall exercise his influence and authority to the utmost extent to secure strict compliance with this condition.

In addition to the above, the contractor shall abide by the safety code provision as per CPWD safety code and Indian Standard Code framed from time to time.

PROFORMA FOR BANK GUARANTEE FOR EARNEST MONEY DEPOSIT

(To be executed on non-judicial stamped paper of appropriate value)

B. G. No._____ Date:_____

1. WHEREAS, M/s National Aluminium Company Limited (A Government of India Enterprise), having its Corporate Office at NALCO BHAWAN, P-1 Nayapalli, Bhubaneswar (hereinafter called "Company"/ "Owner" which expression shall unless repugnant to the subject or context includes its legal representatives, successors and assigns) has issued tender paper vide its Tender No……for ---------- ---------- (hereinafter called "the said tender") to M/s. ……(here in after called the said Tenderer(s)" which expression shall unless repugnant to the subject or context includes their legal representatives, successors and assigns and as per terms and conditions of the said tender, the tenderer shall submit a Bank guarantee for Rs. …… (Rupees ……..only) towards earnest money in lieu of cash.

2. WE ……..Bank having its branch office at ……..do hereby undertake to pay the amount due and payable under this guarantee without any demur, merely on a demand from the Company stating that in the opinion of the company which is final and binding, the amount claimed is due because of any withdrawal of the tender or any material alteration to the tender after the opening of the tender by way of any loss or damage caused to or would be caused or suffered by the Company by reason of any breach by the said tenderer(s) of any of the terms and conditions contained in the said tender or failure to accept the letter of Intent Agreement or that the amount covered under this Guarantee is forfeited. Any such demand made on the Bank by the owner shall be conclusive as regards the amount due and payable by the Bank under this guarantee, However, our liability under this guarantee shall be restricted to an amount not exceeding Rs……..(Rupees……..only).

3. We undertake to pay to the Company any money so demanded not withstanding any dispute or disputes raised by the tenderer (s) in any suit or proceeding pending before any office, court or tribunal relating thereto our liability under this present guarantee being absolute and unequivocal. The payment so made by us under this bond shall be a valid discharge of our liability for payment there under. Our liability to pay is not dependent or conditional on the owner proceeding against the tenderer.

4. The guarantee herein contained shall not be determined or affected or suspended by the liquidation or winding up, dissolution or change of constitution or insolvency of the said tenderer(s) but shall in all respect and for all purposes be binding and operative until payment of all money due or liabilities under the said contract(s)/ Order(s) are fulfilled.

5. WE …….. Bank Ltd. further agree that the guarantee herein contained shall remain in full force and effect during the period that would be taken for the finalisation of the said tender and that it shall continue to be enforceable till the said tender is finally decided and order placed on the successful tenderer(s) and or till all the dues of the company under or by virtue of the said tender have been fully paid and its claims satisfied or discharged or till a duly authorised officer of the company certifies that the terms and conditions of the said tender have been fully and properly carried out by the said tenderer (s) and accordingly discharges the guarantee.

6. That the Owner Company will have full liberty without reference to us and without affecting this guarantee to postpone for any time or from time to time. The exercise of any of the power of the owner under the tender.

7. Notwithstanding anything contained herein before, our liability shall not exceed Rs…….(Rupees……only) and shall remain in force till……..Unless a demand or claim under this Guarantee is made on us within three months from the date of expiry we shall be discharged form all the liabilities under this guarantee.

8. We……Bank, lastly undertake not to revoke this guarantee during its currency except with the previous consent of the Company in writing. We further undertake to keep this Guarantee renewed from time to time on the request of Tenderer (s).

Date……..

…….Bank
Corporate Seal of the Bank

By its constitutional Attorney

Signature of duly
Authorised person
On behalf of the Bank
With seal & signature code

(BGs to be furnished from any of the banks listed in Annexure)

PROFORMA FOR BANK GUARANTEE FOR SECURITY DEPOSIT

(To be executed on non-judicial stamped paper of appropriate value)

B. G. No._____ **Date:_____**

In consideration of National Aluminium Company Limited (A Government of India Enterprise), having its Corporate Office at NALCO BHAWAN, P-1 Nayapalli, Bhubaneswar (hereinafter called "Company"/ "Owner" which expression shall unless repugnant to the subject or context includes its legal representatives, successors and assigns) having agreed to exempt M/s. …… (Hereinafter called "the said Contractor (s)/ Seller(s)" which expression shall unless repugnant to the subject or context includes their legal representatives, successors and assigns) from the demand under the terms and conditions of Contract(s)/ Order(s) No. …… , dt. ……of cash security deposit for the due fulfillment by the said contractor(s) seller(s) of the terms and conditions contained in the said Contract(s)/Order(s), on production of Bank Guarantee for Rs…….…… (Rupees……..only).

2. We ……..Bank having its branch office at ……..do hereby agree and undertake to pay the amount due and payable under this guarantee without any demur, merely on a demand from the Company stating that in the opinion of the company which is final and binding, the amount claimed is due by way of loss or damage caused to or would be caused to or suffered by the Company by reason of any breach by the said Contractor(s)/seller(s) of any of the terms and conditions contained in the said contract(s) orders(s) or by reasons of the said Contractor(s)/ Seller(s) failure to perform the said Contract(s)/ Order(s) including defect liability obligations or that the amount covered under this guarantee is forfeited. Any such demand made on the Bank by the owner shall be conclusive as regards the amount due and payable by the Bank under this guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding Rs……. (Rupees……..only).

3. We undertake to pay to the Company any money so demanded not withstanding any dispute or disputes raised by the contractor (s)/ Seller(s) in any suit or proceeding pending before any office, court or tribunal relating thereto our liability under present guarantee being absolute and unequivocal. The payment so made by us under this bond shall be valid discharge of our liability for payment thereunder. Our liability to pay is not dependent or conditional on the owner proceeding against the Contractor(s)/ Seller(s).

4. The guarantee herein contained shall not be determined or affected or suspended by the liquidation or winding up, dissolution or change of constitution or insolvency of the said Contractor(s)/ Seller(s) but shall in all respect and for all purposes be binding and operative until payment of all money due or liabilities under the said contract(s)/ Order(s) are fulfilled.

5. We ……..Bank further agree that the guarantee herein contained shall remain in full force and effect during the period that would be taken for the

performance of the said Contract(s)/ Order(s) and that it shall continue to be enforceable till all the dues of the company under or by virtue of the said Contract(s)/Order(s) have been fully paid and its claims satisfied or discharged or till a duly authorised officer of the company certifies that the terms and conditions of the said Contract(s)/Order(s) have been fully and properly carried out by the said contractor(s) and accordingly discharges the guarantee.

6. We ……Bank further agree with the Company that the company shall have the fullest liberty without our consent and without affecting in any manner our obligations hereunder to vary any of the terms and conditions of the said Contract(s)/ Order(s) or to extend the time of performance by the said Contractor(s) Seller(s) form time to time or to postpone for any time or from time to time any of the powers exercisable by the Company against the said Contractor(s)/ Seller(s) and to forbear or enforce any of the terms and conditions relating to the said Contract(s)/ Order(s) and we shall not be relieved from our liability by reason of any such variations, or extension being granted to the said Contractor (s)/ Seller(s) or for any forbearance, act or omissions on the part of the Company or any indulgence by the Company to the said Contractor(s)/ Seller(s) or by any such matter or thing whatsoever which under the law relating to sureties would, but for this provision, have affect of so relieving us.

7. Notwithstanding anything contained herein before, our liability shall not exceed Rs…….(Rupees……only) and shall remain in force till……..Unless a demand or claim under this Guarantee is made on us within three months from the date of expiry we shall be discharged form all the liabilities under this guarantee.

8. We……Bank, lastly undertake not to revoke this guarantee during its currency except with the previous consent of the Company in writing. We further undertake to keep this Guarantee renewed from time to time at the request of Contractor(s)/ Sellers(s).

Date…….

……Bank

Corporate Seal of the Bank

By its constitutional Attorney

Signature of duly
Authorised person
On behalf of the Bank
With seal & signature code

(BGs to be furnished from any of the banks listed in Annexure)

PROFORMA FOR CONTRACT CUM PERFORMANCE GUARANTEE BY SELLER/ CONTRACTOR.

(To be executed on non-judicial stamped paper of appropriate value)

B. G. No…… **Date…….**

WHEREAS National Aluminium Company Limited (A Government of India Enterprise) having its Corporate Office at NALCO BHAWAN, P-1 Nayapalli, Bhubaneswar (hereinafter called "Company'/ 'Owner" which expression shall unless repugnant to the subject or context includes its legal representatives, successors and assigns) has entered into a contract with M/s. ……. / has placed a purchase order on M/s…….(hereinafter referred to as "Contractor(s)/ Seller(s)" which expression shall unless repugnant to the subject or context includes their legal representatives, successors and assigns) for ……on the terms and conditions as set out inter alia, in the Company's contract No./ P.O. No. …….. date ……and various documents forming part thereof hereinafter referred to as the "said contract" which expression include all amendments, modifications and/ or variations thereto and where as the Contractor(s)/ Seller(s) has agreed for due execution of the entire contract and guarantees its performance including any parts executed through any other agencies/ subcontractors.

AND WHEREAS one of the conditions of the "said contract" is that "contractor(s)/seller(s) shall furnish to the owner a Bank Guarantee from a bank for …….%(…….percent) of the total value of the "said contract" against due and faithful performance of the "said contract" including defect liability obligations" and the performance guarantee obligations of the contractor(s)/seller(s) for execution/ supplies made under the "said contract."

2. We ……..Bank having its branch office at ……..do hereby agree and undertake to pay the amount due and payable under this guarantee without any demur merely on a demand from the Company stating that in the opinion of the Company, which is final & binding, the amount claimed is due by reason of default made by the Contractor(s)/ Seller(s) in performing any of the terms & conditions of the said Contract including defect liability obligations, in fulfilling the performance guarantee obligation or loss or damage caused to or would be caused to or suffered by the Company by reason of any breach by the said Contractor (s)/ Seller(s) of any of the terms & conditions of the contract. Any such demand made on the Bank by the owner shall be conclusive as regards the amount due and payable by the Bank under this guarantee. However our liability under this guarantee shall be restricted to Rs.…… (Rupees……only).

3. We undertake to pay to the Company any money so demanded not withstanding any dispute or disputes raised by the contractor (s)/ Seller(s) in any suit or proceeding pending before any office, court or tribunal relating thereto our liability under this present guarantee being absolute and unequivocal. The payment so made by us under this bond shall be a valid discharge of our liability for payment

thereunder. Our liability to pay is not dependent or conditional on the owner proceeding against the Contractor(s)/ Seller(s).

4. The guarantee herein contained shall not be determined or affected or suspended by the liquidation or winding up, dissolution or change of constitution or insolvency of the said Contractor(s)/ Seller(s) but shall in all respect and for all purposes be binding and operative until payment of all money due or liabilities under the said contract(s)/ Order(s) are fulfilled.

5. We ……..Bank further agree that the guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the said Contract(s)/ Order(s) and that it shall continue to be enforceable till all the dues of the company under or by virtue of the said Contract(s)/Order(s) have been fully paid and its claims satisfied or discharged or till a duly authorised officer of the company certifies that the terms and conditions of the said Contract(s)/Order(s) have been fully and properly carried out by the said contractor(s) and accordingly discharges the guarantee.

6. We ……Bank further agree with the Company that the company shall have the fullest liberty without our consent and without affecting in any manner our obligations hereunder to vary any of the terms and conditions of the said Contract(s)/ Order(s) or to extend the time of performance by the said Contractor(s) Seller(s) form time to time or to postpone for any time or from time to time any of the powers exercisable by the Company against the said Contractor(s)/ Seller(s) and to forbear or enforce any of the terms and conditions relating to the said Contract(s)/ Order(s) and we shall not be relieved from our liability by reason of any such variation, or extension being granted to the said Contractor (s)/ Seller(s) or for any forbearance, act or omission on the part of the Company or any indulgence by the Company to the said Contractor(s)/ Seller(s) or by any such matter or thing whatsoever which under the law relating to sureties would, but for this provision, have affect of so relieving us.

7. Notwithstanding anything contained herein before, out liability shall not exceed Rs…….(Rupees……only) and shall remain in force till……..Unless a demand or claim under this Guarantee is made on us within three months from the date of expiry we shall be discharged form all the liabilities under this guarantee.

8. We……Bank, lastly undertake not to revoke this guarantee during its currency except with the previous consent of the Company in writing. We further undertake to keep this Guarantee renewed from time to time at the request of Contractor(s)/ Sellers(s).

Date…….
Corporate Seal of the Bank

…….Bank
By its constitutional Attorney
Signature of duly Authorised person on behalf of the Bank with seal & signature code

(BGs to be furnished from any of the banks listed in Annexure.)

BANK GUARANTEE FOR ADVANCE PAYMENT

(To be executed on non-judicial stamped paper of appropriate value)

B.G. No._____ **Date:_____**

In consideration of National Aluminium Company Limited (A Government of India Enterprise), having its Corporate Office at NALCO BHAWAN, P-1 Nayapalli, Bhubaneswar (hereinafter called "Company"/ "Owner" which expression shall unless repugnant to the subject or context includes its legal representatives, successors and assigns) having agreed to make an advance payment of Rs…… (Rupees……..only) to M/s. …….. (here in after called "the said Contractor (s)/ Seller(s)" which expression shall unless repugnant to the subject or context includes their legal representatives, successors and assigns) from the demand under the terms and conditions of Contract/Order dated. ……on production of a bank guarantee of equivalent amount.

2. We ……..Bank having its branch office at ……..do hereby agree and undertake to pay the amount due and payable under this guarantee without any demur, merely on a demand from the Company stating that in the opinion of the company which is final and binding, the amount claimed is due by way of loss or damage caused to or would be caused to or suffered by the Company by reason of non-payment / adjustment of any part of the said advance or any dues to the company or any breach by the said Contractor(s)/seller(s) of any of the terms and conditions contained in the said contract(s) orders(s) or by reasons of the Contractor(s)/ Seller(s) failure to perform the said Contract(s)/ Order(s). Any such demand made on the Bank by the owner shall be conclusive as regards the amount due and payable by the Bank under this guarantee, However, our liability under this guarantee shall be restricted to an amount not exceeding Rs……..(Rupees……..only).

3. We undertake to pay to the Company any money so demanded not withstanding any claim dispute or disputes raised by the contractor (s)/ Seller(s) in any suit or proceeding pending before any office, court or tribunal relating thereto our liability under this present guarantee being absolute and unequivocal. The payment so made by us under this bond shall be valid discharge of our liability for payment thereunder. Our liability to pay is not dependable or conditional on the owner proceeding against the Contractor(s)/ Seller(s).

4. The guarantee herein contained shall not be determined or affected or suspended by the liquidation or winding up, dissolution or change of constitution or insolvency of the said tenderer(s) but shall in all respect and for all purposes be binding and operative until payment of all money due or liabilities under the said tender are fulfilled.

5. We ……..Bank Ltd. further agree that the guarantee herein contained shall remain in full force and effect during the period that would be taken for the finalisation of the said tender and that it shall continue to be enforceable till the said tender is finally decided and order placed on the successful tenderer(s) and/or till all the dues of the company under/ or by virtue of the said tender have been fully paid and its claims satisfied or discharged or till a duly authorised officer of the company certifies that the terms and conditions of the said tender have been fully and properly carried out by the said tenderer(s) and accordingly discharges the guarantee.

6. That the Owner/Company will have full liberty without reference to us and without affecting this guarantee to postpone for any time or from time to time, the exercise of any of the power of the owner under the tender.

7. Notwithstanding anything contained herein before, our liability shall not exceed Rs…….(Rupees……only) and shall remain in force till……..Unless a demand or claim under this Guarantee is made on us within three months from the date of expiry we shall be discharged form all the liabilities under this guarantee.

8. We……Bank, lastly undertake not to revoke this guarantee during its currency except with the previous consent of the Company in writing. We further undertake to keep this Guarantee renewed from time to time on the request of the Tenderer(s).

Date……. ……Bank

Corporate Seal of the Bank

By its constitutional Attorney
Signature of duly
Authorised person
On behalf of the Bank
With seal & signature code

BGs to be furnished from any of the banks listed in Annexure.

LIST OF STANDARDISED BANKS

1. SCHEDULED PUBLIC SECTOR BANKS (INDIAN)

1. State Bank of India.
2. State Bank of Bikaner and Jaipur
3. State Bank of Hyderabad
4. State Bank of Indore.
5. State Bank of Mysore.
6. State Bank of Patialia.
7. State Bank of Saurashtra
8. State Bank of Travancore.
9. Allahabad Bank
10. Andhra Bank
11. Bank of Boroda
12. Bank of India
13. Bank of Maharashtra
14. Canara Bank
15. Central Bank of India
16. Corporation Bank
17. Dena Bank
18. Indian Bank
19. Indian Oversea Bank
20. Oriental Bank of Commerce
21. Punjab National Bank
22. Punjab and Sid Bank
23. Syndicate Bank
24. Union Bank of India
25. United Bank of India
26. UCO Bank
27. Vijaya Bank.

(Twenty Seven Banks)

2. SCHEDULED PRIVATE SECTOR BANKS (INDIAN):

1. Vysya Bank
2. UTI Bank Ltd.
3. SBI Commercial & International Bank Ltd.
4. ICICI Banking Corporation Bank Ltd.
5. HDFC Bank Ltd.
6. IDBI Bank Ltd.

(Six Banks)

3. SCHEDULED FOREIGN BANKS:

1. American Express Bank Ltd.
2. ANZ Grindlays Bank Plc
3. Bank of American NT & SA
4. Bank of Tokyo Ltd,
5. Banque Nationale de Paris
6. Barclays Bank Plc
7. Citi Bank N.A.
8. Deutsche Bank A.G.
9. Hongkong & Shanghai Banking Corporation.
10. Standard Chartered Bank
11. The Chase Manhattan Bank Ltd.
12. Dresdner Bank AG.

(Twelve Banks)

APPENDIX –I A

DETAILS OF WORKS OF SIMILAR NATURE & MAGNITUDE CARRIED OUT DURING THE LAST 5 YEARS

Sl. No.	Name of work done	Estimated cost	When started	When completed	Date of Completion As per contract	Remarks

Note : 1. In the remarks column, please state whether the works stated above are carried out by you in the name of the Firm in which the present Bid is submitted or any other names. If later, state the relationship of the firm and also a copy of the Partnership Deed.

2. Please enclose the true copy of the certificate issued by the authorities, if any.

Signature of Bidder

APPENDIX –I B

Name of Work:

Name of Tenderer:

CONCURRENT COMMITMENTS OF THE TENDERER

Full Postal Address of Client & Name of Officer-in-Charge	Description of the work	Value of contract	Date of commencement of work	Scheduled Completion period	Percentage Completion as on date	Expected date of completion	Remarks if any

SIGNATURE OF TENDERER

APPENDIX –II

NAME OF WORK:

NAME OF TENDERER:

DETAILS OF EQUIPMETNS, TOOLS TACKLES

Tenderer shall submit herein details of equipment, tools, tackles, etc required to perform the work and shall note in each case whether the same is (a) already owned by tenderer and available for use on this contract (b) anticipated to be hired by Contractor or (c) anticipated to be purchased by Contractor, in case of (a) anticipated (b) and (c) Location of hirer or supplier shall be stated.

Sl. No.	Description, Make Mode & Capacity	Year of Manufacture	Category (a) or (b) or (c) below	Location	Remarks
(1)	(2)	(3)	(4)	(5)	(6)

2. Contractor agrees to augment the above chart with additional number/ categories of equipment, if required to complete the work within the agreed time schedule of completion and directed by the Engineer-in-charge.

3. In case of hiring of equipment form other agencies, copies of the arrangements made with the hirer/ supplier shall have to be furnished.

SIGNATURE OF TENDERER

APPENDIX – III

DETAILS OF MINIMUM MANPOWER PROPOSED TO BE DEPLOYED ON THIS WORK

Sl. No.	Details of Manpower	No.	Remarks

Note : Please furnish the above details in two categories – To be deployed by (I) Contractor and (ii) Sub- contractors.

Minimum manpower deployment shall be based broadly as above and will be modified as mutually agreed to suit the detailed construction programme jointly worked out; further if any additional man power is required for completion of work in time, the same shall be provided by you as directed by Engineer without any extra cost.

The manpower proposed to be deployed in the work needs to be given quarter wise separately for direct personnel of the contractor and the manpower proposed to be deployed through the sub-contractors.

APPENDIX - IV

ORGANISATION CHART SHOWING NO. OF QUALIFIED ENGINEERS & SUPERVISORY PERSONNEL ETC.

Sl. No.	Details of personnel to be deployed on this work	No.

Note: Names and short resume of their experiences may also be given for key personnel.

The tentative chart of your site organisation as above furnished by you shall be subject to variation to suit the construction programme/ requirement and as directed by Owner/ Engineer.

APPENDIX – V

LIST OF PROPOSED SUB CONTRACTORS

Sl. No.	Name of sub-contractor	Description of work or trade	Amount (Rs.)

1) Types of work executed by the sub-contractors.
2) The particulars of clients where the sub-contractors did the works.
3) Approximate value of the work carried by the sub-contractors in the last 3 years.

(Signature of Bidder)

APPENDIX – VI

PPROGRESS BILLINGS

(Bidder's anticipated progress billing month by month to be inserted here)

Tentative construction schedule indicating the expected dates of start of activity is to be given by the contractor. This schedule shall be updated within specified milestones from time to time depending upon the availability of fronts equipment and priorities fixed by Engineer. Contractor shall submit within 15 days of the date of letter of intent programme/ schedule for supply of items covering all phases of work including design, procurement, manufacture, assembly, fabrication, testing, transportation, erection, testing at site and commissioning matching the overall completion schedule.

The billing as well as all the connected documents shall be computerized.

(Signature of Bidder)

APPENDIX – VII

NAME OF WORK:

NAME OF TENDERER:

INFORMATION ABOUT TENDERERS (FORM – H)

1.0. In case of Individual:

1.1. Name of Business:

1.2. Whether his business is registered:

1.3. Date of Commencement of Business:

1.4. Whether he pays Income Tax over Rs. 10,000/- per year:

2.0. In case of Partnership:

2.1. Name of Partnership with qualification:

2.2. Whether the Partnership is Registered:

2.3. Date of Establishment of firm:

2.4. If each of the partners of the firm pays Income Tax over Rs. 10,000/- a year and if not, who of them pays the same.

3.0. In case of Limited Liability Company or Company Limited by Guarantees:

3.1. Amount of paid of capital:

3.2. Name of Directors:

3.3. Date of Registration of Company:

3.4. Copies of the Balance Sheet of the Company of the last two years :

Copies of audited Profit & Loss Account and the Balance sheet shall be enclosed in case of Individuals, partnerships as well as limited companies for the last 3 years.

(Signature of Tenderer)
Name & Address of the Tenderer

APPENDIX – VIII

NAME OF WORK:

NAME OF TENDERER:

LIST OF ENCLOSURES (FORM – I)

The tenderer is required to enclose the following documents as part of his tenderer.

1. Power of attorney of the signatory to the tender.

2. Income Tax/ Sales Tax Clearance Certificate in the proforma prescribed by the Govt. of India.

3. Documents showing annual turnover for similar works for the past two years such as annual report, profit and loss account etc.

4. Solvency Certificate by Nationalized Schedule Bank.

Signature of Tenderer

** In absence of Income Tax Clearance Certificate tenderer may not be awarded the work tendered for as per Central Govt. Directives.

APPENDIX – IX

NAME OF WORK:

NAME OF TENDERER:

EXCEPTION AND DEVIATION (FORM – J)

As pointed out in the NIT/ LIT, tenderer may stipulate here exceptions and deviations to the tender conditions, if considered un-avoidable.

Sl. No.	Page No. of tenderer document	Sl. No. of tender document	Subject	Deviation

SIGNATURE OF TENDERER

AMENDMENT TO GCC

Sl No	Clause No	Brief Description of Clause	Modification
01	2.3 2.3.10	Power Supply	i.) Clause No. 2.3 of General Condition of Contract stands modified to the following extent: The cost of construction power appearing in the 10th and 11th line as Rs 1/- per kwh shall be read as Rs.2.85 (Rupees two and eighty five praise only) per kwh The state Electricity Inspector appearing in the second line shall be read as 'Central Electricity Authority at Chennai'.
02	2.4	Land for Contractor's Field office, Godown and Workshop	Clause No. 2.4 of General Condition of Contract modified to the following extend: "The owner shall provide land to the Contractor for their offices, go-down and workshop "
03	2.5	Land for Residential Accommodation	Clause No. 2.5 of General Condition of Contract modified to the following extend: "The land for residential accommodation for staff and labour may be made available to Contractor outside plant boundary limit."
04	22	Extension of time	The word "any one" appearing in the end of the second para of Clause No. 22.0 shall be read as "OWNER".
05	52.3.6	Return of unutilised materials and scrap/wastage	i. The words "SAIL, Bhubaneswar stock yard rate" appearing in 3rd line of first para shall be replaced by " Landed cost" ii. The words "Rs.7000/- per tonne" appearing in last para shall be replaced by " twice the landed cost of materials"
06	53 (xv)	Conditions for issue of materials	The contents of the sub-clause No.53.(xv) shall stand deleted and replaced with the following: "For the free issue materials, the following norms shall be adopted: i. For issue of materials within plant boundary wall limit, the Contractor shall submit only indemnity bond for the entire value of the materials issued to them free of cost as Clause 53 (ix) of GCC. **ii.** For the materials which are issued to out

			side plant boundary like township etc., the Contractor shall furnish Bank Guarantee equivalent to 20 % of value of materials and indemnity bond for the 80 % value of the materials. **iii.** For materials taken out side Damanjodi/ Angul to the vendor's Shop, 100 % Bank Guarantee against value of the materials will be submitted by the vendor before taking of the materials. The Indemnity Bond and the Bank Guarantee shall remain valid till the material account is totally settled.
7	60 (c)	Alterations in Specifications and Design and Extra Works	The words "including equipment hire charges at Schedule hourly/ daily rates" appearing in 7th line shall be replaced by the words " prevalent at site the time of execution".
8	60(d)	Alterations in Specifications and Design and Extra Works	Add new sub-Clause 60(d) as follows: "The quoted prices/rates indicated in Schedule of Rates shall remain firm for all variations in contract value within range of (+) 50 % and (-) 25 % for the entire duration of the contract. In case the actual contract value varies from the awarded contract value beyond the above mentioned limit than adjustment to contract value shall be made in accordance with procedure specified in proforma for adjustment for increase/ decrease in contract value enclosed as per Annexure in SCC".
9	76.3(ii)	Completion documents	Clause No. 76(ii) of General Condition of Contract shall be replaced by: "Six sets of construction drawings showing there in execution of the work duly approved by Engineer-in-charge and one set of reproducible on polyester film."
10	80.1	Employees State Insurance Act	Delete the word "whose aggregate remuneration is Rs.560.00 per month or less and" appearing in the 3rd & 4th line of the 2nd para of this sub clause.
11	New Sub clause	-	Add a new clause designated as Sub clause 80.6 after existing Cl no. 80.5, "80.6 – The contractor shall comply with all relevant and applicable statutory provisions in respect of the workers engaged by him at his cost and above stipulation are only indicative are not exhaustive."

12	83 (viii)	Labour Laws	Clause 83 (viii) of GCC shall be modified to the following extent: Add the words *"all relevant statutes at their own costs including*" between the words "*provisions of*" and "the *payment of Wages Act 1936*" appearing in the first line of this sub-clause. Provided further that- a) The payment of minimum wages to the contract labourers shall be as per the rates notified by the Central Government, as per Minimum Wages Act-1948 and as adopted/ circulated by the NALCO Management from time to time *plus* additional element of Rs.12.00 (Rupees twelve only) and statutory dues thereon. b) The minimum wage as notified by the Chief Labour Commissioner (Central) has a variable component as Special Allowance which is linked to average AICPI for Industrial workers, which keeps on changing every six months. The contractor has to absorb all such variations due to increase in Minimum wage in their quoted price, and no claim whatsoever on this account shall be entertained. c) The classification of workers in different categories will be as per the notification issued by the Central Government fixing the minimum wages for the above scheduled appointment. Where the minimum wages notified by the concerned State Government are higher than the rates notified by Central Government, the State Government rates should apply in concerned *scheduled employment* as long as the same remains higher than the Central Government rates.
13	New Clause	Jurisdiction/ Governing Law	Add a new clause designated as Sub clause 88 (c) after existing Cl no. 88 (b) All the works that will be carried out inside the factory premises shall attract the provisions of

			factory act for the contract labourers engaged therein. The Contractor, before commencement of work will arrange medical examination at his cost and shall submit the certificate of fitness in respect of the workers in the prescribed form from the nearby District HQ hospital or any Govt. Hospital for his workers, who will be handling or working with hazardous substance. In respect of contracts having more than one year, the medical check up of such workers shall have to be repeated by the contractor on completion of every one year.
14	79	Taxes & Duties	The rates quoted by the tenderer will cover all the taxes, duties, and levies as applicable on the date of bid/ revised bid (if any). - In case of any imposition of new taxes by Govt notification at a later date, same shall be reimbursed to the contractor against submission of authentic document towards payment of such taxes by them. - In case of revision of rate of Works Contract Tax by Govt notification, same shall be reimbursed to the contractor against submission of documentary evidence towards payment of such extra amount by them.