712087/2025/SMELTER CAPITAL REPAIR GRP

नालको NALCO

NATIONAL ALUMINIUM COMPANY LIMITED

SMELTER PLANT, NALCONAGAR

ANGUL, ODISHA

16/9/25 (S Singh) | 16/09/25 (B. Arya) | 16.09.25 (P. Raja) | 16/09/25 (P. Sahoo) | 16.09.25 (R.S Thakur) | 16/09/2025 (S Biswal)

(Site Technical Committee)

16/9/25 (PL-Oprn) (R. Kujur) | 16/9/25 (CRG) (S.B. Sahoo) | 16.9.25 (PL-Mech) (P. Raja) | 16/9/25 (PL-Elect) (S. Behera) | 16.9.25 (PL-E&I) (A. Kisku) | 16/9/2025 (Civil) (S. Panda)

(HODs/GMs)

SPECIFICATIONS FOR DESIGN, SUPPLY, INSTALLATION AND COMMISSIONING OF PIPE CLEANING MACHINE IN OLD LPC SHOP

DOC REF. NAL-SMLT-CRG-PROJ-23-24-028

REISION NO	ISSUE NO	DATE
02	00	15.09.2025

1. INTRODUCTION & GENERAL INFORMATION:

National Aluminium Company Limited is one of the largest Aluminium producers in Asia having its Corporate Office at Bhubaneswar, capital city of Odisha, Mines & Refinery at Damanjodi in the Koraput district of Odisha and Smelter & Captive Power Plant at Angul district of Odisha. Nalco has also Port facilities at Visakhapatnam in the state of Andhra Pradesh in addition to regional marketing office at Delhi, Kolkata, Mumbai, Chennai, and Bangalore.

In the Smelter Plant, Aluminium is produced by electrolysis of Alumina (Al_2O_3) in a specially made pot cell (Voltaic Cell). Pre baked Carbon Blocks are used as Anodes in the process of electrolysis. During the electrolytic process, Carbon Anodes get oxidized and therefore, carbon blocks are periodically replaced. These Carbon Blocks are manufactured at Green Anode Plant (GAP) by mixing liquid coal tar pitch and calcined petroleum coke. Green anodes are baked in a ring type open hearth furnace to impart desired/ improved physical properties like electrical conductivity mechanical strength & resistivity.

1.1 **Location**: The plant and equipment to be supplied under this package will be installed in the Smelter plant of National Aluminum Company Limited, located at a site approximately 07 Kms. from the nearest town Angul in the Odisha State of India. This site is connected by a link road to the existing highway NH- 55, linking NH- 16 (Kolkata-Chennai) and NH- 53 (Kolkata-Mumbai). The nearest Railway Station is about 07 kms from the plant and the plant is approximately 150 Kms. from state capital Bhubaneswar

1.2 **Site Condition & Climate:**

Climate:

Temp. °C	Dry Bulb	Wet Bulb	Relative Humidity
Maximum	50	25.7	83 % at 26 °C
Minimum	06	14.80	33 %
Design	50 Max./ 06 Min		

Rain Fall:

Annual: Maximum: Minimum: Average:	 2148.7 mm 756 mm 1243.7 mm
Heaviest Rainfall	257 mm
Peak Intensity	100 mm/ Hour
Design Intensity	100 mm / Hour
Rainy Season	Mid June- Mid. Sept.

Wind Data:

Wind Direction Wind Velocity	West & North-West 180 KMPH Max.
Max. Wind pressure	At 10 m: 193 da N/M2 At 20 m: 219 da N/M2 At 30 m : 231 da N/M2
Design Intensity	100 mm / Hour
Rainy Season	Mid June- Mid. Sept.

Barometric Pressure:

Maximum	1001.4 mbs (Average Monthly)
Minimum	981.6 mbs (Average monthly)
Average yearly	Morning (08:30 hours) 993.5 mbs Evening (17:30 hours) 989.3 mbs
Design	981 mbs

1.3 **Seismic Data:**

Design of structure for seismic load (due to earthquake) shall be as per design requirement of IS: 1893, considering zone-III and importance factor shall be 1.5.

2. VENDOR'S SCOPE:

2.1 The intent of this requisition is to outline the requirements of the Purchaser for the design, manufacture, supply/ dispatch, installation, erection, testing & commissioning of Pipe (Siphon tube) Cleaning machine in Old LPC Shop which shall include site assessment to study the requirements, conceptualization of the project within battery limits, collection of required data/inputs/drawings, design, engineering, approval from Nalco, manufacturing, procurement, supply/ dispatch, transport/shipment both air & sea, inland transportation, receipt at site, storage & warehouse management, fabrication, assembly, erection, installation, painting, hook-up with the existing system mechanically, electrically and for automation, testing, commissioning, PG test, handing over, drawings & documents of the Pipe (Siphon tube) Cleaning machine in Old LPC Shop of Smelter Plant, Angul, in accordance with the specifications and drawings enclosed with this document. In the process of engineering, vendor may have to assess the site number of times for gauging physical requirements and collection of data relevant to the process design.

2.2 The supplied system shall be a complete operating unit including all required auxiliary equipment for efficient and satisfactory operation as a System and integral part of the existing Old LPC Shop. Vendor shall be responsible for furnishing all mechanical, electrical, instrumentation and other inter-connecting and safety items as required to make the system complete. The job needs to be carried out in the operating Old LPC Shop. After successful erection and commissioning only the existing machine will be dismantled. The existing machine will continue to run till the handover of the new PCM. Any deviation from mutually agreed time and duration should be unanimously agreed upon before placement of PO. The job includes dismantling of old structure/ equipment /

system, if any and cutting to small sizes and shifting to designated location as per the instruction of Manager-in-Charge or his/her authorized representative to accommodate the installation of the new system. Vendor has to categorically note that proposed work is purely brown field project.

2.3 All the equipment and materials supplied & installed under these specifications shall be installed in accordance with standard designing & engineering principles and good fabrication and construction practices. No omission from these specifications shall relieve the vendor of his responsibility for an adequate system as above. All materials supplied under this requisition shall be adequate for proposed service. Proper consideration shall be given to their function with regard to corrosion, chemical and process hazards and erosion due to the material being handled.

2.4 The proposed system shall be complete integrated unit that includes but not limited to Pipe (Siphon tube) Cleaning machine with all accessories & switchgears, sensors & control instruments and other accessories required for the complete system.

2.5 All the electrical & instrumentations within battery limit required for supply, installation, testing & commissioning and handing over of the proposed Pipe (Siphon tube) Cleaning machine to Nalco, shall be in vendor's scope.

3. PURCHASER'S SCOPE:

3.1. Nalco shall appoint a project coordinator who will associate and facilitate the project activities with the vendor.

3.2. Nalco shall provide available data, drawings & software etc. to the vendor, if required.

3.3. Free Land and water at site for temporary office cum store cum warehouse cum work shop for smooth execution of the project. However, vendor has to arrange necessary tapping connections from the source identified by Nalco.

3.4. Free electricity and construction water shall be made available for the erection and commissioning of the plant.

4. FREE ISSUE OF MATERIALS:

There will be **no free issue of materials** for the proposed "Pipe (Siphon tube) Cleaning Machine in Old LPC Shop". The vendor shall arrange all the materials required for the proposed system within the battery limit. However, free land, electricity & water for office cum store cum workshop during the tenure of the WO/PO to execute the work as per the clause no. 3.3 & 3.4 will be made available for the vendor.

5. SAFETY:

5.1 The manpower safety and construction safety shall be given prime importance during site execution of the jobs. Since, the site activities are to be conducted in the vicinity of a running plant, the contract, their sub-contractor, workmen, labourers shall strictly follow the safety guidelines of Nalco. There will be no compromise with safety at any point of time which may attract disciplinary action on the contractor.

5.2 Adequate number of safety officers are to be deployed at site to ensure safety of the man power and safety of the equipments. The tool box meeting shall be carried out on regular basis.

5.3 The work shall be carried out inside the plant as per safety practices enforced by NALCO safety section and instructions of Manager-In-Charge or his/her authorized 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 argument for time and financial implications.

5.4 To obtain work 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 Section shall be considered.

5.5 The Contractor shall abide by all safety regulations of the plant and ensure that safety equipment or specific job kit as stipulated in the Factory Act / Safety Hand Book is issued to the employee during the execution of work, failing which all the works at site will be suspended.

5.6 All the lifting tackles including wire ropes, slings, shackles and electrically operated equipment shall be got approved by NALCO Engineer before they are actually put on use. Test certificates should be submitted before their usage.

5.7 For the movement of cranes etc. it may become necessary to lay sleeper bed for obtaining leveled safe approach for usage of equipment. It shall be the contractor's responsibility to lay necessary sleepers. Required sleepers shall be arranged by the contractor at their cost. It shall be contractor's responsibility to arrange necessary cranes/tractors, trailer or trucks/slings/tools and tackles/ labourers including operators and on to transport equipment, move it to erection site/pre-assembly yard and unload the same at pre-assembly yard/ erection site and the quoted rate shall include the same.

5.8 All equipment so used by contractor shall be of proven quality and safe in operation as approved by the statutory authorities as per the law in force.

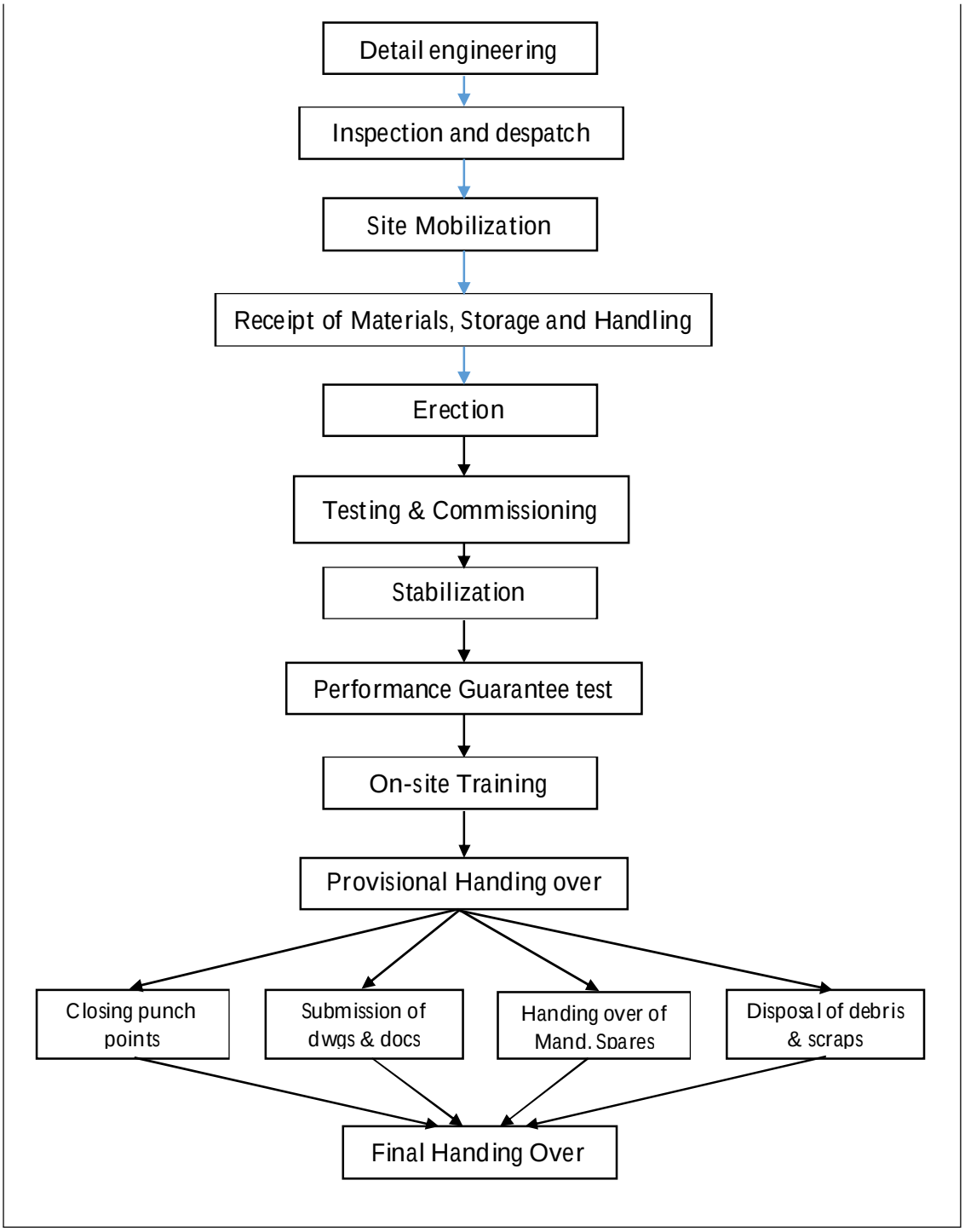
5.9 **Site cleanliness and safety requirements:** Contractor shall strictly follow all safety regulations/conditions and its sub clauses of General Conditions of Contract. Non-conformity of safety rules and safety appliances will be viewed seriously. The contractor should exclusively deploy one Safety Engineer along with a safety supervisor for effective implementation and co-ordination of safe working conditions.

6. COMPLETION SCHEDULE:

The total Completion period of the project in all respect as per Technical Specification and scope of supply/work of our NIT shall be **12 months** from the effective date of contract.

7. MODALITY OF PROJECT EXECUTION:

A typical flow diagram is given below which is to be followed for execution of the project after placement of order.



7.1 DETAIL ENGINEERING:

The detail engineering shall be carried out by the vendor from the effective date of Purchase order. As a part of detail engineering, kick-off meeting shall be conducted at site within 15 days of effective date of order. The vendor has to visit site with their project team to deliberate on the modality of project execution, physical assessment of execution area. Subsequently, the vendor shall submit detail project schedule, design & engg. Documents, drawings, datasheet, P&ID, QAP etc. for approval of Nalco.

First, a list of all documents/drawings which are required for the project shall be submitted to Nalco for review. It shall contain the tile of the document/drawing, document/drawing no. and schedule date of submission. Based on this document/drawing submission schedule, the documents/drawings are to be submitted to Nalco for approval/review/retention.

7.2 INSPECTION & DESPATCH CLEARANCE:

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 pre dispatch inspection (PDI) shall be carried out by Nalco personnel at the works of the vendor for full system or few major equipment as per “Inspection Categorization plan” (ICP). This document shall contain description of the equipment, agency for inspection and basis of inspection i.e. QAP document. The ICP document shall contain description of the equipment, 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.

Despatch Inspection calls shall be given by the vendor/contractor 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.

Note:

- No material shall be despatched without getting dispatch clearance from Nalco either from Nalco office in case of Cat-II & III items or from vendor's works in case of Cat-I item.
- The despatch clearance does not absolve the vendors responsibility to ensure overall performance of the system which is to be demonstrated at site during testing and commissioning.
- The To & Fro travel expenses, lodging, boarding, conveyance etc. of the Nalco inspectors for PDI will be borne by Nalco.

7.3 SITE MOBILIZATION:

Before arrival of the supplied equipment at site, the contractor shall mobilize the site, set up site office, storage yard, and appoint sub-contractor, if required. For sub-contracting the jobs, prior approval of manager-in-charge is required in writing as per the procedure described in the GCC. Adequate man power shall be deployed including safety officer before commencement of site activities.

7.4 RECEIPT OF MATERIALS, STORAGE AND HANDLING:

While transporting the supply materials to site, these are to be entered at Smelter CISF gate and then taken to the site storage yard already set up by the contractor and unloaded these by the transporter in presence of the contractor representative. The received materials shall be inspected by Nalco personnel physically and if found OK, will be issued to the contractor for erection. If any material is found to be damaged at the time of site inspection, it will be informed to the contractor and subsequent actions to be followed as per relevant clauses in GCC.

The equipment shall be under the custody of the contractor till handing over of the complete system. The materials may have to be stored for longer period before installation and so, proper storage is to be ensured by the contractor against heavy rains/high ambient temperature, unless otherwise agreed. Watch and ward of the supplied equipment round the clock till handing over of the system is the responsibility

of the contractor. For any damage, theft or shortfall in the supplied materials observed during execution of work, the contractor has to arrange the required materials without additional financial implication to Nalco.

7.5 ERECTION:

The vendor shall carry out physical erection of all supplied equipment including Mechanical, Electrical, instrumentation items and Civil construction works as per approved QAP, drawing and project schedule. This also may include dismantling, re-routing of road/drains/cable tray for successful erection of the supplied equipment within the battery limit as per site requirement. The erection protocols for individual items shall be prepared by the contractor and get prior approval of Manager-in-charge or his/her authorized representative. All results of inspection will be recorded in the erection protocol and signed by both vendor & NALCO. The mechanical completion certificate shall be issued by the Manager-in-charge or his/her authorized representative on the basis of the signed protocols.

7.6 TESTING AND COMMISSIONING:

After completion of erection, individual equipment shall be powered ON and checked for it's operation as per OEM specification/QAP. Prior to commencement of commissioning work, the commissioning protocol/Site Acceptance Test (SAT) of individual equipment as well as overall system shall be prepared by the vendor/contractor in line with the approved operation & control philosophy and get it approved from Nalco. After trial testing of individual equipment, the vendor/contractor will operate the system with load and demonstrate agreed operation philosophy to Nalco personnel. All test results will be recorded in the commissioning protocol by the vendor.

7.7 STABILIZATION:

After commissioning of the proposed system, the same shall be under observation for minimum two week time (i.e. stabilization period). During this period, the total system shall be operated by the vendor on continuous basis. If the system requires some fine tuning, the vendor will do the same and any change made by the vendor in the system during this period shall be recorded in the commissioning protocol. After completion of stabilization period, the commissioning protocol is to be signed by both Nalco personnel and vender representative.

7.8 PERFORMANCE GUARANTEE TEST:

i. In order to demonstrate the PG parameters, the vendor has to submit a PG test procedure prior to PG test. This is to be mutually agreed by Nalco. The performance guarantee tests shall be jointly carried out by the representative of the vendor and Nalco or his nominee with all the test equipment arranged by the bidder. The parameters to be tested during PG Test are given below:

The Performance Guarantee Tests shall be conducted for 8 Hrs per day in "G" shift only during 8 AM to 1 PM and 2 PM to 5 PM for consecutive five days excluding Sundays & Holidays. The necessary instrument, duly calibrated, for measuring the parameters is to be organized by the bidder.

a) **Average Internal Diameter of Pipe after Cleaning** : 95 to 100 mm

b) **No. of Pipes to be cleaned satisfying Average ID of Pipe :**
Tapping Spout Assembly : 15 Nos per shift (8 Hrs)

c) **Noise Level** :
Noise level shall not exceed 85 dBA at a distance of 1 m from the machine (when other machines are not running in the shop).

d) **Dust Level** :
Dust level at the work zone shall not exceed to 10 mg/Nm3 (As per IS:5182-Part-IV) over and above the background dust level. The measurement of dust has to be taken at multiple points in the shop floor which will be decided before commencement of PG test.

e) **Dust emission at the chimney/stack:**
Maximum dust emission at the outlet of the chimney/stack shall be below 30 mg /Nm3

ii. All equipment and components shall be guaranteed as per the clause mentioned elsewhere under commercial terms and conditions.

iii. The bidder shall have the total responsibility for the design and performance of the complete system supplied under the requisition. The bidder shall warrant the systems furnished by him and the performance of the said system in accordance with this specification

7.9 ON-SITE FAMILIARIZATION TRAINING:

At the successful completion of P.G. test and acceptance thereof, the vendor shall conduct on-site training for at least 20 O&M personnel including Mechanical, Operation, Electrical and Instrumentation discipline of Nalco. The content of technical training shall cover overall structure of equipment, working principle of electric control, pneumatic and lubrication systems, parameter setting and selection, operation, maintenance, troubleshooting knowledge. After training, Nalco personnel will operate the machine as per accepted operation philosophy under the supervision & guidance of the vendor. The training materials (different from the instruction manuals) for operation and another for maintenance shall be distributed to all participants with three master copies each for technical archives. The cost of training including training materials shall be borne by the vendor.

7.10 PROVISIONAL HANDING OVER:

After successful completion of on-site training, the Pipe/Siphon Tube Cleaning Machine system shall be provisionally handed over to Nalco for day-to-day operation by Nalco personnel. However, the vendor/contractor shall carry out the maintenance of the system and provide support for running the system till handing over of Mandatory Spares(if any) and As built Electrical & Instrumentation drawings.

7.11 FINAL HANDING OVER:

The system shall be finally handed over to NALCO by the contractor after successful completion of the following activities:

- erection, commissioning & PG test
- Stabilization period
- On-site training to Nalco personnel
- Compliance of mutually agreed punch points
- Submission of As-Built drawings & documents as per requirement mentioned elsewhere in the document
- Handing over of mandatory spares and surplus materials to Nalco
- Disposal of debris, project scraps and dismantled materials, if any

8. INSTRUCTIONS TO BIDDERS (TECHNICAL)

8.1 Technology: System, process, equipment, and components selected for this turnkey project shall be based on latest & proven and technology acclaimed Nationally and Internationally.

8.2 Vendor has to provide bio-data of key personnel presently in the rolls of the company and proposed site organization for carrying out the work including deployment of Engineers and Supervisors.

8.3 The bidder shall read the technical specification and understand the requirement fully before bidding. The bidder may visit the site for assessing exact site conditions before bidding.

8.4 Vendor shall ensure continued technical agreement and aftersales spares & service support for minimum period of five years from the date of commissioning of the system.

8.5 The bidder shall submit deviation to Technical Specification and Commercial terms of NIT, if any, separately in the specified format given the commercial document.

8.6 The bidder shall submit the desired documents to meet PQC and duly filled PTR(Proven Track Record) format indicating their previous installations to be considered against PQC

9. DRAWING AND DATA REQUIREMENT:

The following data and information shall be furnished by vendor:

Sl. No	Description	With Bid	After Job Award		
			For Review	For Information	Final in Book Form
1	2	3	4	5	6
1.	Basic Calculations for system design and equipment selection				x
2.	Makes of all equipment & materials		x		x
3.	Technical Literature like erection manual, start-up and operating manual, maintenance hand book, equipment data sheets, lubrication drawing and manual,				x
4.	Process Flow Diagram (PFD)		x		x
5.	System Flow diagram with material balance				
6.	Process and Instrumentation diagram		x		x
7.	Bill of material and schedule quantity			x	x
8.	Overall general arrangement drawing	x	x		x
9.	Completed data sheet (Bidder shall submit his own standard data sheets for items whose data sheets are not enclosed)		x		x
10.	Utility Requirement	x	x		x
11.	Foundation Layout & Data			x	x
12	Drawings and documents as asked for under electrical and instrumentation control specifications	x	x	x	x
13	GA drawing with cross section for Pipe/Siphon Tube Cleaning Machine and all		x	x	x

	components at the battery limit.				
14	Component cross sectional drawings with parts list			x	x
15	Test Procedures		x		x
16	Start-up and operating instruction			x	x
17	Repair and maintenance instruction			x	x
18	Maintenance manual, including assembly showing all critical clearances.			x	x
19	Manufacturer's test certificate for sub vendor items.		x	x	x
20	Stage inspection test reports		x	x	x
21	Final acceptance testing and performance test records		x	x	x
22	Detail list for recommended spare parts (preliminary/ final)				x
23	Spare Parts Identification Drawings				x

9.1 Document distribution schedule:

a) Document listed under column 4 and 5 are to be submitted in 02 copies.

b) Document listed under column 6 are to be submitted as hard bound indexed book and soft copies as well containing the details in 08 copies to be submitted within 04 weeks of release note/ dispatch of materials/ equipment from vendor's works.

c) The O&M Manual should be submitted as per the following details:

i) **Process and Mechanical**-08 Hard copies and 08 Soft copies in USB STICK/PORTABLE HARD DISK

- Operation philosophy
- Standard Operating Practice (SOP) for the system and individual equipment
- Basic process with Process flow diagram
- Design calculations
- Manufacturing data book containing all test certificates of components, raw materials, stage manufacturing tests and inspection, final tests and inspection

documents and welding procedure qualification, repairs and reworking carried out in shops

- Spares details including assembly drawings, part numbers, delivery, prices, and ordering information
- Final drawing index and all as built drawings reduced to A3/A4 size & soft copies and wherever reduction is not possible, full size copies appropriately folded and placed in plastic folders
- Data Sheets of the supplied equipment/components
- Catalogue/leaflets of sub vendors/ suppliers of various bought out components highlighting the components actually supplied correlated to P.O. item numbers
- Operating and maintenance instructions including lubrication schedule with requirement of first fills, flushing fluids, inhibitors, chemicals required for pre-commissioning
- Trouble shooting

ii) **Electrical** -08 Hard copies and 08 Soft copies in USB STICK/PORTABLE HARD DISK

- Design calculations
- Standard Operating Practice (SOP) for individual equipment
- Manufacturing data book containing all test certificates of components, raw materials, stage manufacturing tests and inspection, final tests and inspection documents, repairs and reworking carried out in shops
- Spares details including assembly drawings, part numbers, delivery, prices, and ordering information
- Final drawing index and all as built cable wiring drawings reduced to A3/A4 size & soft copies and wherever reduction is not possible, full size copies appropriately folded and placed in plastic folders
- Data Sheets of the supplied equipment/components
- Operation & Maintenance manuals of components/ equipment(i.e. MCC, VFD, UPS, ACB, Micom & Protective Relays, Maintenance Hoists, etc)
- Final Operational Settings (i.e. VFD parameters, ACB, MOTPRO, Protection Relays, Instruments etc.)
- Catalogue/leaflets of sub vendors/ suppliers of various bought out components highlighting the components actually supplied correlated to P.O. item numbers

- Operating and maintenance instructions including lubrication schedule with requirement of first fills, flushing fluids, inhibitors, chemicals required for pre-commissioning
- Trouble shooting

iii) **Instrumentation** - 08 Hard copies and 08 Soft copies in USB STICK/PORTABLE HARD DISK

- Control philosophy
- Process instrumentation diagram
- Standard Operating Practice (SOP) for individual equipment
- Manufacturing data book containing all test certificates of components, raw materials, stage manufacturing tests and inspection, final tests and inspection documents
- Spares details including assembly drawings, Bill of Materials with make ,quantity, part/model numbers, and ordering information
- Final drawing index and all as built cable wiring drawings reduced to A3/A4 size & soft copies and wherever reduction is not possible, full size copies appropriately folded and placed in plastic folders
- Data Sheets of the supplied equipment/components/instruments
- Catalogue/leaflets of sub vendors/ suppliers of various bought out components highlighting the components actually supplied correlated to P.O. item numbers
- Operating and maintenance instructions for specialised instruments and automation systems
- Trouble shooting

9.2 Special Instruction for submission of Drawings:

a) Fold all prints to 216 mm x 279 mm size.

b) Vendor to forward drawings and documentation to National Aluminium Company Limited clearly specifying the Order or tender number.

c) The drawing / Document no with revision number are essential. The number may be up to a maximum of 28 characters in length.

d) Each drawing submitted to Nalco must be checked and signed / stamped by the vendor's authorized representative.

e) Revision number must change during subsequent submission of vendor document.

f) Multi sheet documents other than drawings must be submitted in their entirety in the event of a resubmission even of only few sheets are revised.

g) All vendor drawings to be provided with a blank space measuring 75 mm W x 38 mm H for marking review codes.

h) Drawings shall also include preparation of interconnection diagrams and integration diagram with existing Old LPC Shop.

i) Review of the drawing by Nalco would be only to check compatibility with basic design and concepts and would no way absolve the contractor/ vendor of his responsibility to meet applicable codes, specifications and statutory regulations/ rules.

j) Final submission in bound volumes shall necessarily have a cover page giving project title, item name, P.O. No, particulars of the purchaser and vendor and an index-giving list of drawings & documents included.

k) Hard copies of the Electrical and instrumentation drawings should be separately hard bound preferably in A3 size and to be submitted 8 copies each at the time of final submission.

l) Complete documentation of the PLC schematic, Instrument loop drawings, ladder and I/O cross reference (08 sets) for proposed system and modification in existing system in A3/A4 size at the time of final submission. Instrument loop drawings shall show each component from field device to final receiver including physical location, initiating device, its terminal number, junction box with its terminal number, cable number, receiver instrument terminal number, and system functional blocks etc of loop in simplified manner.

m) The electronic files of all As-Built drawings shall be submitted USB STICK/PORTABLE HARD DISK(Eight copies each). All As-Built shall be in pdf format and editable dwg format. Drawings shall be sketched in AutoCAD in proper scale. Not to scale drawings shall not be acceptable.

10. PAINTING AND SHIPMENT:

10.1 Equipment and materials supplied shall be painted after test at shop and after installation and testing at site. The painting shall be done as per the specification given.

10.2 All the surfaces prior to painting shall be well prepared.

10.3 The units shall be disassembled into major components suitable for shipment and shall be properly packed to provide adequate protection during transport/ shipment. All assemblies shall be properly match marked for site erection.

10.4 Each equipment shall have an identification plate giving salient equipment data, make, year of manufacture, equipment number etc.

10.5 All exposed carbon steel parts be painted shall be thoroughly cleaned to remove scale, rust, dirt and other foreign materials by wire brushing and sand blasting as applicable. Minimum acceptable standard in case of power tool cleaning shall be St.3 and in case of blast cleaning shall be Sa 2-1/2 as per Swedish standard SIS 055900/ EQ IS.

10.6 Non-ferrous materials, austenitic stainless steel, plastic or plastic coated materials, insulated surface of equipment and pre painted items shall not be painted.

10.7 Stainless steel surface, both inside and outside shall be pickled and passivated. Machined and bearing surface shall be protected with varnish or thick coat of grease.

10.8 Seaworthy / Roadworthy packing of the equipment to be ensured for safe delivery at NALCO- Angul. Shock and vibration proof packing with Impact recorders to be provided to indicate the date and time of impacts, if any.

11. DESIGN BASIS:

11.1 The bidder shall have the total responsibility for the design and performance of the complete system supplied under the requisition. The bidder shall warrant the systems furnished by him and the performance of the said system in accordance with this specification.

The proposed scheme has been based on the following design considerations:

a) Availability of Plant Compressed Air at Battery Limit 4.5 kg/ cm².
b) LT Power 415 V ± 10 %, 50 Cycles ± 3 %
c) Equipment Design basis: 20 % more than the ratings
d) Handling Medium/ Product: Pipe (Siphon Tube, attachment for Ladle/Crucible)
e) Pipe (Siphon Tube) : Ref Drg no: PL/PRJ/SPR/A1/11622
f) Ambient Temperature : 50^{0}C Maximum
g) Maximum Temp of Pipe (Siphon Tube) : 100 ^{0}C (Approx)
h) No. of Pipe (Siphon Tube Assembly) to be cleaned Per 8 Hours : 20
i) Life of the cutters : Minimum 100 Nos cleaning of Pipe (Siphon Tube Assembly)

11.2 PLANT OPERATING CONDITION:

Operating conditions involve 3 x 8 hour shifts per day, twenty one shifts per week except two shifts for Preventive maintenance (PM) per week throughout the year.

11.3 SYSTEM DESCRIPTION:

a) **Existing System**:

The Pipe (Tapping Spout End Tube/ Tapping Spout Intermediate Tube/ the Tapping Spout End Tube & Intermediate Tube Assembly), desired for cleaning, is placed in the container unit of the Pipe Cleaning Machine (Siphon Tube Cleaning Machine) through existing Slewing Jib Crane. The Pipe is clamped and the cover is closed manually. One carriage unit having rotating milling head with cutter is moved towards the item (clamped in the container) for cleaning the aluminum/dross present inside diameter of the Pipe. After cleaning upto the end of the Pipe and achievement of desired ID (Inner diameter) , the rotating milling head carriage unit is retracted back. The movement of the rotating milling head carriage unit and torque/force required for cleaning of the aluminum/dross present inside the Pipe is automatically controlled by hydraulic driven motors and dedicated Hydraulic Power pack. The Pipe, after cleaning, is taken outside by manually unclamping and slewing Jib Crane.

The entire machine unit is installed with an angle of 10 Deg in order to facilitate the flow of generated Aluminim Chips/Dust to a discharge chute present towards

downward slanting position of the machine. The generated Aluminim Chips/Dust is collected in a container placed under the hole through a rotary air lock.

The dust extraction system is connected to the existing system for Crucible Cleaning Machine.

b) **Proposed System:**

i. The proposed Pipe Cleaning Machine (Siphon Tube Cleaning Machine) shall be designed as indicated in the clause 11.1 above.

ii. The proposed machine shall be able to clean intended Pipe (Tapping Spout End Tube/ Tapping Spout Intermediate Tube/ the Tapping Spout End Tube & Intermediate Tube Assembly) to achieve the requirement.

iii. Multiple lengths i.e. Tapping Spout End Tube/ Tapping Spout Intermediate Tube/ the Tapping Spout End Tube & Intermediate Tube Assembly can be cleaned by the proposed machine.

iv. The vendor may use the design of movement of rotary milling cutter unit with stationary Container (clamped with the Pipe for cleaning) OR Stationary rotary milling cutter unit with Movable Container (clamped with the Pipe for cleaning).

v. The vendor may use the design of movement of Rotary Milling Cutter unit/ Movable Container (clamped with the Pipe for cleaning), torque/force required by rotating milling cutter for cleaning of the aluminum/dross present inside the item and RPM of the milling cutter by Hydraulic Motors or Electrical Motors. Accordingly, the vendor has to provide system with Hydraulic Power Pack Unit or VFDs required for their design.

vi. Guiding rails for smooth movement of carriage unit.

vii. The design mentioned in Technical Specification or any alternative design, adopted by the vendors, shall meet the PG Test parameters motioned elsewhere in the document.

viii. The Pipe shall be placed in the container with the help of a Slewing Jib Crane (supplied by the vendor).

ix. The container shall have required nos. of Clamping facilities (Minim Three) in order to ensure proper clamping of the Pipe. The Length of the pipe shall be auto detected by the machine so that rotating milling cutter can reach to the end of the Pipe. The Container cover shall close automatically after clamping of the Pipe.

x. The siphon Tube (Pipe) shall be cleaned inside a Cabinet with hood/cover.

xi. Proper alignment of the centreline of Rotational cutter unit with centreline of the Pipe.

xii. The proposed machine shall be installed with an angle of 10 Deg in order to facilitate the flow of generated Aluminim Chips/Dust/debris to a discharge chute present towards downward slanting position of the machine. However, the degree of inclination may be vary depending upon the design of different vendors.

xiii. Rotary air lock at discharge chute of dedusting system.

xiv. Separate dedicated Dedusting System with ID fans and Chimney of 30 Mtr Height. The vendor shall provide suitable sampling point as per IS 11255 (Part III)-2008 and the approach to the sampling point must be provided with a spiral ladder and platform so that a person along with measuring equipment can walk down to sampling point through steps for collecting samples.

xv. All the function like clamping of the Pipe, , RPM of the milling cutter, Feeding speed of the carriage unit, Auto reverse & Forward movement of carriage unit depending on the torque/force required by rotating milling cutter for cleaning of the hard aluminum/dross , Rotation of Milling cutter in reverse direction in case of blockage inside the Pipe, Removal of debris and dedusting system including ID fans shall be controlled by PLC. However, the cover may be closed manually by the operator from the HMI controlled by PLC, before the automated cleaning process is started from the HMI

xvi. Provisions for running the Machine in both Auto and manual Mode.

xvii. A dedicated Operating Panel/Desk near the proposed machine. The Operating panel shall have minimum following Features:

- Air Conditioned Electric panel
- In Built PLC in separate panel
- Suitable Joy Sticks/Push Buttons for operation/Control
- Selector Switch for selecting Auto, Manual and Maintenance Mode
- Emergency Stop Push Button
- Indication lights (On/Off) for Machine Running
- Blinking Indication light with sound when cutter is Jam

xviii. Dedicated Slewing Jib Crane (Minimum 2 MT capacity) for placement and removal of the Pipe (Siphon Tube) in the proposed Pipe Cleaning machine. The Jib crane should be able to lift the parts of the Pipe cleaning machine during maintenance activities.
(**Note:** 1. There must be a platform for working personnel to carry out job at hoist /CT trolley.
2. Also proper structure shall be provided for ascending up to the hoist assembly safely.
3. The control panel of the JIB crane must be mounted at floor level with in a maximum height of 2 mtrs.)

xix. Special consideration shall be given to machine maintainability. The Vendor shall incorporate any change required for addressing safety and maintenance issues during detail engineering.

c) **Plant & Equipment**:

i. All equipment and structures shall be designed for an indoor installation with environment and seismic conditions stated under clause 1.2 & 1.3. Design of all electrical systems shall be in accordance with the respective electrical standards.

ii. Each 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 dismantling. The specifications indicate minimum standard of quality for the materials, fabrication and construction of the proposed plants.

iii. All equipment shall be of proven design. Prototypes or extensive modifications of basic designs are unacceptable. However, small modifications suitable for site condition or improve performance are acceptable.

iv. All equipment and materials (mechanical piping, electrical, instrumentation, control etc.) shall be sourced from vendors/make acceptable to Nalco. The list of acceptable makes/ brand preference for major items is specified in the tender documents.

v. Noise level of any equipment shall not exceed 85 dBA measured at a distance of one meter from the equipment.

vi. All out door located motor / valves/ instruments and electrical equipment shall be protected by rain protection hood.

d) **Input Pipe Details:**

Ref Drawing No: PL/PRJ/SPR/A1/11622

i. Tapping Spout End Tube and Intermediate Tube Assembly
   - Length : 2255 mm
   - Internal Diameter with built-up material :20 to 80 mm

ii. Tapping Spout End Tube
   - Length : 1157 mm
   - Internal Diameter with built-up material: 20 to 80 mm

iii. Tapping Spout Intermediate Tube
   - Length : 1088 mm
   - Internal Diameter with built-up material: 20 to 80 mm

e) **Desired Parameters after cleaning of Pipe :** ID= 95-100 mm up to Total length of Pipe

f) **Implementation Philosophy**

The new Pipe (Siphon tube) Cleaning machine shall be installed in the existing operating Old LPC Shop. The vendor shall commission the new machine in shortest possible time so that loss of production due to down time can be averted.

Commissioning of the new machine shall be done in a phased manner during the planned maintenance schedule of Old LPC Shop.

Adaptation of the new machine with existing system shall be in the scope of the vendor.

The proposed layout showing the proposed equipment is attached (Ref Drg no: PL/MECH/LAY/A2/11490 Rev:02. This is indicative only. This lay out Design may vary during detailed engineering mutually agreed with NALCO. The Vendor may adapt their design of their proposed machine to yield the desired results mentioned under PG test and acceptance criteria.

11.4 CODES AND STANDARDS:

The design, fabrication, supply and testing shall conform to codes and standards listed below and specified elsewhere in this document. Bidder may also base his design on other international standards subject to approval of the purchaser. Only latest editions including addenda shall always be referred to. Please note that codes and standards mentioned below are minimum requirement and bidder may upgrade to achieve the optimum efficiency subject to prior approval from Nalco.

Design, fabrication & operation of the systems shall be based on but not limited to the following,

1. Indian Factory Act
2. Regulations laid down by Explosive Directorate and Electrical Inspectorate
3. NFPA code of practice
4. Regulation for electrical equipment of Buildings Insurance Association of India
5. Indian Electricity Rules
6. IS-3103 (code and practice of Industrial Ventilation)
7. IS: 2062(Steel for general structural purposes)
8. IS: 1239 and 3601 or ASTM A 106 GR B (Steel Tubes & Fittings)
9. ASME B 31.3 / EQ IS (Process Piping)
10. IS: 6392 or ANSI B 16.5 (Pipe flanges)
11. IS: 1239 or ASTM A234 Grade B WPB(Bends)
12. IS: 816 & 9595 or AWS D1.1/ D1.1M (Structural Welding)
13. IS: 814 or AWS A5.1, A5.1M, A5.5 (Welding Electrodes)
14. National Electrical Manufacturers Association (NEMA)
15. IEC/IS 61511-Functional safety - Safety instrumented systems for the process industry sector
16. IS: 14254 or IEC 61131-standard for programmable controllers
17. VFD: as per standard mentioned in the attached 'Standard Specification of VFD'
18. Motors: As per the standards mentioned in the attached 'Standard specifications of Motors'
19. MCC: As per the standards mentioned in the attached 'Standard Specification of M.V. Board'
20. LBS: IS/IEC 60947
21. Cables: IS 1554
22. IS:14817 – Vibration limits for all rotating equipment

12. BATTERY LIMIT

12.1 Mechanical:

The battery limit and the scope of work of vendor starts from site assessment, design, detail engineering, manufacturing, procurement, transport, receipt, storage, warehousing, assembly, shop erection, construction, painting, inspection, testing, trial run, commissioning, performance guarantee, documentation, site training to Nalco personnel as per the intent of the owner (Nalco). The physical battery limit has been shown in Drg. PL/MECH/LAY/A2/11490 Rev:02.

12.2 Electrical:

Battery limit of the vendor for electrical portion starts from MCC switchboard of Substation-21 of Potline to the proposed Pipe Cleaning Machine area. The location MCC switch board at substation - 21 is around 150 meter from the proposed Pipe Cleaning Machine.

12.3 Battery limit for the Instrumentation starts from providing complete automation system that includes installation of new field instruments as per the standard industrial control philosophy, laying of power cables, control cables, communication cables & signal cables from field instruments and operator control panel to the proposed new PLC panel to be located at existing Old LPC shop .

12.4 Civil

All the civil works required for completion of the project are to be in the scope of the bidder except mentioned in the Purchaser's Scope.

13. JOB SPECIFICATION – MECHANICAL

SCOPE OF SUPPLY & SERVICES (MECHANICAL):

13.1 Scope of Supply:

The scope of supply shall include but not limited to all equipment, materials mentioned in the tender documents. Supply for the proposed " Pipe(Siphon Tube) Cleaning machine in Old LPC Shop" with auxiliary equipment shall be minimum as per the specifications and drawings enclosed and forming a part of this document. Vendor's supply shall be complete in all respect as specified in the Design Basis (Ref Clause:11) within the battery limit for safe, efficient operation and easy maintenance of the system which includes but not limited to the following :

a) Supporting structures for all equipment etc.

b) Operating and maintenance platforms, staircase, access ladder etc. for the complete system.

c) HPP along with the connections and required hydraulic valves (If the machine is designed for hydraulic control)

d) Dedicated Slewing Jib Crane (Capacity Minimum 2 MT) for placement/removal of Pipe (Siphon Tube) and lifting of the parts/the Pipe Cleaning machine during maintenance activities.

e) A dedicated de-dusting system having ID fans, bag house and chimney to trap the Aluminium dust/particles generated during pipe (Siphon Tube) cleaning Process.

f) All pneumatic valves, pipes and attachments, required for the proposed system.

g) The ID fan shall be made of MS with suitable stiffening and robust supports. The impeller will be of high efficiency, radial blade type etc. The ID fan shall be dynamically balanced of grade G 6.3 as per IS/ISO 1940-1: 2003.

h) Sheds for Bag House and ID fan along with it's motor.

i) All the ducting pipe line including from exhaust duct from outlet of ID fan to Chimney. The chimney shall be made of MS with minimum 30 meters height. The chimney shall be provided with platforms, ladders, hand railings, guy rope, aviation lamp and lightening arrestor.

j) All exposed power drives of the equipment are equipped with totally enclosed guards. These guards shall be designed so that they may be easily and quickly dismantled when removal is required for maintenance purpose.

k) Arrangement of required tools and tackles for erection and commissioning of the system.

l) All bolts, nuts and rivets used shall be of high finish, good quality, High Tensile (H.T.) Steel.

m) The supply shall include erection & commissioning consumables including first fill of lubricants and hydraulic oil etc. The bidder shall arrange the commissioning accessories like flanges, fasteners, gaskets etc.

n) Mandatory spares mentioned in the chapter "Spare Parts" of this document.

o) Energy efficient components/ equipment mentioned in the chapter "GENERAL GUIDELINE TO VENDOR/ CONSULTANTS FOR ENERGY EFFICIENCY IN DESIGN/ENGINEERING" of this document.

p) Any additional items or features required during detailed engineering for the completeness and trouble free performance of the system shall be included in the bidder's scope without any price and time implications as long as system performance parameters and requirements within the battery limits of the vendor defined under this specification are kept unchanged.

q) Other scope of supply mentioned in description of system & auxiliaries and battery limit.

13.2 Scope of Services:

a) Kick off meeting preferably within 7 to 15 days of receipt of LOI/Purchase order on the successful LSTK bidder

b) Site assessment including study of existing proposed Pipe (Siphon Tube) Cleaning Machine in old LPC Shop, collection of required data for the design of proposed Machine by the vendor.

c) Submission of base line project schedule indicating major Task, activities and shutdown plan within one month of Kick-off meeting

d) Basic engineering, detail engineering, designing, approval from Nalco, manufacturing, dispatch, transport both sea & air, inland transport, follow-ups, receipt, storage & warehouse management, site work shop, erection, testing, trial run, commissioning, performance guarantee and handing over the system to client on turnkey basis.

e) Designing of Pipe (Siphon Tube) Cleaning Machine, presentation to Nalco and seeking approval from Nalco for further manufacturing.

f) Installation & commissioning of Pipe (Siphon Tube) Cleaning Machine including its auxiliaries like dust extraction system, dust conveying so as to make a complete unit suitable for Old LPC Shop.

g) Design and engineering for structural modification, if required, to accommodate the new Pipe (Siphon Tube) Cleaning Machine.

h) Dismantling of any structure, if required, to facilitate the installation of vendor supplied system.

i) Dismantling of Two nos. of Ladle stands to create space for installation of proposed Pipe(Siphon Tube) Cleaning machine.

j) Dismantling of existing Pipe (Siphon Tube) Cleaning machine after successful commissioning of the proposed machine.

k) Shifting of the dismantled items, if any, to the designated place as decided by NALCO within the plant premises.

l) Fabrication, assembly at works and site fabrication if required.

m) Dispatch of the complete consignment.

n) Transportation to site, receipt at site, storage and warehouse management,

o) Strengthening of structures, if required, for Old LPC Shop area as per requirement.

p) Hook up with existing compressed plant air network system. The compressed air required for the Pipe (Siphon Tube) Cleaning Machine and purging of the bags for the vendor supplied de-dusting system shall be made available from plant air network. The vendor has to arrange necessary tapping for the system supplied by them from the available Compressed air line in Old LPC Shop. The available compressed air line will be approximately at a distance of 10 meters from proposed bag house.

q) Equipment shop testing, performance guarantee test of the system at site

r) Surface preparation, sand blasting, protective coatings and painting including supply of paints.

s) Modification of existing reinforcement, platforms, stairs, allied structure, all field sensors, related cables, other fabrication etc. required exclusively to make space for the installation of proposed “Pipe (Siphon Tube) Cleaning Machine” or its auxiliaries within battery limit.

t) Additional approach & access platforms required for the proposed system

u) Installation of vendor supplied Jib Cranes of appropriate capacity.

v) Provision for ready access to the Pipe/Siphon Tube Cleaning Machine components shall be provided.

w) Other scope of service mentioned in description of system & auxiliaries and battery limit.

14. JOB SPECIFICATION – ELECTRICAL

SCOPE OF SUPPLY & SERVICES (Electrical):

14.1 Scope of Supply:

The scope of supply shall include but not limited to all equipment, materials mentioned in the tender documents. Supply for the proposed "Pipe (Siphon Tube) Cleaning Machine in Old LPC Shop" with auxiliary equipment shall be minimum as per the specifications and drawings enclosed and forming a part of this document. Vendor's supply shall be complete in all respect within the battery limit for safe, efficient operation and easy maintenance of the system which includes but not limited to the following:

a) Preparation of electrical load data and its analysis,

b) Preparation of Single line diagram.

c) Preparation of power, control and protection schematics.

d) Preparation of MCC & VFD Schematic (if required) and power distribution scheme.

e) The PMCC shall be of non-draw out type and care shall be taken to provide adequate space between components for easy and safe maintenance. The VFD and PLC shall not be installed in the PMCC. Excluding the ACB/VCB if any the depth of MCC shall be with in 400 mm maximum. The opening length and width of any door in PMCC must not be less than 400mm.

f) The VFDs, if any, shall be installed in separate cabinet.

g) PLC also shall be installed in a separate cabinet.

h) However all three i.e. PMCC, VFD Cabinet and the PLC shall be installed in the same air conditioned room.

i) All the electrical including energy efficient motors, variable frequency drives and VFD panels, control panels modification of existing MCC for power supply to the proposed Pipe(Siphon Tube) Cleaning Machine, field devices, JB, Limit switches, Proximity switches, switch gears, control switches, power & control cables, cable trays, cable management accessories, contactors, O/L relays, isolators, push buttons, indication lamp, LBS, illumination fixtures etc required to complete the project with in battery limit.

j) All electrical switch gears must be suitable for 50KA fault level.

k) All MV and LV motors including protection devices.

l) All MV power and control cables required for interconnecting equipment supplied by the vendor.

m) Cable trays, supporting racks, risers, duct, GI pipe, sleeves and accessories like cable glands, lugs, markers, tags etc. required for the package area for installation of cables supplied by vendor and owner's, if any, for the revamping and addition.

n) Earthing materials for equipment safe earthing, earthing grid for the complete proposed revamping and addition and its connection to purchaser's earthing grid, located inside/outside the shop

o) Lightning protection system material including earth electrodes required for stack and high structures pertains to proposed revamping and addition etc supplied by vendors. So required number earth pit shall be made as per IS by the vendor.

p) Any additional items or features required during detailed engineering for the completeness and trouble free performance of the system shall be included in the bidder's scope without any price and time implications as long as system performance parameters and requirements within the battery limits of the vendor defined under this specification are kept unchanged

In this project, if any software required for any relay, energy meter, soft starter, VFD, Circuit Breaker etc, Vendor has to provide original software in CD with license. The vendor has to provide required connecting hardware i.e. connecting communication cable, connector etc for downloading / programming /accessing data/file. One Laptop preloaded with required software should be provided for the above purpose.

q) Other scope of supply mentioned in description of system & auxiliaries, battery limit, specification of electrical.

R) Mandatory spares and special tools mentioned in the chapter "Spare parts" of this document.

s) Energy efficient components/equipment mentioned in the chapter "GENERAL GUIDELINE TO VENDOR/ CONSULTANTS FOR ENERGY EFFICIENCY IN DESIGN/ENGINEERING" of this document

- **EXCLUSIONS FROM VENDOR'S SCOPE:**

  - 415V AC feeders for feeding vendor's lighting panels.

  - General illumination inside plant/building of Old LPC Shop.

14.2 Scope of Services:

a) Designing and preparation of schematic drawings for MCC, Cable Schedule/route, BOM, BOQ, VFD of required capacity for the proposed revamping & addition compatible with the existing system.

b) Presentation of the designed scheme to NALCO for approval before manufacturing and supply.

c) Manufacturing, purchasing & fabrication of electrical system for the modification and addition including MCC, VFD panels.

d) Installation of all motors including variable frequency drives.

e) Installation of emergency push button cabinets.

f) Transportation to site, Receipt at site, storage and warehouse management of electrical items required for the proposed Machine.

g) Apply & receive work permit & shut down as per the Nalco's laid down procedure to commence the work.

h) Completion of all electrical works including modification in MCC panels, VFD panels, cables & accessories etc. within the battery limit. All the civil work for installation of electrical equipment i.e. MCC panels, VFD panels, motor foundations shall be in vendor's scope.

i) Modification of MCC & Installation of VFD panels shall be carried out without interrupting the normal operation of old LPC Shop.

j) Laying of cables on cable trays for the proposed project ,if required.

k) Installation of all electrical switchgears, cable trays required for the proposed project.

l) Site fabrication if required.

m) Each emergency push button identification provided along with security relay shall be taken as an input signal to the PLC for better identification of the machine stoppage.

n) The positioning of all field device including limit switches and proxy switches should be such that these are accessible from outside for easy maintenance.

o) Vendor has to design the MCC panel's internal components subject to availability of working space in existing MCC feeders. Vendor has to design VFD panels (if required) and any other equipment to be located inside the VFD room.

p) Other scope of service mentioned in description of system & auxiliaries, battery limit, specification of electrical.

q) Dismantling of floor and wall (if required) for cable laying and/or other electrical works for MCC, VFD, field panels etc.

r) Certification of electrical installation from statutory & regulatory bodies required during construction and prior operation, if any, shall be organized by the vendor.

s) Please note that scope of work mentioned above is indicative only and it is vendor's responsibility to assess and supply the Pipe(Siphon Tube) Cleaning Machine as a complete package within battery limit.

14.3 TECHNICAL SPECIFICATION FOR ELECTRICAL SYSTEM

i) Introduction

This specification defines the scope of work and minimum basic requirement for electrical system design, engineering, equipment selection, sizing procurement, supply erection, trial run, testing and commissioning for proposed Pipe (Siphon Tube) Cleaning machine complete in all respect for old LPC Shop, Smelter Division, M/s Nalco's, at Angul, Odisha.

ii) Brief description of electrical system

All solenoid valves, control panel, cables, LBS, JB, MCC, ACB, VFD, UPS, sensors control panel, control switchgears, indications, safety devices, control devices, 415V motors, specific illumination etc for the proposed project shall be supplied, installed and fed from a 415V AC MCC which shall be located nearer to Pipe (Siphon Tube) Cleaning machine.

The vendor will make arrangement to take the required power from the MCC for any load of rating 415 VAC, 50 Hz. Any voltage other than 415 VAC, 50 Hz shall be obtained by stepping down through transformer or through rectifier if DC voltage is required, for the proposed machine.

The vendor has to install appropriate rating VFDs (if necessary) for the motors used in applications of Pipe (Siphon Tube) Cleaning machine requiring speed variations & controls. The vendor has to supply & install complete VFD systems including VFDs, Squirrel Cage Induction Motors (suitable for VFD application) & Control Panels for these applications.

iii) SYSTEM VOLTAGE & FREQUENCY:

Principal voltage levels for power distribution and utilization

a) 415V AC (nominal), 3-Phase 3/4-Wires, 50Hz, Solidly Earthed Neutral: This voltage shall be used for all motors and all other three phase loads e.g. power sockets etc.
b) 240V AC (nominal) 1-Phase 2/3-Wire, 50Hz, Solidly Earthed Neutral for low power single phase loads such as lighting, small power receptacles & control supply etc: This voltage to be derived by using a transformer and same is to be supplied and installed by the vendor. If required can be used.

iv) Voltage & frequency variation:

The following maximum variation shall be considered for equipment design:

a) Voltage: Differing from its nominal value by not more than ± 10%
b) Frequency: Differing from its nominal value by not more than ± 3%

v) Design ambient temperature:

The design ambient temperature for electrical equipment shall be 50^0 C.

vi) SPECIFICATION OF ELECTRICAL EQUIPMENT:

a. **ELECTRIC MOTOR:** Electrical induction Motor shall be as per the "Standard specifications of squirrel cage Induction Motor" enclosed elsewhere in the tender documents.
b. **VARIABLE FREQUENCY DRIVE:** Variable frequency drive shall be as per "Standard specifications of AC variable frequency drive" enclosed in the tender document.
c. **M.V SWITCHBOARD:** M.V. Switchboard shall be as per the "Standard Specification for MV Switchboard" enclosed in the tender document.
d. **CONTROL DEVICE:** Control Devices shall be as per the brand mentioned in the "Brand Preference".

vi) Power cable sizes for 415v motors:

S. No.	Motor Rating (KW)	CABLE SIZE mm2	CABLE SIZE mm2
		CU	AL
1	2.2 AND	3Cx2.5	
2	3.7	3Cx4	
3.	5.5	3Cx6	
4.	7.5	3Cx6	
5.	9.3	3CxI0	
6.	11.0	3CxI0	
7.	15.0	3CxI0	
8.	18.5	3CxI6	
9.	22.0	3Cx25	
10.	30.0	3Cx35	
11.	37.0	3Cx50	
12.	45.0	3Cx50	
13.	55.0	3Cx70	
14.	75.0	3Cx95	
15.	90.0	3Cx120	
16.	110.0	3Cx150	2(3CxI20)
17.	125.0	3Cx185	2(3CxI50)
18.	132.0	3Cx185	2(3CxI50)
19.	160.0	3Cx240	2(3CxI85)
20	180.0	(3Cx150)x 2 runs	3(3CxI85)
21.	200.0	(3Cx150)x 2 runs	3(3CxI85)
22	220.0	(3Cx150)x 2 runs	3(3Cx185)

NOTES:

a. Cables will be 1100 V, copper or aluminium multi strand conductor, PVC insulated, PVC extruded inner sheath armoured with overall PVC sheath.
b. (*) Cable diameter shall be furnished after finalization of purchase order for cables.
c. This table is applicable for cables between 415 V switchboard and power isolation cabinet for 415 V motors. However, cable between power isolation cabinet and 415 V motor shall be of copper conductor only.

vii) DETAIL TECHNICAL SPECIFICATION OF ELECTRICAL SYSTEM:

a) All 415 V AC Motors shall be provided with local power isolation cabinets or load break switch Isolator with visible power isolation.

b) The cable sizes for 415V AC Motors shall be selected from enclosed data sheet. However, all MV power and control cables to be used for interconnecting equipment supplied shall be of unarmored type. Flexible PVC insulated copper cables conforming to IEC-228 Class –5 shall be used for connection between local

power isolation cabinets or (LBS) and 415V motors. The cable sizes for motors indicated in cable data sheet are the minimum requirements. Vendor shall check adequacy of these sizes based on actual cable lengths, during detailed engineering and provide cables of higher sizes, if required.

c) GI strip shall be used for earthing system and lightning protection system. Separate earthing must be provided for welding job.

d) The size of earthing conductor to be used for main earth grid shall be 50x6 mm or above based on the earthing load calculation to be done by the vendor.

e) The size of horizontal air termination and down conductor shall be 20x5 mm or higher based on actual earthing load calculation to be done by the vendor.

f) All hardware necessary for interfacing control system with motor starters shall be in Vendor's scope.

g) Local control station with push buttons shall be provided near each motor for local operation.

h) Separate control cables shall be used for AC circuits and DC circuits for interfacing signals between 415V AC (MCC) Switchboards and Microprocessor based control system, wherever applicable.

i) Separate earthing shall be used for VFD & PLC applications.

j) Emergency Stop push buttons shall be suitably distributed throughout the installation and positioned so as to be clearly visible and readily accessible. Emergency stop command shall permit the stoppage without delay, by acting to trip the main contactor /circuit breaker. Suitable supervision device to monitor emergency switch circuits must be provided so as to meet the latest safety standard. In the event of emergency stop where the security relay operates the main contactor supplying power to the VFD shall not be put off. Instead of that, the control power for enabling MCC control power shall be switched off. This ensures that the PLC control power will not be switched off by the above process.

k) Motors in general shall be asynchronous squirrel cage type having synchronous speed of 1500 rpm, IP 55 Enclosure, 'F' Class insulation, energy efficient motor of standard IEC frame size. However, temperature rise must be limited to class B insulation value and forced cooling fans must be provided where ever necessary as per actual operating condition.

l) Suitable canopy shall be provided for all outdoor motors & LBS.

m) In view of dusty environment of the shops, electrical panels/cabinets (e.g. control stations, welding receptacle cabinets, local control panels, etc.) shall have minimum IP-65 degree of protection and shall be provided with special constructional features to have projecting roof/canopy to avoid falling of dust inside the electrical cabinet while opening the panel door during operation/ maintenance.

n) Cable trays on which dust accumulates shall not be used. Cable trays supports shall be able to bear the weight of a man without giving way or being permanently deformed. Minimum vertical clearance between two cable trays shall be 250 mm.

o) Vendor has to consider bottom entry of cables as available suitably in the existing design of the MCC panels

p) UPS shall be provided for power supply to the PLC

q) Non-UPS power supply for PLC shall be fed from MCC. The vendor shall provide suitable Control Transformers, i.e. one operating & one Standby, in the MCC for feeding of Non-UPS power to PLC.

r) Local Control Stations for local operation of motors with start/stop push buttons, selector switches, and ammeters (for all motors). It shall also contain other devices like selector switches, as per operational requirements. Else, Display of current at any suitable location to be provided

s) Complete Variable Frequency Drive (VFD) Panels with power isolator, power fuses, and power contactor & other switchgears, input and output choke, control transformer, required terminal blocks, panel illuminations and exhaust fan for cooling in IP55 enclosure only. The specification of VFD shall be as per Nalco's standard specifications of VFD.

t) Earthing system pits (Chemical earthing) shall be provided by vendor as per latest IS/IEC Standard. Separate earthing system shall be provided for MCC, VFD, PLC & Lightning protection. These Earth pits shall be connected to their respective earth grids of Plant if available within 50 meter distance.

viii) STANDARD SPECIFICATION FOR M.V SWITCH BOARD (DRAW-OUT TYPE):

Contents:

1. SCOPE:

a) This specification covers the requirements of modification, design and testing of Medium Voltage Draw-Out Type Switchboard i.e. Motor Control Centre (MCC) required for receipt, control and distribution of power to various medium voltage equipment of the project.

b) MCCs would receive power from PCCs/PMCCs and distribute the same to medium voltage motors up to and including 37 KW unless otherwise specified in data sheets. MCCs would generally have motor starter feeders and a few Switch Fuse Unit (SFU) Feeders.

2. CODE AND STANDARDS:

The switchboard assembly shall conform to following Indian Standards.

IS: 5578 Guide for marking of insulated conductor.

The individual equipment mounted in the switchgear shall conform to the following Indian Standards.

IS: 15707 AC Electricity Meters: general requirement and tests
IS: 1248 Direct acting electrical indicating instruments
IS: 2705 Current transformers
IS: 3156 Voltage transformers
IS: 11353 Guide for uniform system marking and identification of Conductors and apparatus terminals
IS: 13703 Low voltage fuses.
IS: 60497 LV Switchgear and control gear. (Part-I to Part-5)

3. SITE CONDITIONS:

a) The switchboards shall be suitable for installation and satisfactory operation in a pressurized or without-pressurized substation with restricted natural air ventilation in a tropical, humid and corrosive atmosphere. The switchboards shall be designed to operate under site conditions as specified in the data sheets. If not specifically mentioned therein a design ambient temperature of 50º C and altitude not exceeding 1000 meters above mean sea level shall be considered.

b) All the equipment described in this specification is intended for continuous duty at the specified rating under the specified ambient conditions unless indicated otherwise.

4. DESIGN REQUIREMENT OF MCC PANELS:

- All openings, covers and doors shall be provided with neoprene Gaskets. Blanking plates shall be provided for all sizes of modules to cover the openings in the event of withdrawing the feeder modules.
- For all power and control cables, Vendor to provide double compression cable gland for armoured cables and to use nonmetallic cable gland for non armoured cables. Panels is suitable for bottom entry of cables.
- Non-Magnetic/Metallic cable gland plates shall be provided for termination of single core cables.
- All auxiliary devices for control, indication, measurement and protection such as Push Buttons, Control and Selector Switches, Indicating Lamps, Ammeters, Voltmeters, KWH meters , Motor Protection and other Protective Relays shall be mounted on the front side of the respective compartment only. MCC compartment's door close open movement must be perfectly aligned, and necessary door closing mechanism, gasket must be fixed as necessary in the panels.
- Vendor has to retrofit appropriate rating(reputed brand) power contactor, isolator, overload relay, MPCB, fuses with base , aux relay, push buttons, ammeter, indication light, along with wirings in the MCC panels as per the load requirement.
- All switch drives other than rotary switches, shall be lockable in both 'ON' and 'OFF' positions. The switches/molded case circuit breakers shall be interlocked with the compartment door to prevent opening of the door when the switch/molded case circuit breaker is in 'ON' position and to prevent

switching on when the door is open. A defeat mechanism for this interlock shall also be provided.

- Unused modules in the panel shall be fully equipped with hinged door, power and control terminals for starter modules and cradle for future use.
- Energy meters shall be provided in the Incomer feeder of MCC.
- Digital Motor Protection relays shall be provided for the motor feeders.
- The MCC shall have two control transformers i.e. one operating & another standby for supply of power to control circuit of MCC.
- The MCC shall have two Auxiliary transformers i.e. One Operating & another standby on each side of MCC Busbar, for supply of power to Space heaters(MCC & Motor), lighting & utility sockets.
- Heavy duty starters shall be provided with saturable type current transformer operated overload relay only, which shall be suitable for motor starting time of 15 -60 seconds.
- If vendor wishes to include the VFDs in their MCC , then the complete system shall be installed in the proposed AC room (in the scope of the vendor).

- **WIRING AND TERMINALS**

a) Inside the switchboards the wiring for power, signaling, protection and instrument circuits shall be done with BIS approved PVC insulated copper conductors. The insulation grade for these wires shall be 660 volts grade. All control wiring shall preferable be enclosed in plastic channels or neatly bunched together.

b) PVC insulated copper conductor of cross section 1.5²mm may normally be used provided the control fuse rating is 10 amps or less. For 16 amps control fuse circuit 2.5 mm² copper conductors shall be used. Each wire shall be terminated at a separate terminal. C.T. circuit wiring shall be done with 2.5 sq mm. Copper conductor. Shorting links/suitable shorting arrangement for shorting CT secondary shall be provided.

c) Each wire shall be identified at both ends by PVC ferrules.

d) Conductors shall be terminated with adequately sized compression type lugs. Clamp type terminal for direct conductor termination shall be acceptable for wires upto 10 mm² size and bolted type terminals with crimping type copper lugs shall be provided for all outgoing cable connections large than 10 mm².

- **NAME PLATE**

A nameplate with the switchboard designation shall be fixed at the top of the central panel. A separate nameplate giving details for each compartment of bus section shall be provided.

Nameplate or polyester adhesive stickers shall be provided for every equipment (lamps, push buttons, switches, relays, auxiliary Vendors etc.) mounted on the switchboard. Special warning plate shall be provided on removable covers or doors giving access to cable terminals and busbars. Special warning labels shall be provided inside the switchboards also, wherever considered necessary. Identifications tags shall be provided inside the panels matching with those shown on the circuit diagram.

Engraved nameplates shall preferably be 3 ply (Black-White-Black) lamicoid sheets or anodized aluminum. However back engraved perspex sheet nameplates may also be acceptable. Engraving shall be done with square / vee groove cutters. Hard paper nameplates shall not be acceptable. Nameplates shall be fastened by screws and not by adhesives.

The name plates for feeder compartments shall be in two parts. One part shall have necessary details pertaining to the switchboards. The other parts shall be removable and shall contain all details regarding the drives/equipment controlled by the particular module.

- **SWITCHBOARD COMPONENTS**

  - **SWITCHES**

    i. All switches or fuse switches shall be load break, heavy duty/motor duty air break type provided with quick make/brake manual operating mechanism. The operating handle shall be mounted on the door of the compartment having the switch.

    ii. Rating of heavy duty switches for a particular starter module shall be as indicated in the switchboard data sheet. Motor duty switches of smaller ratings meeting the requirement of AC 23 duty as per IS: 13947, may be acceptable in place of specified heavy duty switch rating for particular starter module only if, motor duty switches have been tested and certified for use with the large size of fuse link specified in the switchboard data sheet for the same starter module.

  - **FUSES**

    i. Fuses shall be non-deteriorating HRC cartridge link type. Diazed fuses are not acceptable.

ii. All power fuses shall be NH knife blade type with IS Standard

iii. Power Fuses shall be pressure fitted type and shall preferable have ribs on the contact blades to ensure good line contact.

iv. It shall be possible to handle fuses during off load conditions with full voltage available on the terminals. Wherever required fuse pullers shall be provided. The fuse base both power and control circuit shall be so located in the modules to permit insertion of fuse pullers and removal of fuse links without any problem.

- **CONTACTORS**

i. The contactors shall be air break type, equipped with three main contacts and minimum 2 NO + 2 NC auxiliary contacts. The main contacts of a particular contactor shall have AC 3 ratings as shown in the relevant switchboard data sheet for that contract.

ii. Unless otherwise specified, the coil of the contactor shall be suitable for operation on 240 V, 1 PH, 50 HZ AC supply.

- **MOULDED CASE CIRCUIT BREAKER(MCCBs)/MPCB**

i. If required as per design, MCCB's shall be provided in the switchboards for circuit protection. MCCBs rating shall be as indicated in the switchboard data sheet.

ii. MCCB/MPCB shall be provided adjustable type tripping device with inverse time characteristic for over load protection and instantaneous characteristics for short circuit protection.

iii. 'ON' and 'OFF' position of the operating handle of MCCB's shall be displayed and the operating handle shall be mounted on the door of the compartment housing MCCB.

iv. MCCB shall be provided with minimum 1 NO + 1 NC auxiliary contacts.

v. MCCB's as part of motor starter mould shall be current limiting type.

- **INSTRUMENT TRANSFORMER**

i. Current transformer shall generally conform to IS: 2705. The CT ratio and ratings shall be as indicated in the switchboard data sheet. For general guidance the vendor shall note that the protective current transformer shall have an accuracy class "5p" and an accuracy limit factor greater than "10".

However Cts for restricted earth fault and differential protection shall be of class "PS".

ii. Current transformers for instruments shall have an accuracy class 1.0 and accuracy limit factor less than 5.0. However accuracy class of 3.0 is acceptable for CTs meant for remote ammeters. The current transformers shall be capable of withstanding the applicable peak momentary short circuit and the symmetrical short circuit current for 1.0 second and shall have a minimum rating of 10 VA.

iii. The voltage transformers shall be cast resin type and shall be provided with primary fuses. Miniature circuit breakers with auxiliary contact shall be provided on the secondary side.

- **MEASURING INSTRUMENTS**

i. All measuring instruments shall be of 96 x 96 mm square pattern, flush mounting type. All auxiliary equipment such as shunts transducers, CT's PT's etc. as required shall be included in the supply of the switchboard.

ii. All AC ammeters/voltmeters shall be of moving iron type or digital display type with accuracy class of 1.5 as per IS: 1248. Ammeters for motor feeder shall have a nonlinear compressed scale at the end to indicate motor starting current. Volt meter shall be suitable for direct line connection.

iii. The KW/KWH meter shall be suitable to measure unbalanced loads on 3-Phase, 4 wire system. Test terminal block shall be provided for KWH meters. The accuracy class of KW/KWH meters shall be minimum 2.5.

- **CONTROL SWITCHES**

i. The selector switch shall generally have 4 positions for reading 3 phase currents and fourth position for OFF. The voltmeter selector switch shall also have 4 positions. There shall be used to measure phase to phase voltage and fourth shall be OFF position.

ii. Remote/Trip/Off selector switch for the motor feeders shall be lockable in OFF position.

- **PUSH BUTTONS**

Push button colours shall be as follows:

Stop/Open/Emergency -Red
Start/Close -Green
Reset/Test -Yellow/Black/White

- **INDICATING LAMPS**

  Indicating lamps shall preferably be suitable for 240 Volts AC.

- **AUXILIARY RELAYS/CONTACTORS**

  Auxiliary relays /contactors shall generally be used for inter locking and multiplying contacts. Auxiliary contact shall be capable of carrying the maximum anticipated current.

- **TIMERS**

  For reacceleration duty, timers unless otherwise stated, shall be pneumatic type and shall have adjustable time setting of 0-60 seconds. The time settings, where specified shall be accurately set before dispatch of the switchboard.

ELECTRICAL LOAD DATA

Datasheet for Medium voltage Squirrel Cage induction motor

ELECTRICAL DESIGN DATA

1	Motor tag no.				
2	Voltage (V) 415V ± 10%	Phase 3	Frequency(Hz.) 50Hz ± 3%		
3	System Fault level (KA)	50kA for 1 sec.			
4	Method of starting	DOL			
5	Phase	Three	Connection	Delta	No. of terminals 6
6	Design Ambient temp©	50 ° C	Temp. rise	70 ° C	
7	Cable size (mm ²)	As per data sheet	Type	As per data sheet	
8	Enclosure type	IP55	Cooling	TEFC	
9	Insulation class	F			
10	Hazardous Area classification/Gas Group: Not applicable (Safe area)				
11	Type of explosion protection (Ex(n)/Ex(e)/Ex(d): Not applicable				
12	Suggested Motor Rating in KW/Manufacturer		Applicable Standards: Nalco's Stand. Specs. for MV Motor		
13	Shaft kw/ kw at end of curve				
14	Speed/Rotation of equipment from Coupling End				
15	Starting/max. Torque required (mkg)				
16	WK² of equipment Including/excluding flywheel (kgm ²)				
17	Thrust up/down (kg)				
18	Equipment/ coupling type				
19	Starting Condition- On no load/Under loaded Condition				
Technical particulars from motor manufacturer					
20	Manufacturer				
21	KW Rating		No .of poles		
22	Frame designation		Mounting		
23	Full load speed (rpm)		Full load Torque (mkg)		
24	Starting torque as % of full load torque				
25	Full load current (A)				

26	Starting current at 100% Voltage (A)	
27	Break down or pull out torque %	
28	Rotation viewed from coupling end	
29	Starting time at 80 % V (sec.)	Starting time at 100 % V (sec.)
30	Time (Te) for increased safety motors at 100 % Voltage (sec.)	
31	Locked rotor withstand time cold/hot at 80% V (sec.)	At 100 % V (sec.)
32	WK ^{2} of motor (kg m ^{2})	
33	Power factor at 100 % load	Power Factor at 75% load
34	Efficiency at 100 % load	Efficiency AT 75% load
35	Space heater watts/ volts	
36	Bearing type/ no. DE	Bearing type/ no. NDE
37	Type of Lubrication	
38	Weight of motor (kg)	
39	Canopy	Required/ Not required

CABLE DATA SHEET
Part-2
(Data by Vendor)

GENERAL

A. Name of Manufacturer :
B. Cable type/ Code

Technical Particulars (To be furnished separately for each size)

A. Thickness of insulation :
B. Thickness of inner sheath :
C. Calculated diameter of cable under armour (as per IS: 10462) :
D. Type and size of armour :
E. Nominal diameter of cable under outer sheath :
F. Calculated diameter of the cable under outer sheath :
G. Thickness of outer sheath :
H. Nominal outer diameter of cable :
I. Tolerance on outer diameter :
J. Type of Compound for Conductor insulation, Inner sheath and outer sheath. :
K. Maximum drum length of cable :

ix) SPECIFICATION OF MEDIUM VOLTAGE SQUIRREL CAGE INDUCTION MOTORS

a) SCOPE:

This specification covers the design, manufacture and testing of three phase squirrel cage induction motors.

b) CODES AND STANDARDS:

The Squirrel cage induction motors and their components shall comply with the latest editions of following standards issued by BIS (Bureau of Indian Standards) unless otherwise specified:

IS - 5	Colours for ready mixed paints and enamels Performance
IS - 1231	Dimensions of three-phase foot-mounted induction motors
IS - 1271	Specification for thermal evaluation and classification of electrical insulation
IS - 2148	Flame proof enclosures of electrical apparatus
IS - 2223	Dimensions of flange mounted AC Induction motors
IS - 2253	Designation for types of construction and mounting arrangement of rotating electrical machines
IS - 2254	Dimensions of vertical shaft motors for pumps
IS - 2968	Dimensions of slide rails for electric motors
IS - 4029	Guide for testing three-phase induction motors
IS - 4691	Degree of protection provided by enclosures for rotating electric machinery
IS - 4722	Rotating electrical machines – specifications
IS - 4728	Terminal markings and direction of rotation for rotating electrical machinery
IS - 4889	Methods of determination of efficiency of rotating electrical machines
IS - 6362	Designation of methods of cooling of rotating electrical machines
IS - 6381	Construction and testing of electrical apparatus with type of protection ‘e’
IS - 7389	Pressurised enclosure of electrical equipment for use in hazardous area
IS - 7816	Guide for testing insulation resistance of rotating machines
IS - 8223	Dimensions and output series for rotating electrical machines
IS - 8789	Values of performance characteristics for three-phase induction motors
IS - 9283	Motors for submersible pump sets
IS – IEC 60079	Construction, Test and Marking of Type of Protection "n" Electrical Apparatus
IS - 12065	Permissible limits of noise levels for rotating electrical machines
IS - 12075	Mechanical vibration of rotating electrical machines with shaft height 56mm and higher – measurement, evaluation and limits of vibration severity
IS - 12802	Temperature-rise measurements of rotating electrical machines
IS - 12824	Types of duty and classes of rating assigned to rotating electrical machines
IS - 13529	Guide on effects of unbalanced voltages on the performance of three-phase induction motors
IS - 13555	Guide for selection and application of three-phase AC induction motors for different types of driven equipment
IS - 14568 (Part-2):	Dimensions and output series for rotating electrical machines

Note:

- In case of imported motors, standards of the country of origin shall be applicable, if these standards are equivalent or stringent than the applicable Indian standards.
- The motor shall also confirm to the provisions of Indian Electricity rules and other statutory regulations currently in force in the country.
- In case Indian standards are not available, standards issued by IEC/ BS/ VDE/ IEEE/ NEMA or equivalent agency shall be applicable.
- In case of any contradictions between various standards/ specifications/ data sheets and statutory regulations, the following order of priority shall be given:
  - Statutory regulations
  - Data sheets
  - Job specifications
  - This specification
  - Codes and standards

c) GENERAL REQUIREMENTS

- The offered equipment shall be brand new with state of art technology and proven field track record. No prototype equipment shall be offered.

- Vendor shall ensure availability of spare parts and maintenance support services for the offered equipment at least for 15 years from the date of supply.

- Motor shall be rated for continuous duty (S1), unless otherwise specified.

- Unless otherwise specified, the starting current (as % rated current) shall not exceed 600% subject to tolerance.

- Starting torque and minimum torque of the motor shall be compatible with the speed torque curve of the driven equipment under specified starting and operating conditions.

For heavy duty drives such as blowers, crushers etc. high starting torque motors shall be provided.

In case where characteristics of driven equipment are not available while selecting the motor, minimum starting torque shall be 110% of rated value for motors up to 75 KW and shall be 90% of rated value for motors above 75 KW.

- The pull out torque at the rated voltage shall be not less than 175% of the rated load torque with no negative tolerance. Unless otherwise agreed, the pull out torque shall not exceed 300 percent of the rated load torque.

In case of motors driving equipment with pulsating loads (e.g. reciprocating compressors) the minimum value of pull out torque at 75 percent of the rated voltage shall be more than the peak value of pulsating torque and the current pulsation shall be limited to 40%.

- The minimum value for product of efficiency and power factors for motors rated up to and including 37 KW shall be as per IS:8789.

The minimum value for product of efficiency and power factor of 2-pole, 4-pole and 6-pole motors rated above 37 KW shall be as given in Table –II below.

TABLE-II

Rated output	Product of efficiency and power factor at rated load (minimum)		
	2-Pole	4-Pole	6-Pole
45 KW	0.82	0.80	0.79
55 KW	0.82	0.80	0.79
75 KW	0.82	0.80	0.80
90 KW	0.82	0.80	0.80
110 KW	0.86	0.80	0.80
125 KW	0.86	0.80	0.80
160 KW	0.86	0.81	0.80
180 KW	0.86	0.83	0.80
200 KW	0.86	0.83	0.80

Efficiency and power factor figures for motors having synchronous speeds of 750 R.P.M. and below, shall be agreed between the purchaser and the manufacturer.

d) Constructional Details:

Windings:

- **Insulation and bracing:**

  Unless otherwise specified in the motor data sheet, motors shall be provided with class 'F' insulation as a minimum. In case of motors with class 'H' insulation the permissible temperature rise above the specified ambient temperature shall be limited to those specified in the applicable Indian standards for class 'F' insulation.

  The windings shall be tropicalized. The windings shall preferably be vacuum impregnated. Alternately the windings shall be suitably varnished, baked and treated with epoxy gel for operating satisfactorily in humid and corrosive atmospheres.

  Windings shall be adequately braced to prevent movement during operation. In this respect, particular care shall be taken for the stator windings for direct-on-line starting squirrel cage motors. Insulation shall be provided between coils of different phases which lie together. Core lamination must be capable of withstanding burnout for rewind at 400°C without damage or loosening.

  In case of motors driving equipment with pulsating loads, special care shall be taken for the joints of rotor bars and end rings to avoid premature failures due to induced fatigue stresses.

- **Phase Connections:**

  The windings shall be connected in delta. However for motors rated 2.2 KW and below, star connection may be accepted.

In case of motors with star-delta starting, the motor windings shall be fully insulated for delta connection.

- **Winding Terminations:**

The ends of the windings shall be brought out into a terminal box. These shall be terminated by means of terminals mounted on an insulating base made of non-hygroscopic and non-flammable material.

All motors shall be with six terminals and suitable links to connect them in star or in delta except for motors rated up to including 2.2 KW which may be accepted with three terminals.

All terminals shall be thoroughly insulated from the frame with material resistant to tracking.

Anti-loosening, anti-vibration type of terminals shall be provided in case of increased safety(Type Ex-e) and non-sparking(Type Ex-n) motors.

- **Terminal Box and Cable Entries:**

Unless otherwise agreed, the terminal box shall be located on the right hand side as viewed from the driving (coupling) end. However, for motors up to 3.7 KW, terminal box located on top may be accepted. The terminal box shall be rotatable in steps of 90° to allow cable entry from any direction.

The terminal box shall be of robust construction and large enough to facilitate easy connection of the cables. The box shall be with necessary clearances, creepage distances between live parts and between live parts to earth considering air insulation and without any compound filling. Terminal box cover shall be provided with handles to facilitate easy removal. However, for terminal box covers weighing less than 5 kg, terminal box covers without handles can be accepted.

An adequately sized earth terminal shall be provided in the motor terminal box for termination of fourth core of specified cables.

The terminal box shall be provided with cables lugs and entries for suitable cable glands corresponding to the size of the specified cable. Nickel plated brass (or aluminium if specifically required), double compression type cable glands shall be supplied along with the motors for the specified cable sizes.

Equipment and accessories provided shall confirm to the hazardous area classification and the environmental conditions a specified in the motor data sheet.

Unless otherwise specified, the terminals, cable lugs, terminal box, cable entries and cable glands shall be suitable for the cables sizes specified in the Table-III for 2-pole, 4-pole or 6-pole motors:

TABLE-III	
Motor rating up to and including	Size of phase conductor(mm^2)
2.2 KW and below	3Cx2.5 Copper
3.7 KW 5.5 KW	3Cx4 Copper 3Cx6 Copper
7.5 KW	3Cx6 Copper
11.0 KW	3Cxl0 Copper
15.0 KW	3Cxl0 Copper
18.5 KW	3Cxl6 Copper
22.0 KW	3Cx25 Copper
30.0 KW	3Cx35 Copper
37.0 KW	3Cx50 Copper
45.0 KW	3Cx50 Copper
55.0 KW	3Cx70 Copper
75.0 KW	3Cx95 Copper
90.0 KW	3Cx120 Copper
110.0 KW	3Cx150 Copper
125.0 KW/ 132.0 KW 160.0 KW	3Cx185 Copper 3Cx240 Copper
180.0 KW	(3Cx150) x 2 Copper
200.0 KW	(3Cx150) x 2 Copper

Cable sizes for motors having synchronous speeds 750 RPM and below shall be as agreed between the purchaser and manufacturer.

Cables are of 650/1100 V grade Aluminium conductor, PVC insulated, PVC extruded inner sheath, armoured with overall PVC sheath. However for cables up to & including 16 mm^2 cross-section cables used may be with copper or aluminium conductor as indicated in the motor data sheet.

The terminal box shall be capable of withstanding internal short circuit conditions without danger to personnel or plant from the emission of hot gases or flame or due to excessive distortion or damage to the terminal enclosure.

- **Phase Marking:**

Appropriate phase marking as per IS shall be provided inside the terminal box. The marking shall be non-removable and indelible.

- **Motor Casing and Type of Enclosure:**

Motors for use in safe areas shall be industrial type meeting the specified ambient conditions, starting and operating requirements.

Motors for use in hazardous areas (Zone-1 or Zone-2) shall have type of protection Ex-d or Ex-e or Ex-n as specified in the motor data sheet and shall meet the requirements of applicable Indian standards.

The minimum degree of motor enclosures including terminal boxes and bearing housing shall be IP-55 as per IS: 4691.

Motors for outdoor use shall be suitable for installation and satisfactory operation without any protective shelter or canopy. Motor casing shall be provided with a suitable drain for removal of condensed moisture except in case of flameproof motors (Type Ex-d)

Vertical motors with downward shaft shall be provided with suitable canopies covering the motor fully. Vertical motors with upward shaft e.g. on fin-fan-coolers, shall be adequately protected, such as cowls/canopies) against ingress of water into the enclosure or the bearing housing even when standing still for long periods of time. Motors designed to handle external thrust from the driven equipment shall be supplied with a thrust bearing at the non-driving end.

All internal and external metallic parts, which may come in contact with cooling air, shall be of corrosion resistant material or appropriately treated to resist the corrosive agents which may be present in the atmosphere. Screws and bolts shall be of rust proof material or protected against corrosion.

Unless otherwise agreed, motors shall have standard frame sizes for various output ratings as stipulated in IS: 1231.

- **Bearing and Lubrication:**

Motors shall have grease lubricated ball or roller bearings. In all cases, the bearings shall be chosen to provide a minimum L-10 rating life of 5 years, (40,000 hours) at rated operating conditions (the L-10 rating life in the number of hours at constant speed that 90% of a group of identical bearings will complete or exceed before the first evidence of failure.)

Unless otherwise specified, the bearings shall be adequate to absorb axial thrust produced by the motor itself or due to shaft expansion.

Vertical motors shall be provided with thrust bearings suitable for the load imposed by the driven equipment.

In cases such as pumps for hot liquids where the driven equipment operates at high temperatures, bearings shall be cooled by shaft mounted fan. This shall ensure efficient ventilation of the bearing and dispense the heat transmitted from the driven equipment by conduction or convection.

Bearings shall be capable of grease injection from outside without removal of covers with motors in the running conditions. The bearing boxes shall be provided with necessary features to prevent loss of grease or entry of dust/ moisture e.g. labyrinth seal. Where grease nipples are provided, these shall be associated, where necessary, with appropriately located relief devices which ensure passage of grease through the bearings.

Pre-lubricated sealed bearings may be considered provide a full guarantee is given for 4 to 5 years of trouble-free service without the necessity of re-lubrication.

- **Cooling System:**

All motors shall be self-ventilated, fan cooled. Fans shall be corrosion resistant or appropriately protected. They shall be suitable for motor rotation in either direction

without affecting the performance of the motor. If this is not possible for large outputs, it shall be possible to reverse the fan without affecting the balancing of the rotor.

For motors operating in hazardous area, the fans shall be of an anti-static non-sparkling material.

- **Rotor:**

The rotor shall be of squirrel cage type, dynamically balanced to provide a low vibration level and long service life for the bearings. The accepted values of peak to peak vibration amplitudes for a motor at rated voltage and speed on a machined surface bedplate with the motor leveled and with a half-key or coupling fitted shall not exceed those given in IS:12075. Die cast aluminium rotors for motors in hazardous areas may be accepted provided the same are type tested and approved by competent authorities.

- **Shaft Extension:**

Motor shall be provided with a single shaft extension with key-way and full key. Motor shaft shall be sized to withstand 10 times the rated design torque.

- **Lifting Hook:**

All motors except for fractional horse power motors shall be provided with lifting hooks of adequate capacity.

- **Earth Terminals:**

Two earth terminals located preferably on diametrically opposite side shall be provided for each motor. The size of each earth stud shall be as given below in Table –IV:

TABLE-IV	
Motor Rating	Stud Size
Up to and including 7.5 KW	6 mm
11 KW to 30 KW	10 mm
Above 37 KW	12 mm

Necessary nuts and spring washers shall be provided for earth connection.

i) Miscellaneous Accessories:

- **Name Plates:**

A stainless steel name plate manufactured from series 300 stainless steel and having information as per IS-325 shall be provided on each motor.

In addition to the motor rating plate, a separate motor plant equipment number plate (i.e. motor tag number) shall be fixed in a readily visible position. This number shall be as per motor data sheets.

Additional information as stipulated in applicable Indian Standards shall be included in the name plate for motors meant for use in hazardous atmospheres as per IS:13408.

j) Noise Level:

The permissible noise level shall not exceed the stipulations laid down in IS: 12065, unless otherwise specified in the motor data sheet.

k) Motor Vibrations:

Motor vibrations shall be within the limits of IS:12075 unless otherwise specified for the driven equipment.

l) Critical Speeds:

The first actual speed of stiff rotors shall not be lower than 125% of the synchronous speed. For flexible rotors this shall be between 60% and 80% of the synchronous speed; the second actual critical speed shall be above 125% of the synchronous speed.

m) Painting:

Internal and external parts of the casing and all metal parts likely to come in contact with the surrounding air shall be protected with anti-acid paint that will resist the specified environmental conditions.

All external surfaces shall be given a coat of epoxy based paint.

n) Inspection and Testing:

During manufacturing of motors, the motors shall be subject to inspection by Owner's Inspector or by an agency authorized by the Owner. The manufacturer shall provide all necessary information concerning the supply to Owner's Inspector.

- Type tests, if specified, all the routine tests and other acceptance tests shall be witnessed by the Inspector. The manufacturer shall give prior notice of minimum 4 weeks to the Inspector for witnessing the tests.
- All tests shall be carried out at manufacturer's shop under his care and expense.
- Test certificates duly signed by the Owner's Inspector shall be a part of final documentation.
- The manufacturer shall submit all internal test records of the tests carried out by him on the brought-out items, motor sub-assembly and complete motor assembly to the Inspector before offering the motors for final inspection and testing.

- **Type test:**

The manufacturer shall periodically carry out the following type tests as per applicable Indian Standards for all the frame sizes and ratings of motors:

- Full load test and measurement of voltage, current, power & slip
- Measurement of starting torque, starting current, full load torque and pull out torque
- Measurement of efficiency and p.f. at 100%, 75% and 50% load
- Temperature rise test
- Momentary overload test
- Measurement of vibration
- Measurement of noise level

The above tests must be witnessed and approved by reputed inspection agencies. The manufacturer shall maintain test records and submit to the Owner's Inspector at the time of final inspection & testing. In no case, the test records shall be more than 5 year old.

In special cases where the type tests are asked to be carried out, these shall be witnessed by the Owner's Inspector.

- **Routine test:**

The manufacturer shall carry out routine tests as per applicable Indian Standards on all the motors. Routine tests not limited to the following shall form part of the acceptance testing:

- General visual checks, name plate details, mounting, terminal box location and cable gland sizes
- Measurement of shaft centre height dimensions
- Measurement of clearances in the terminal box
- Verification of type of terminals (for Ex-e & Ex-n motors)
- Verification of direction of rotation
- Measurement of winding resistance
- Insulation resistance test (before & after high voltage test)
- High voltage test
- No load test and measurement of voltage, speed, current & power input
- Locked rotor test at reduced voltage and measurement of voltage, current & power input
- Reduced voltage starting & running
- Tests on the Ex-d enclosures as per IS

- **Test Certificates:**

The manufacturer shall submit the following certificates for verification by the Owner's Inspector:

- Test certificate for degree of protection of enclosure
- Test certificates issued by the recognized independent test house for hazardous area motors
- Approval certificates issued by Statutory Authorities for hazardous area motors
- BIS license and marking as required by Statutory Authorities for Ex-d motors.
- Though the motors shall be accepted on the basis of the satisfactory result of the testing at the shop, it shall not absolve the Vendor from liability regarding the proper functioning of the motors coupled to the driven equipment at site.

o) Certification

The hazardous area motors and associated equipment shall have test certificates issued by recognized independent test house (CMRI/BASEEFA/LCIE/UL/FM or equivalent). All indigenous motors shall conform to Indian Standards and shall be certified by Indian testing agencies. All motors (indigenous & imported) shall also have valid statutory approvals as applicable for the specified location. All indigenous flameproof motors shall have valid BIS license & marking as required by statutory authorities.

p) Packing And Despatch:

All the equipment shall be divided into several sections for protection and ease of handling during transportation. The equipment shall be properly packed for transportation by ship/rail or trailer. The equipment shall be wrapped in polythene sheets before being placed in crates/cases to prevent damage to the finish. Crates/cases shall have skid bottom for handling. Special notations such as 'Fragile', 'This side up', 'Centre of gravity', 'Weight', 'Owner's particulars', 'PO Nos.' etc. shall be clearly marked on the package together with other details as per purchaser order.

The equipment may be stored outdoors for long periods before installation. The packing shall be completely suitable for outdoor storage in areas with heavy rains/high ambient temperature, unless otherwise agreed.

x) STANDARD SPECIFICATION FOR AC VARIABLE FREQUENCY DRIVE

a) SCOPE:

The scope of this specification is to define the minimum technical requirements for the design, manufacture, testing and supply of Medium Voltage, AC Variable Frequency Drive (VFD) System. The VFD shall be complete with Squirrel Cage Induction Motor, Converter, Converter transformer (if required), AC/DC link reactor with associated auxiliaries and local panel.

The vendor shall be responsible for engineering and functioning of the complete system meeting the intent and requirement of this specification and data sheets.

In this specification, the word 'drive' shall refer to the power and control module (rectifier-inverter-controller system) along with the associated electrical such as AC/DC link reactor, filters, contactors and other auxiliary panel components/ circuitry. The word 'system' shall refer to all the above and the associated motor and local panel put together.

This specification applies to drives connected to line voltage up to 1000 V AC.

b) CODES AND STANDARDS:

The equipment shall comply with the requirements of latest revision of following standards issued by BIS (Bureau of Indian Standards), unless otherwise specified:

IS – 5	Colours for ready mixed paints and enamels
IS – 325	Three phase induction motors
IS – 3700 & 14901	Essential ratings and characteristic of semi-conductor devices
IS – 3715 & 14901	Letter symbols for semi-conductor devices
IS – 4411	Code of designation of semi-conductor devices
IS – 5001	Guide for preparation of drawings for semi-conductor devices
IS – 5469	Code for preparation of drawings for semi-conductor devices
IS – 8789	Performance parameters for motors
IS – 60947 Part-1	Low voltage switchgear and control gear: General rules

- In case of imported equipment, standards of the country of origin shall be applicable, if these standards are equivalent or stringent than the applicable Indian standards.
- The equipment shall also conform to the provisions of Indian Electricity rules and other statutory regulations currently in force in the country.
- In case Indian standards are not available for any equipment, standards issued by IEC/BS/VDE/IEEE/NEMA/IS or equivalent agency shall be applicable.
- In case of any contradiction between various referred standards/specifications/data sheet and statutory regulations the following order of priority shall govern.
- For imported equipment, standards of the country of origin shall be applicable, if these standards are equivalent or stringent than the applicable Indian standards.

c) STANDARD SPECIFICATION FOR AC VARIABLE FREQUENCY DRIVE

AC VARIABLE FREQUENCY DRIVE AS PER THE FOLLOWING SECIFICATIONS.

Technical specifications:

General specification is given in the annexure to this chapter. Vendor has to prepare specification sheet for each unit and submit for approval. Make of the VFD shall be as per the brand preference of NALCO only.

Ratings:

Power Rating (kW/HP)	: 25 % higher than the rated kW of the motor for which it is required.
Input Voltage	: 380-500 VAC +/-10%
Input Frequency	: 50 Hz + / - 5 %
Rated continuous current of VFD	: more than the rated current of the motor for which it is required.
Over load capacity	: 150 % for 60 seconds 200 % for 03 seconds
Language	: English.

Important notes for the bidders:

1. All the above specifications based on 50 degree centigrade ambient temperature without de-rating.
2. VFD Enclosure: IP 20 for VFD module if it is installed in air conditioned control room.
3. Each VFD shall be supplied in a standalone panel having single door, both front & rear opening, IP 43 enclosure if installed in ac control room and minimum IP 66 enclosure if installed in other than ac control room with panel ac as required depends on application, floor mounting, with fans, filters, door lock and handle. If VFD modules are outside the MCC , then VFD panel with IP 43 enclosure to be installed in Air Conditioned room. Enclosure if installed in other than Air Conditioned room with panel then the degree of ingress protection shall be minimum IP55.Prior approval shall be taken from Nalco for type of enclosure and VFD.
4. The power wiring shall be with appropriate size of fine core stranded copper conductor with appropriate size lugs.
5. All the control wiring shall be with copper Minimum 1.5 sq. mm. Flexible wire.
6. All the internal wiring shall be as per the design scheme of vendor duly approved by Nalco at appropriate stage.
7. The drive shall be suitable for variable and constant torque depends on application.
8. The transformer, input choke, output choke shall be mounted at the back of the panel. All the electrical like contactor, MCB and fuse shall be mounted in the front of the panel.
9. VFD shall be mounted in the front of the panel.
10. The VFD, control transformer, input choke, output choke and all electrical like MCCB, MCB, contactor and fuse shall be mounted on a mounting plate /din rail and then in the panel for ease of maintenance.
11. Erection supervision & commissioning will be done by the party.
12. All the terminal block shall be of phoenix make, type: uk6n & numbered.
13. The entire relay, MCB shall be of approved brand and make only.
14. Final scheme of the drawing & hooking with existing plc for automation will be finalized after discussion and consultation with Nalco.

15. GC / TC (Guarantee Certificate/Test Certificate) shall be submitted by the party
16. The panel shall have a separate transformer for illumination and ventilation fan supply.
17. The panel will have LED based illumination with door interlock.
18. The panel shall have one MCCB for VFD of appropriate rating as incomers.
19. A breaking resister, if required, of suitable rating to provide 150% breaking torque will be supplied separately.
20. The VFD shall have external brake chopper to provide 150% braking torque.
21. The panel shall have ammeter and voltmeter to monitor input current and voltage.
22. Indication lamps for drive status and power status to be provided.
23. Party shall submit final as built GA drawing and schematic drawings (soft copies in pdf format, soft copies in editable dwg format and hard copies)after commissioning of the panel.
24. Party must submit their complete technical literature along with the offer for our technical scrutiny.
25. It is mandatory for the bidder to confirm each and every technical data mentioned in the NIT for technical scrutiny purpose.
26. Vendor shall provide printed user manual, maintenance & trouble shooting manual, VFD programming kit, etc required for installation and maintenance of the system.

ANNEXURE

General Specification of Variable Frequency Drive

Reference: IEC 146 International Electrical Code

Regulatory Requirement: IEC 801

Product Rating:

Input Power:
The Drive shall be self-adjustable to accept an input voltage range between 380-500 VAC, 3-Phase ± 10 %.
Frequency Range shall be 50 Hz ± 6%.
Displacement Power Factor shall range between 1.0 and 0.95, lagging, over the entire speed range of drives.
The efficiency of the drive shall be minimum of 97.5 % at full load and speed.

Environment:

Storage ambient temperature range: (-) 40 to (+)70 Degree Centigrade (-40 to 158 F). Operating ambient temperature range should be 0 to 50 Degree Centigrade (0 to 109 F). The relative humidity range should be 5 % to 95 % non-condensing.
Operating elevation: Upto 1000 meters (3,300 ft) without de-rating.

Out Power:

The output voltage should be adjustable from 0 to rated input voltage. The output frequency range should be adjustable from 0 to 400 Hz. The inverter section shall produce a pulse width modulated (PWM) waveform using latest generation IGBTs.

Hardware:

The drive hardware should employ the following power components:

- Diode or fully gated bridge on the input.
- Phase to Phase and Phase to Ground voltage surge protection.
- Gold plated plug-in connections on printed circuit boards.
- Microprocessor based inverter logic isolated from power circuits.
- Protection against input voltage dips and swells.
- Latest generation IGBT inverter section.
- Inverter section shall not require commutation capacitors.
- Peripheral Interface to enable attaching common options.
- Drive must be designed to operate at full load without cooling fan operation at designed ambient temperature of 50 deg. C without any component damage.
- All PCB should have conformal coating for protection against harsh and corrosive environments, class C3C as per IEC standard.

Control Logic:

The drive should be programmable or self-adjusting for operation under the following conditions:

- Operate drive with motor disconnected.
- Controlled shut down, when properly fused, with no component failure in the event of an output phase to phase or phase to ground short circuit and annunciation of the fault condition.
- Adjustable PWM carrier frequency within a range of 2-8 KHz.
- Selectable Sensor less Vector or V/Hz mode.
- 250 % Starting Torque and 260 % Peak Torque.
- Selectable for Variable or Constant Torque Loads. Selection of variable torque provides 115 % of rated VT current for up to one minute. Selection of constant torque provides 150 % of rated CT current for up to one minute.
- Multiple programmable stop modes including- Ramp, Coast, DC- Brake, Ramp-to-Hold and S-Curve.
- Multiple acceleration and deceleration rates.
- All adjustment to be made with the door closed.
- Adjustable output frequency up to 400 Hz.

Power Conditioning:

The Drive shall be designed to operate on an AC line which may contain line notching and up to 10 % harmonic distortion. An input isolation transformer shall not be required for protection from normal line transients. If the conditions dictate the use of a transformer, the K factor shall be 4 or less.

Operator Interface:

Interface to the drive is to be provided via a removable Human Interface Module with integral display. The display should be 2 lines, 16 characters alphanumeric, backlit LCD used to show drive operating conditions, fault indications and programming information. The display should also be configurable for simultaneously displaying two values using customized multi-lingual text and user scaled units.

Reference Signals:

The drive shall be capable of the following input reference signals:

- Digital Pulse Train Input

- HIM(Program/Control Panel)
- Analog Input Signals as
    - Remote Potentiometer
    - 0 to 10 VDC
    - 0 to 20 mA

- Digital MOP
- Serial

The analog inputs shall have programmable gain adjustments for both upper and lower settings to allow for system calibration. The analog inputs shall be programmable for normal, inverted or square root operation.

Loss of Reference:
The drive should be capable of sensing the following reference loss conditions:

- Remote potentiometer wiper loss.
- 2-10 V DC signals below 2 Volts.
- 4 to 20 mA signals below 4 mA.

In the event of loss of an analog input reference signal, the drive should be user programmable for one of the following conditions.

- Fault and Stop.
- Alarm and maintain last reference within 10 %.
- Alarm and go to the preset speed.
- Alarm and go to the minimum speed.
- Alarm and go to the maximum speed.

Signal loss detection should also be available when the signal being monitored is

- The active Process PI reference or feedback.
- The active Frequency reference.

Digital I/O:
Digital I/O shall consist of seven inputs, accessible through input cards and two Form A and two Form C relay outputs as standards.

Digital Inputs:
Out of seven Digital Inputs, 6 should be freely programmable for any fixed function that includes external fault, Speed select, Jog, Process PI functions, Second Acceleration /Deceleration, Stop Type and others.

Digital Outputs:
Standards "On Board" Digital outputs shall include two Form A (1 N.O.) and two Form C (1 N.O. - 1 N.C.) out put relays. Contact output ratings should be 240 VAC. All four relays provided should be programmable to different conditions including Fault, Alarm, At Speed, Drive Ready, PI Excess Error and others.

Communication:
Drive should have profibus, device net & Ethernet interface modules.

Features:

Start Up Mode:
An Assisted Start-Up Feature should be available for the user to commission the drive by supplying basic information and answering simple Yes/No questions. Basic setup parameters shall include Minimum and Maximum Frequency, acceleration and deceleration times and other can conveniently entered. Motor nameplate data, Encoder information and I/O setup shall also be included in the assisted start up.
A motor rotation test and automated sensor less vector tuning also should be possible in simple assisted startup. A full manual start up should also be possible.

Control Mode:
The ability to select sensor less vector or V/Hz mode should be available through programming. The sensor less vector mode should use motor nameplate data plus motor operating data such as IR drop, nominal flux current and flux up time to adapt to various operating conditions. The volts per hertz mode shall be fully programmable for fixed boost or full custom patterns.

Current Limit:
Programmable current limit from 20 % to 160 % of constant torque rating shall be provided. Current limit should be active for all the drive states, accelerating, constant speed and decelerating. The current limit parameter shall also be externally controlled through Analog Input.

Acceleration/Deceleration:
Acceleration/Deceleration setting should provide separate adjustments to allow either setting to be adjusted from 0.0 seconds to 3600.0 seconds. A second set of remotely selectable Acceleration/ Deceleration setting should be accessible with Control Interface option. An adaptive current limit circuit should be available to allow enabling for high Inertia and Disable the programming for fast acceleration of low inertia loads.

Speed Regulation:
The programmable speed regulation modes shall include the following.

i. Open Loop.
ii. Slip Compensation with 0.5 % speed regulation.
iii. Droop-Negative Slip Compensation with 0.5 % speed regulation.
iv. Traverse Function.
v. Closed Loop encoder feedback with 0.1 % speed regulation.
vi. Process PI Control.
vii. Speed range should be 120:1 or better to get good Torque at low speed.

Speed Profiles:
Programming capability to produce speed profiles with linear acceleration/ deceleration or S-Curve profiles that provide changing acceleration/deceleration rates shall be available. S-Curve profile shall be selectable for fixed or adjustable values.

Bus Regulation:
DC Bus regulation shall be available to reduce the possibility of drive Over Voltage trips due to regenerative. Bus regulation shall be enabled or disabled via programming.

Skip Frequency:

Three adjustable set points that lockout continues operation at frequencies which may produce mechanical resonance shall be provided. This should have a bandwidth adjustable from 0 Hz to 15 Hz.

Run on Power Up:
A user programmable restart function should be provided to automatically restart the equipment after restoration of power after an outage.

Fault Memory:
Last four faults as well as operating frequency, drive status and power mode should be stored at the time of fault. Information should be maintained in the event of power loss.

Auto Economizer:
This feature should automatically reduce the output voltage when the drive is operating in an idle mode (Drive output current less than programmed motor FLA). The Voltage should be reduced to minimize flux current in a lightly loaded motor thus reducing KW usage. If the load increases, the drive should automatically return to normal operation.

Flying Start:
The drive should be capable of determining the speed and direction of a spinning motor and adjusts its output to “Pick-Up” the motor at the rotating speed. The flying start feature should be operable with or without encoder feedback.

Adjustments:
The digital interface should be used for all set-up, operation and adjustment settings. All adjustments should be stored in nonvolatile memory (EPROM). No potentiometer adjustments are permitted.

Protection:
Following protection should be inbuilt into the drives:
Ground Fault, Short Circuit each Phase, Drive over Current, at temperature, Over Temperature, Under Voltage, Over Voltage, DC bus over voltage, External Signal Loss, Analog Signal Loss etc.

if not required by design calculations. The diameter of main bars in column / beam shall be so selected to limit the maximum spacing of bars to 150 mm.

15. JOB SPECIFICATION – INSTRUMENTATION

SCOPE OF SUPPLY & SERVICES (Instrumentation):

15.1 Scope of Supply:

Complete instrumentation package required for automation of the proposed Pipe (Siphon Tube) Cleaning Machine shall comprise of:

a) Supply, installation & commissioning of field sensors/ instruments, PLC, HMI and PLC I/Os as per operational/ control philosophy as well as standard of process industry automation. All PLC hardware and I/Os are to be installed inside the new proposed PLC panel with easy access for maintenance which is to be located in a dedicated air conditioned PLC room

b) Latest series PLC, Power supply, I/Os and communication network shall be provided. Point I/O modules and I/Os at the field are not acceptable.

c) The PLC Panel shall be supplied with IP66 or better degree of protection. The paint shade shall be powder coated textured RAL 7035.

d) HMI panel (Operator Control Panel) should be installed along with mounting arrangements near the Supplied machine so that proper visualization of cutting process can be available to the operator.

e) The supplied operator control panel/ HMI shall be of latest model, minimum 10” color with IP66 or better degree of protection. The licensed software required to configure & modify the Operator Control Panel/ HMI pages shall be provided in the original OME data media.

f) The HMI may essentially include the Mimics, General Overview of the machine, Individual pages for all the main Equipment or sub systems with conditions for healthiness, Fault & Alarm page, digital input/output(I/O) status pages, Trend Page(Current Trend & Historical Trend with proper Date & Time stamp).

g) Supply of all system software cum license as well all tools used during installation and commissioning of any instruments/PC/PLC/HMI etc.

h) The communication between Local Control Panel/HMI and PLC shall be preferably over Ethernet. The communication between IO rack and PLC communication shall be preferably over Ethernet. The communication cable

must be routed separately via metal conduit specially outside the PLC panel & around cutting machine frame.

i) Interposing relays are to be provided for all PLC inputs & outputs

j) PLC programming language must be in Ladder format.

k) A portable programming device (Industrial grade service laptop 15" of configuration latest generation Intel i5 (or later) processor, minimum 8GB RAM, 1 TB SSD storage , DVD-RW/USB or latest configuration) along with licensed PLC programming software and SCADA/HMI software (Run plus Development) shall be exclusively supplied along with the PLC system shall be supplied for trouble shooting purpose.

l) Supply of all required signal & communication cables, connectors & other accessories like separate cable trays for power & control cables and separate perforated cable trays for signal & communication cables.

m) Arrangement of complete tools and tackles required for the system.

n) The dedusting unit air purging system, if any, shall be controlled by main PLC preferably. Dedicated sequential controller/timer card for the same is acceptable

o) This is only qualitative specifications of commonly used instruments & industry automation system. Those which are not covered here shall be submitted by vendor for approval.

p) Historical trending of important parameters with date and time stamp shall be provided

q) The SCADA/HMI shall visually display the interlock status in each individual case rather than giving some confusing common alarm/ trip conditions. The requirement should address the needs for machine operation and easy trouble shooting.

r) At least 20% spare I/Os shall be considered while designing the PLC system. Max. 16 channels DI/DO modules & 8 channel AI/AO modules shall be considered while designing the PLC system.

s) Requirement of any system & application software and tools like Hart calibrator, Laptop etc. during installation & commissioning of the system will be in the scope of vendor .The same has to be purchased in the name of

'NATIONAL ALUMINIUM COMPANY LIMITED' and handed over to NALCO after execution of job.

t) The Alarm messages shall be properly classified/ configured in order to avoid confusions to the users.

u) In case of the field devices, proper access to be ensured for ease of maintenance and to reduce break down time in identification and rectification. Also no sensor shall be mounted above 2-meters height above ground/ platform.

v) Mandatory spares and special tools mentioned in the chapter "Spare Parts" of this document.

w) Energy efficient components/ equipment mentioned in the chapter "GENERAL GUIDELINE TO VENDOR/ CONSULTANTS FOR ENERGY EFFICIENCY IN DESIGN/ENGINEERING" of this document.

x) Suitable interlocks to be provided for safe running of the machines such as:

i. The Pipe(Siphon Tube) Cleaning Machine unit cannot be switched ON unless The pipe is clamped and all enclosure covers are closed

ii. The exhaust fan of the dust collector is ON before cleaning operation begins

iii. Any other Safety Feature not elaborated above but considered essential for safe working of the system

y) Any additional items or features required during detailed engineering for the completeness and trouble free performance of the system shall be included in the bidder's scope without any price and time implications as long as system performance parameters and requirements within the battery limits of the vendor defined under this specification are kept unchanged.

z) All the software Licenses supplied to NALCO shall be of Original Licenses and shall be issued in the Name of "DGM (E&I), Potline, Smelter Plant, NALCO

15.2 Scope of Services:

a) Transportation to site. Receipt at site, storage and Warehouse management,

b) Erection of new Operator Control PLC Panel of the proposed machine near the proposed machine.

c) Development/modifications suggested by Nalco of PLC program for automation and incorporation of various faults for trouble free operation of the machine.

d) Design & development of PLC program & SCADA/ HMI program as per process & End user requirement

e) Calibration, testing of installed instruments and simulation/testing of PLC programs.

f) Equipment shop testing, performance guarantee test of the system at site and check compatibility with operation requirement etc.

g) PLC communication with its associated I/Os, VFDs and HMI shall be through Ethernet network (open protocol).

h) Laying of optical fiber cables, splicing, termination and other communication cables if any shall be in the scope of the vendor.

i) Laying and termination of all the control cables, signal cables from the field instruments to junction boxes, junction boxes to PLC panel , MCC to PLC panel etc. shall be in the scope of the vendor.

j) Tagging of the control/ signal cables and ferruling of each core for easy identification shall be in the scope of the vendor.

k) Each PLC input/ output channel shall be provided with fuses (LED indicating type) of suitable ratings to prevent damage to the modules in case of short circuit in the field.

l) Each & every Emergency push button identification should be provided along with security relay & relay's contact shall be taken in the Electrical MCC panel as hardwire safety in case of emergency. An input signal to the PLC shall be provided for better identification (HMI screen) of the machine stoppage.

m) The positioning of all field devices should be such that these are accessible from outside for easy maintenance. Movable Platform for access to jib crane hoist for maintenance shall be provided.

n) The control panel of Jib crane shall be preferably placed within 2 meters of height from ground level.

o) Other scope of service mentioned in description of system & auxiliaries, battery limit, specification of instrumentation.

16. JOB SPECIFICATION – CIVIL

1. All civil test reports including concrete test report for 7 days, 28 days compressive strength and tensile strength test report for reinforcement steel required to be submitted for foundation RCC work, if required, for installation of the system supplied by the vendor.

2. All civil works for installation of Electrical equipment i.e. MCC panels, VFD panels, cables & accessories, motor foundations etc.

3. Construction of VFD room (12' x 8') with transparent glass windows and vinyl covered particle board laying supported by steel frames for installation of VFD panel. Suitable capacity of Split Air Conditioner (not less than 2 T Capacity) shall be supplied and installed by the vendor. This will be applicable for the vendors who offer Electrically controlled Pipe(Siphon tube) cleaning machine.

4. Construction of Hydraulic Power Pack (HPP) Room (12' x 8') for installation of hydraulic Power packs. This will be applicable for the vendors who offer hydraulically controlled Pipe (Siphon tube) cleaning machine.
5. Aluminium frame door and windows for the VFD/HPP room

6. All Civil works for installation of PLC panels near the machine.

7. All Civil works for installation of Pipe(Siphon Tube) Cleaning Machine, HPP, De-dusting system, Chimney , ID fans etc for successful erection and commissioning of the system.

8. Demolition of wall, if required, for successful erection and commissioning of the system.

9. The rerouting/modification of existing roads and drains, if required, in the proposed project plan based on general lay out of the vendor.

10. Dismantling of sheet and structural work, if required, of the building for connecting outside equipment located beyond anode handling building related to dedusting/pneumatic conveying system.

11. Aggregates, if any, to be used for the civil jobs are to be properly graded and sieve analysis report is to be submitted by the vendor for both coarse and fine aggregates.

12. During excavation of earth, if any water table is encountered, the vendor has to bail out the water for laying of foundations.

13. Foundation for installation of Pipe (Siphon Tube) Cleaning Machine and any other machines in scope of vendor shall be as per "DESIGN SPECIFICATION FOR FOUNDATIONS" as indicated in this document.

DESIGN SPECIFICATION FOR FOUNDATIONS

1. GENERAL

Scope

This specification covers the requirements for design of foundation, equipment foundation, local foundation, etc.

Codes and Standards

Latest editions of codes and standard as referred below shall be followed IS 456 – 2000	Code of practice for plain and reinforced concrete. (Fourth Revision)
IS 1786 - 2008	High strength deformed steel bars and wires for concrete reinforcement.
IS 1893 - 2002	Criteria for earthquake resistant design of structures.
IS 1904-1986	Code of practice for design and construction of foundations – General requirement.
IS 8009 (Part II)	Code of practice for calculation of settlement of foundation – Deep foundation.
IS 11089-1984	Code Of Practice For Design And Construction Of Ring Foundation; (Amendment 1), Reaffirmed 1995
IS 2950 – 1981 (Part – I)	Code of practice for design and construction of raft foundation.
IS 6403 -1981	Code of practice for determination of bearing capacities of shallow foundations.
IS 8009 -1976 (Part –I)	Code of practice for calculation of settlement of foundations - Shallow foundation.
IS 2974 (Part 2) - 1980	Code of practice for design and construction of machine foundations; Part 2 Foundation for impact type machine.
IS 2974 (Part 3) - 1992	Code of practice for design and construction of machine foundations; Part 3 Foundation for rotary type machine (medium and high frequency).
IS 2974 (Part 4)	Code of practice for design and construction of machine foundations; Part 4 Foundation for rotary type machine of low frequency.
IS 2974 (Part 5) - 1987	Code of practice for design and construction of machine foundations; Part 5 Foundation for impact type machine other

	than hammers (forging and stamping press, pig breakers, drop crusher and jolter).
IS 13920 - 1993	Ductile detailing of reinforced concrete structures subjected to seismic forces - Code of Practice.
IS 5249 - 1992 IS 4091 - 1979	Determination of dynamic properties of soil – method of test. Code of practice for design and construction of foundation for transmission line towers and poles.
IS: 875 (Part-1,2,3,5)-1987	Code of practice for design loads (other than earthquake) for buildings and structures.
IS: 875 Part 1	Dead Loads – Unit Weights of building material and stored materials (Second revision) (Incorporating IS: 1911-1967), Reaffirmed 1992.
IS: 875 Part 2	Imposed Loads (Second revision), Reaffirmed 1992.
IS: 875 Part 3	Wind Loads (Second revision), Reaffirmed 1992.
IS: 875 Part 5	Special Loads and Load Combinations (Second revision) - Reaffirmed 1992.
	Any other codes required for designing & execution of civil works

2. MATERIALS

General

Unless otherwise specified in the Drawings, material specifications shall conform to the following.

(1) Cement

Cement used for all concrete works both above and below ground shall be Portland Slag cement-PSC conforming to IS: 455 and OPC-43 Gr conforming to IS:8112.

(2) Aggregates

Aggregates used in the concrete works shall be graded from locally available gravel or crushed stone conforming to IS: 383.
Unless otherwise specified, the maximum size of aggregates shall be as follows: For large foundations and mass concrete -40mm graded down (provided the pitch of reinforcement is more than 100mm).

For others: 20mm graded down.

(3) Reinforcement: High strength deformed steel bars of grade Fe 415 conforming to IS 1786 shall be used for all building/Structures outside the process units.

(4) Anchor Bolts

Anchor bolts shall be turned from M.S. round conforming to IS : 2062, Grade-B Hexagonal Bolts & Nuts and washer of Grade-C and Washers shall conform to IS : 1363 and IS : 2016 respectively.

(5) Insert Plates

Insert plates shall be of structural steel quality conforming to IS: 2062 and shall be provided with mild steel lugs as per drawings/ standards. Mild steel lugs shall conform to IS: 432.

3. Design Basis

3.1 Foundation Design

For foundation design, Safe Bearing Capacities values, OF Soil investigation report shall be used. Minimum depth of foundation should be considered from NGL or FGL whichever is lower.

i. General

Foundation sizing shall be based on working loads not on loads, which may have been increased by factors for the purpose of concrete design.
For load combinations including seismic forces, the Safe Bearing Pressure of Soil and the Safe Bearing Load of piles shall be increased as permitted in IS: 1893.
Grade of concrete to be used in foundation shall be minimum M30.
For tie beams, below ground consideration shall be given for designing, additionally, for superimposed load and / or traffic loading, where applicable.

ii. Uplift on foundations

In the design of foundations, the upward pressure of water, where applicable, shall be taken as the full hydrostatic pressure applied over the whole area. Ground water table shall be assumed to be at existing ground level for calculating the existing hydrostatic pressure. Any other upward load shall also be included in the design.
Allowable loss of contact area between underside of foundation and soil (due to resultant overturning moment) under different loading conditions shall be considered.

iii. Mechanical Equipment Foundations

Mechanical equipment foundations shall satisfy the requirements of IS: 2974 and any other parameters as per machine vendors.
Foundation block extensions supporting auxiliary equipment requiring rigid positioning with respect to the main equipment shall be detailed to act integrally with the block.

Generally, foundations and structures supporting rotating machinery shall be so proportioned that their natural frequency shall not fall within the range of 0.8 to 1.2 of normal operating speed of the equipment.

Further, design shall be carried out such that amplitude of vibration during normal operation or other critical conditions shall not exceed the allowable amplitude specified by the equipment manufacturer or IS: 2974,whichever is more stringent. The above design criterion may be omitted for centrifugal pumps and fans and other minor rotating equipment weighing less than 1 ton or if the mass of the rotating parts are less than 1/100 th of the mass of foundation installed directly on concrete foundation provided that the weight of foundation is not less than 3 times of the equipment weight. In such cases, dynamic analysis is not necessary.

When dynamic analysis is called for:

The combined centre of gravity of the machine and foundation system shall, as far as possible, pass through the centre of area of the foundation raft or centroid of the pile group. Wherever unavoidable eccentricity shall be less than 5% for block foundations and 3% for frame foundations. However, in highly compressible soils, no eccentricity shall be permitted.
Foundations shall be so designed that natural frequency of the foundation system shall not resonate with the following:

a) Operating speed of the motor / machine.
b) Operating speed of the machine
c) 2 x operating speed of the machine
d) Critical speed of the machine (for centrifugal machines)

Where deviations (resulting from inaccuracies in soil parameter measurements, approximations in design method, etc.) from calculated natural frequencies, leading to amplitudes in excess of specified limits, are foreseen, provisions for increasing foundation mass without removal of the machine and without affecting surrounding space availability or connected piping shall be made, if possible.

Machine foundations shall satisfy the following requirements:
Minimum reinforcement as per requirements of IS: 2974 shall be provided unless required otherwise by design.
All units of the foundation system, except foundation raft shall be provided with symmetric reinforcement on opposite faces, even if not required by design considerations.
No common raft shall be designed for set of machines.
The soil stress below foundations under dead loads shall not exceed 80% of the allowable soil bearing capacity, or safe load on pile, for static loading.

The CONTRACTOR shall ensure that there is no transfer of vibrations from machine foundations to any part of the adjoining structures. Such foundations shall be isolated from other foundations and floor /paving slab by providing adequate gap between the foundation faces and surrounding soil mass; the gap shall be filled with fine Shalitex Board.

The foundations and its superstructure shall be separated from adjacent floors and platforms. Clear air gap shall be provided in superstructure to avoid transmission of vibration to adjacent structures. Special note shall be given on the drawing in this respect, and suitable details shall be shown as required.

Block foundations for machine shall be cast in a single concreting operation. Foundations consisting of various blocks of the same machine seated on a common foundation raft may be provided with a single, properly designed construction joint at the top of base raft. However, a special note shall always be given on the drawing regarding the recommended procedure of construction.
All faces of the foundation block shall be provided with surface reinforcement. Minimum reinforcement diameter in horizontal and vertical directions shall be 12 tor, and maximum spacing of bars shall not exceed 200 mm.
For frame foundations, base raft shall be cast in a single concreting operation. A properly designed construction joint shall be provided between the base slab and columns. The entire superstructure of columns and upper deck shall be cast in a continuous concreting operation.
If height of the frame columns above raft level exceeds 8.0 m, an additional construction joint at the junction of columns / top-deck may be provided.
The location of beams and columns, and their reinforcement shall be arranged, as far as possible, symmetrically with respect to the vertical plane passing through the longitudinal axis of the machine.
The transverse frames (perpendicular to the axis of the machine) shall be located directly under the bearings, wherever possible.

Adequate haunches shall be provided at all intersections of beams and column to avoid concentration of stresses and increase general rigidity of the frame.
The minimum beam depth shall be one-fifth of the span and the beam width is normally equal to the width of the column, consistent with anchor bolt requirements, embedded depth, and edge distances etc.

Weight of base raft of the frame foundation shall not be less than the combined weight of the machine and foundation superstructure above the base raft, i.e. columns, top-deck slab/beams etc.

For frame type of foundations, all the elements of foundations shall be provided with top and bottom, two way reinforcements. Reinforcement shall be provided on all the faces of beams and columns even if not required by design calculations. The diameter of main bars in column / beam shall be so selected to limit the maximum spacing of bars to 150 mm.

17. SPARE PARTS

17.1 MANDATORY SPARES

Vendor shall supply the following recommended Mandatory spares of the complete system:

i. Mechanical:

a)	Hydraulic/Pneumatic Hose	: 01 no each type
b)	Milling Cutter Heads, if any	: 02 no each type
c)	Cutting Tools/Inserts, if any	: 03 Sets of each type
d)	Cutting Shaft	: 01 no
e)	Hydraulic/Pneumatic Cylinder, if any	: 01 no each type
f)	Hydraulic/Pneumatic Valves, if any	: 01 no each type
g)	Brake Liners, if any	: 01 Set each type
h)	Hydraulic Pump, if any	: 01 no each type
i)	Hydraulic/Pneumatic pipe fitting if any	: 01 no each type
j)	Filter Bags/ Cartridges	: 01 Set

ii. Electrical

a) MCC Draw-out/ Lyra Power terminals (Fixed + Moving part) - 01 set minimum of each type
b) MCC Draw-out Control terminals(Fixed + Moving part) – 01 set minimum of each type
c) MCC Power Contactors - 01 no. minimum of each type
d) MCC Control Relays - 01 no. minimum of each type
e) MCC SFU with Operating handle – 01 set minimum of each type.
f) MCC Power & Control Fuses – 10 nos. minimum of each type
g) Relays (Protective relays, MOTPRO, Overload relays etc) – 01 no. minimum of each type
h) Drag Chain with associated electrical cables – 01 set minimum of each type
i) VFD / Softstarters – 01 no. minimum of each type
j) VFD Choke – 01 no. minimum of each type
k) Motors and Geared Motors – 01 no. minimum of each type
l) Electrical Brakes – 01 no. minimum of each type
m) Encoder with connector and cable – 01 set minimum of each type
n) Pneumatic Solenoid Valves with Coil – 1 set minimum of each type
o) Programming/Acessing software & kit for VFD, ACB, MOTPRO – 01 set each
p) Position/Proximity Sensors, Limit Switches – 01 no. minimum of each type

iii. Instrumentation

a.	Pressure Switches ,if any	: Minimum 1 no each type
b.	Level Switch, if any	: Minimum 1 no each type
c.	Level Transmitter, if any	: Minimum 1 no each type
d.	DP gauge/Transmitter, if any	: Minimum 1 no each type
e.	Pressure Transmitter, if any	: Minimum 1 no each type
f.	Photo Cell , if any	: Minimum 1 no each type
g.	PLC Processor	: 1 no
h.	PLC I/O Card	: Minimum 01 no for each type of I/O
i.	Load Cell, if any	: Minimum 01 No

17.2 COMMISSIONING SPARES

The contractor shall supply the required spares for smooth commissioning of their supplied system without any additional price implication to NALCO.

17.3 TWO YEAR O&M SPARES (Only List)

The contractor shall submit only a list of two year O&M spares with unit price either with the bid or during detail engineering. If the bidder intends to submit the list with unit price during detailed engineering stage, they have to mention the same in the bid. The list shall be a reference for future procurement by NALCO.

Note:

a) The contractor has to supply the mandatory spares mentioned above. If any of the mandatory spares do not exist in the bidders design, they have to categorically specify that the same spares do not exist in their supplied system. If it is found that the spares appear during detailed engineering stage or later, those have to be supplied by the contractor to NALCO without any additional financial implication.

b) The cost of Mandatory spares and Commissioning spares, if quoted separately by the bidder, shall be included to main price for evaluation of L-1 bidder.

c) The price of two year O&M spares shall not be considered for evaluation of L-1 bidder.

18. GENERAL GUIDELINE TO VENDOR/ CONSULTANTS FOR ENERGY EFFICIENCY IN DESIGN/ENGINEERING

18.1 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.

18.2 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

18.3 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

18.4 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

18.5 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

19. PREFERRED VENDOR/MAKE/BRAND LIST

CIVIL & STRUCTURAL

Sl. No.	Item Name	List Of Make/ Brand/ Suppliers	LOCATION
1	Aluminium Sheet	Balco	INDIA
		Hindalco	INDIA
2	Bituminous felt	Nerolac	INDIA
		Shalimar	INDIA
3	Bituminous paint	AsianPaints	INDIA
		Jenson and Nicholson	INDIA
		Berger Paints	INDIA
		ICI	INDIA
4	Cement	ACC Limited	INDIA
		Ultratech	INDIA
		Lafarge	INDIA
		L&T	INDIA
		Jaypee	INDIA
		Konark	INDIA
5	Chloro rubber paint	Asian Paints	INDIA
		Jenson and Nicholson	INDIA
		Berger	INDIA
6	External cement paint / Weather coat	ICI	INDIA
		Asian Paints	INDIA
		Berger Paints	INDIA
		Durocem(Berger)	INDIA
		Super Snowcem of Killick Nixon	INDIA
		Robacem(J&N)	INDIA
		Nerolac	INDIA
7	GI pipes	Jindal	INDIA
		ITC	INDIA
		TATA	INDIA
8	Expansion joint treatment	Sika	INDIA
		Fosroc	INDIA
9	Epoxy paint	Asian Paints	INDIA
		Sika	INDIA
		Nerolac	INDIA
		ICI	INDIA
		Berger Paints	INDIA
		Jenson and Nicholson	INDIA
		Fosroc	INDIA
10	Gunmetal valves	Annapurna	INDIA
		Leader	INDIA
11	Mineral hardener	Sika-Chapdur of Sika Qualcrete	INDIA
12	MS Angle/Channel/Beams	IISCO	INDIA
		TISCO	INDIA
		SAIL	INDIA

13	PVC pipes & fittings	RINL	INDIA
		Jindal	INDIA
		EMCO General Plastics	INDIA
		Poly olefins Industries Ltd	INDIA
		Hariplast	INDIA
		Oriplast	INDIA
14	Steel Rod	Jindal	INDIA
		RINL	INDIA
		SAIL	INDIA
		TISCO	INDIA
15	Non-shrink & free flow cementitious grout	Anckor-NSG of Sika Qualcrete	INDIA
16	Synthetic enamel paint/ Acrylic Emulsion Paint/ Primer	Nerolac	INDIA
		Asian Paints	INDIA
		Berger Paints	INDIA
		ICI	INDIA
		Jenson and Nicholson	INDIA
17	Aluminium doors/Partition doors/Windows/ Louvers	Alum-lite	INDIA
		JINDAL	INDIA
		Hindalco	INDIA
		INDAL	INDIA
18	Door Hardware	Everite	INDIA
		Godrej	INDIA
19	Glass	Atul	INDIA
		Hindustan Safety	INDIA
		AIS	INDIA
		MODI	INDIA
		Saint Goben	INDIA
20	Glazed Ceramic/ Vitrified tiles	Johnson	INDIA
		Kajaria	INDIA
		Rak	INDIA
		Somany	INDIA
		Orient Bell	INDIA
21	Material for flush door/ Panel Door/ Plywood/ Particle Board	Bhutan Board	INDIA
		Century Ply	INDIA
		Greenply	INDIA
		Kitply	INDIA
		National	INDIA
		Novopan	INDIA
		Marblex of Bhor	INDIA
22	Vinyl asbestos tiles	Rikvin	INDIA
		Wonder floor	INDIA
23	Water proofing admixer	Plastocrete-N of Sika Qualcrete	INDIA

ELECTRICAL

Sl. No.	Item Name	List Of Make/ Brand/ Suppliers	LOCATION
1	Switchgears	ABB	INDIA
		Schneider	INDIA
		Siemens	INDIA
2	Auxiliary Relays	ABB	INDIA
		Schneider	INDIA
		Siemens	INDIA
3	Control Relays	ABB	INDIA
		Schneider	INDIA
		Siemens	INDIA
4	Bimetallic Overload relays	ABB	INDIA
		Schneider	INDIA
		Siemens	INDIA
5	Motor protection relays	ABB	INDIA
		Schneider	INDIA
		Siemens	INDIA
6	Protection Relays	ABB	INDIA
		Schneider	INDIA
		Siemens	INDIA
7	Power Contactors	ABB	INDIA
		Schneider	INDIA
		Siemens	INDIA
8	Control Switches	ABB	INDIA
		Schneider	INDIA
		Siemens	INDIA
9	Timers	ABB	INDIA
		Schneider	INDIA
		Siemens	INDIA
		GIC	INDIA
		GE	INDIA
10	Emergency Stops	ABB	INDIA
		Schneider	INDIA
		Siemens	INDIA
11	Emergency Stop Box, Push Button Station, Pendant Box	ABB	INDIA
		Schneider	INDIA
		Siemens	INDIA
12	Pushbuttons	ABB	INDIA
		Schneider	INDIA
		Siemens	INDIA
13	Indication lamps	ABB	INDIA
		Schneider	INDIA
		Siemens	INDIA
14	Selector switches	ABB	INDIA
		Schneider	INDIA
		Siemens	INDIA

15	ELCB, RCCB & RCD	ABB	INDIA
		Schneider	INDIA
		LEGRAND	INDIA
		Siemens	INDIA
16	MCB	ABB	INDIA
		Schneider	INDIA
		Siemens	INDIA
		LEGRAND	INDIA
17	MCCB	ABB	INDIA
		Schneider	INDIA
		Siemens	INDIA
18	Switch Fuse Unit	ABB	INDIA
		Schneider	INDIA
		Siemens	INDIA
19	Fuses	Bussmann	INDIA
		Ferraz Mersen	INDIA
		Indo Asian Fuse Gear	INDIA
		Siemens	INDIA
20	Meters	AE	INDIA
		Rishabh	INDIA
		Schneider	INDIA
		MECO	INDIA
		IMP	INDIA
		SECURE	INDIA
21	Current Transformers & Potential Transformers	ABB	INDIA
		Siemens	INDIA
		AE	INDIA
		Jyoti	INDIA
		Newtek Electricals	INDIA
		Precise	INDIA
		GUPTA	INDIA
22	Control Transformers	ABB	INDIA
		Siemens	INDIA
		AE	INDIA
		Jyoti	INDIA
		Newtek Electricals	INDIA
		Precise	INDIA
		GUPTA	INDIA
23	Current/Voltage/Power/Frequency Transducers	Minilec	INDIA
		Masibus	INDIA
		Rishab	INDIA
		ABB	INDIA
24	Electrical Panel	Rittal	INDIA
		Hoffman	INDIA
		PYROTECH	INDIA

25	Control panels, Junction Boxes & Enclosures	Schneider	INDIA
		Siemens	INDIA
		Rittal	INDIA
		Hoffman	INDIA
		PYROTECH	INDIA
		BCH	INDIA
26	Power cables	Lapp	INDIA
		Helukabel	INDIA
		KEI	INDIA
		FINOLEX	INDIA
		HAVELLS	INDIA
		Polycab	INDIA
		Radiant Cables Ltd	INDIA
		RPG	INDIA
		Torrent	INDIA
		Universal	INDIA
27	Control cables	Lapp	INDIA
		Helukabel	INDIA
		KEI	INDIA
		FINOLEX	INDIA
		HAVELLS	INDIA
28	Power & Control Wires	Lapp	INDIA
		Helukabel	INDIA
		KEI	INDIA
		FINOLEX	INDIA
		HAVELLS	INDIA
29	Cable Termination & Jointing Kit	Raychem RPG	INDIA
		3M	INDIA
		Multi Shrink	INDIA
		REPL	INDIA
		Yamuna	INDIA
		Lapp	INDIA
30	Glands above M32x1.5(Ni plated brass)	Connectwell	INDIA
		Phoenix	INDIA
		BRACO	INDIA
		DOWELLS	INDIA
31	Glands upto M32x1.5	Lapp	INDIA
		Connectwell	INDIA
		Phoenix	INDIA
		BRACO	INDIA
		DOWELLS	INDIA
32	General Purpose Motors	SEW Eurodrive	INDIA
		Siemens	INDIA
		Bauer	INDIA
		ABB	INDIA

		CG	INDIA
		KEC	INDIA
		BHEL	INDIA
33	Illumination	Bajaj	INDIA
		Crompton	INDIA
		Havells	INDIA
		Philips	INDIA
		Wipro	INDIA
34	Load Break Switches & Local Power Isolation Cabinets	Kabelite	INDIA
		Cefem	INDIA
		Socomec	INDIA
35	Switchboards	ABB	INDIA
		Schneider	INDIA
		Siemens	INDIA
36	UPS	Emerson	INDIA
		Fuji	INDIA
		Hitachi-HiRel	INDIA
		Schneider APC	INDIA
		NUMAX	INDIA
		EATON	INDIA
		VERTIV	INDIA
37	Battery Bank for UPS	Amar Raja	INDIA
		Exide	INDIA
		Rocket	INDIA
		Schneider	INDIA
38	Selector switches	SALZER	INDIA
		SIEMENS	INDIA
		ABB	INDIA
		Rockwell	INDIA
39	Limit Switches	Schneider	INDIA
		BCH	INDIA
		SICK	INDIA
		SIEMENS	INDIA
40	Proximity detectors	P&F	INDIA
		ABB	INDIA
		SIEMENS	INDIA
		Telemechaniqe	INDIA
		SICK	INDIA
		Connectwell	INDIA
41	Terminal blocks	Elmex	INDIA
		Phoenix	INDIA
		Weidmuller	INDIA
		Wago	INDIA
42	Plugs & Sockets	Marechal	INDIA
		BCH	INDIA

		Schneider	INDIA
		Cape Electric	INDIA
		ABB	INDIA
43	Air Conditioner	Voltas	INDIA
		Blue Star	INDIA
		Hitachi	INDIA
		LG	INDIA
		Carrier	INDIA
		Lloyd	INDIA
		O General	INDIA
43	Zero speed switch	Turck	INDIA
		Schneider	INDIA

INSTRUMENTATION

Sl. No.	**Item Name**	**List Of Make/ Brand/Suppliers**	**LOCATION**
1	Air/Gas Flow transmitters	E&H	INDIA
		ABB	INDIA
		Forbes Marshall	INDIA
		Emerson	INDIA
2	Cable glands (for Hazardous area)	Lapp	INDIA
		Connectwell	INDIA
		Phoenix	INDIA
		BRACO	INDIA
		DOWELLS	INDIA
3	Computer & Printer table	Godrej	INDIA
		Zuari	INDIA
4	Control Valves	Audco	INDIA
		KSB	INDIA
		Tyco	INDIA
		Samson Control	INDIA
		SEVERN GLOCON	INDIA
		DRESSER VALVES	INDIA
		Klein	INDIA
5	Differential pressure gauge	Ashcroft	INDIA
		Wika	INDIA
		Baumer	INDIA
		Kobold	INDIA
		Waaree	INDIA
6	Digital multi meter	Meggar	INDIA
		Fluke	INDIA
		Yokogawa	INDIA
7	Flow switch	P&F	INDIA
		E&H	INDIA
		IFM	INDIA

		Honeywell	INDIA
8	HART Configurator	E&H	INDIA
		Yokogawa	INDIA
		Emerson	INDIA
9	Instrument tubing, fittings & needle valves	Parker	INDIA
		Samson Control	INDIA
		Swagelok	INDIA
10	Jamming detector	E&H	INDIA
		Kobold	INDIA
		Siemens	INDIA
		SWR	INDIA
		MUTEC	INDIA
		Vega	INDIA
11	Level switch	E&H	INDIA
		P&F	INDIA
		Vega	INDIA
		Siemens	INDIA
		Kobold	INDIA
12	Level transmitter	E&H	INDIA
		Vega	INDIA
		Siemens	INDIA
		UWT	INDIA
		Emerson	INDIA
13	Load cell	Avery	INDIA
		HBM	INDIA
		Precia Molen	INDIA
		Sartorious	INDIA
14	Manometer	Asian Industrial Valves	INDIA
		Sigma Industries	INDIA
		Phoenix	INDIA
		Bliss Anand Pvt Ltd	INDIA
		E&H	INDIA
15	Mass flow meter	Yokogawa	INDIA
		Honeywell	INDIA
		Siemens	INDIA
		Emerson	INDIA
16	Orifice plates & Flanges	Baliga Lighting	INDIA
		Start Mech Controls	INDIA
		Micro Precision Products Pvt Ltd	INDIA
		Guru Nanak Engineering works	INDIA
		Eureka Industrial Equipments	INDIA
17	PC & Laptop	Dell	INDIA
		HP	INDIA
18	Photo Cell	P&F	INDIA
		Sick	INDIA

		Schneider	INDIA
19	Pile detector (Diffuse reflection type)	IFM	INDIA
		Sick	INDIA
		Schneider	INDIA
		P&F	INDIA
		Omron	INDIA
		Allen Bradley	INDIA
		LEUZE Electronics	INDIA
20	PLC I/O cards	Rockwell	INDIA
21	PLCs	Rockwell	INDIA
22	Pressure gauge	Ashcroft	INDIA
		Waree	INDIA
		Kobold	INDIA
		Wika	INDIA
		Baumer	INDIA
23	Pressure Relief Valves	Anderson Greenwood Crosby	INDIA
		Alstom	INDIA
		Weir	INDIA
		Safety Systems UK Ltd	INDIA
		BHEL	INDIA
24	Pressure switch	Baumer	INDIA
		Turck	INDIA
		IFM	INDIA
25	Pressure/Flow/Differential pressure transmitter	E&H	INDIA
		Yokogawa	INDIA
		Siemens	INDIA
		ABB	INDIA
		Emerson	INDIA
26	Printer(Laser / Inkjet)	Cannon	INDIA
		Epson	INDIA
		HP	INDIA
		Jumo	INDIA
27	RTD	Toshniwal	INDIA
		Tempsens	INDIA
		Kanthal	INDIA
		Tempcon	INDIA
		Kobold	INDIA
28	Signal cables	KEI	INDIA
		RPG	INDIA
		Polycab	INDIA
		Helukabel	INDIA
		Lapp	INDIA
29	Temperature gauges	Waaree	INDIA
		Kobold	INDIA
		Wika	INDIA

		General Instruments	INDIA
30	Temperature transmitter	E&H	INDIA
		ABB	INDIA
		Yokogawa India Ltd	INDIA
		Siemens	INDIA
		Honeywell	INDIA
		Emerson	INDIA
31	Thermocouples	Exotherm	INDIA
		Toshniwal	INDIA
		Tempsens	INDIA
		Jumo	INDIA
		Kanthal	INDIA
32	Thermo wells	Exotherm	INDIA
		Toshniwal	INDIA
		Jumo	INDIA
		Tempsens	INDIA
		Kanthal	INDIA
33	Universal digital indicator and controller	Eurotherm	INDIA
		Honeywell	INDIA
		Yokogawa	INDIA
		ABB	INDIA
34	Universal Temperature indicator/ controller	Eurotherm	INDIA
		Honeywell	INDIA
		ABB	INDIA
		Yokogawa	INDIA
35	Sequencer Timer Card	EAPL	INDIA
		SEFRAM	INDIA
		DELTA NEU	INDIA
36	Weighing system	Avery	INDIA
		Schenck	INDIA
		Vishay Nobel	INDIA
		Precia Molen	INDIA

MECHANICAL

Sl. No.	Item Name	List Of Make/ Brand/Suppliers	LOCATION
1	Air filters	Festo	INDIA
		Donaldson	INDIA
		Parker	INDIA
2	Air lubricators	Festo	INDIA
		Parker	INDIA
3	Air regulators	Festo	INDIA
		Parker	INDIA
4	Axial fans & propeller fans	ACCEL	INDIA
		ISEL	INDIA

		Reitz	INDIA
		Flaktwoods	INDIA
		Dustven	INDIA
5	Ball valves	Audco	INDIA
		BDK	INDIA
		VAAS	INDIA
		Legris	INDIA
		HAWA	INDIA
		KSB	INDIA
		Audco	INDIA
6	Butterfly valves	VAAS	INDIA
		KSB	INDIA
		HAWA	INDIA
		BDK	INDIA
7	Cam Follower	McGill	INDIA
		INA	INDIA
		Osborn	INDIA
		Canada	INDIA
		C.R	INDIA
8	Centrifugal blowers	Flakt woods	INDIA
		Reitz	INDIA
		James Hoyden (UK)	INDIA
9	Couplings	Concord	INDIA
		Wellman	INDIA
		Greaves	INDIA
		Fenner	INDIA
		Elecon	INDIA
10	Fasteners	GKW	INDIA
		Unbrako	INDIA
		TVS	INDIA
11	Fluid coupling	Precision	INDIA
		Fludomat	INDIA
		Pembril	INDIA
		Voith	INDIA
12	Gate valves	Audco	INDIA
		VAAS	INDIA
		KSB	INDIA
		HAWA	INDIA
		BDK	INDIA
13	Gearboxes	DEMAG	INDIA
		Sew Eurodrive	INDIA
		New Allen berry Works	INDIA
		LENZE	INDIA
		Flender	INDIA
14	Globe valves	Audco	INDIA

		BDK	INDIA
		HAWA	INDIA
		KSB	INDIA
		VAAS	INDIA
15	Hard Facing Electrodes	D&H	INDIA
		Diffusion	INDIA
		ESAB	INDIA
		Eutectic	INDIA
		Modi	INDIA
		L&T	INDIA
16	Hydraulic check valves	Parker	INDIA
		Vickers Perry	INDIA
		Rexroth	INDIA
17	Hydraulic counter balance valves	Parker	INDIA
		Rexroth	INDIA
18	Hydraulic cylinders	Parker	INDIA
		CPOAC	INDIA
		Yuken	INDIA
		Wipro	INDIA
		Vickers Perry	INDIA
		Veljan	INDIA
		Telehoist	INDIA
		Usha	INDIA
19	Hydraulic filters	Rexroth	INDIA
		HYDAC	INDIA
		MP Filtri	INDIA
		Parker	INDIA
		Rexroth	INDIA
20	Hydraulic flow control valves	Parker	INDIA
		Vickers Perry	INDIA
		Rexroth	INDIA
21	Hydraulic hoses	Aeroquip	INDIA
		Parker	INDIA
		Rexroth	INDIA
22	Hydraulic solenoid valves	Parker	INDIA
		Vickers Perry	INDIA
		Rexroth	INDIA
23	Hydraulic Pump	Parker	INDIA
		Linde	INDIA
		Eaton	INDIA
		Rexroth	INDIA
24	Knife gate valves	Audco	INDIA
		BDK	INDIA
		VAAS	INDIA
		KSB	INDIA

		HAWA	INDIA
25	Liner Plates	SAIL HARD	INDIA
		TISCRAL	INDIA
26	Lubricating Systems	AFMC Lubrication Pvt Ltd	INDIA
		Lincoln Helios	INDIA
		Lubcon	INDIA
27	Lubrication fittings	AFMC Lubrication Pvt Ltd	INDIA
		Lubcon	INDIA
28	Needle valves	Lincoln Helios,	INDIA
		Parker	INDIA
		Rexroth	INDIA
29	Pipe(MS)	Jindal	INDIA
		TATA	INDIA
		Surya	INDIA
		SAIL	INDIA
		Prakash	INDIA
30	Pipe(SS)	Jindal	INDIA
		SAIL	INDIA
		REMI	INDIA
31	Pipe fittings	True Fab Pvt Ltd	INDIA
		Arbind Pipes & Fittings	INDIA
		EBYIndustries	INDIA
		MS Fittings	INDIA
		Stewart &Llyods	INDIA
		Teekay Tubes Pvt Ltd.	INDIA
32	Pneumatic check valves	Festo	INDIA
		ASCO	INDIA
		Parker	INDIA
33	Pneumatic cylinders	Festo	INDIA
		Legris	INDIA
		ASCO	INDIA
		Parker	INDIA
		Schrader	INDIA
34	Pneumatic flow control valves	Festo	INDIA
		Legris	INDIA
		ASCO	INDIA
		Parker	INDIA
35	Pneumatic hoses	Festo	INDIA
		Legris	INDIA
		ASCO	INDIA
		Parker	INDIA
		Gates India	INDIA
36	Pneumatic solenoid valves	Asco	INDIA
		Legris	INDIA
		ASCO	INDIA

		Schrader	INDIA
		Parker	INDIA
		Festo	INDIA
37	Pulsejet valves	ASCO	INDIA
		Festo	INDIA
38	Quick couplers	Aeroquip	INDIA
		Parker	INDIA
		Legris	INDIA
39	Rotary Air Lock Feeder	Air Lanco	INDIA
		FLAKT	INDIA
		Rieco	INDIA
		Scorpio	INDIA
		Fluid Air	INDIA
		DMN Westing house	INDIA
		Delta-Ducon	INDIA
40	Steel plates	IISCO	INDIA
		TISCO	INDIA
		SAIL	INDIA
		RINL	INDIA
		Jindal	INDIA
41	V-Pulley	Fenner	INDIA
		Contitech	INDIA
42	V-Belts	PIX	INDIA
		Fenner	INDIA
		Gates	INDIA
		Contitech	INDIA
43	Welding electrodes	D&H	INDIA
		L&T	INDIA
		Modi	INDIA
		Diffusion	INDIA
		ESAB	INDIA
		Eutectic	INDIA
44	Wire ropes	Bharat Wire ropes	INDIA
		Usha Martin	INDIA
		Orion Ropes PvtLtd	INDIA

Note:

a) The preferred vendor/make/brand list is for bought out items only.

b) This preferred vendor/make/brand list is to be followed in conjunction with the vendor/make/brand of equipment addressed in the detailed/standard specifications.

c) Any Substantial Equivalent material/make/brand from other reputed vendors required to complete the project, but not included in the preferred vendor/make/brand list and detailed/standard specifications, to be procured post order after taking prior approval from the Nalco-EIC on submission of proven track record documents.

20. SPECIAL CONDITIONS OF CONTRACT

a) 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.

b) 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.

c) 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 within the battery limit.

d) 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.

e) 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. A mutually agreed shutdown schedule is to be followed.

f) The contractor shall carry out the work in accordance with instructions/ drawings/ specification/ standard practices/ national and international norms.

g) Good quality and accurate workmanship for proper performance of equipment / systems shall be guaranteed by the contractor on every stage of supplies and works.

h) Preservation of all components at all stages of pre-assembly/ erection/testing and commissioning till completion of trial run of unit.

i) 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. This should be completed before submission of Final Bill. In the event of his failure to do so, the expenditure towards clearance of the same will be recovered from the contractor.

j) 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.

k) 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. They shall hold valid certificates wherever necessary.

l) 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.

m) 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.

n) 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.

o) 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. The statutory approvals related to consent to establish the new facility, is to be arranged by NALCO with necessary document support from the vendor. All other statutory approvals like PF,

ESI, Labor license, Electrical license, load test certificates of lifting equipment / tools etc. to be used by the vendor to be arranged by themselves.

p) 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 within the project battery limit 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.

q) All electrical installation covered in contractors scopes, as per applicability, 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.

r) It shall be the responsibility of the contractor to apply touch up painting on all vendor supplied 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.

s) 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.

t) 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.

u) 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.

v) 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.

w) 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, shutdown plan (if required), commissioning, PG Test and Hand Over.

x) 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.

y) 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.

z) 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.

aa) 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.

bb) 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.

cc) 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 authorized representative shall be construed as having been given to the Contractor.

dd) 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.

ee) 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.

ff) 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 after mutual agreement 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.

gg) 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:

hh) 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.

ii) 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.

jj) 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.

kk) 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.

ll) 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.

mm) All inspection and test for complete or major supply items shall be made as required. Various stages of inspection and testing shall be identified after receipt of Quality Assurance Plan (QAP) from the Contractor / manufacturer. Pespatch Inspection calls shall be given by the vendor/contractor 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.

nn) 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.

oo) 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.

pp) All Tools & tackles required for the satisfactory execution of work shall be arranged by contractor at his cost.

qq) All instruments, measuring tools etc. should have valid calibration certificate from National acrediated testing laboratories as a part of ISO requirement and necessary calibration certificates are to be submitted to Nalco before use.

rr) 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.

ss) 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.

tt) 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.

uu) 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.

vv) 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.

ww) 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.

xx) 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.

yy) 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.

zz) All design basis, calculations, drawings, layout, & specifications etc. are to be ratified / verified by the contractor. The Contractor to ensure full compatibility of the proposed system with the existing layout/ system & processes.

aaa) While selecting of the equipment, protection, enclosures, safety devices, drives etc.; emphasis has to be laid down on existing site conditions and operational practices.

bbb) Shut down planning: There may be requirement of taking shut down of the existing running plant for carrying out installation of any new equipment or integration with existing system. For shut down required for less than 8 hrs, the vendor has to intimate one day prior to such shut down. NALCO will try to provide the same based on sparability. 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 done during progressive execution of the project.

For shut down required for more than one day may not be possible by hampering Plant Production. In such case, a micro planning for activities for such 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 organized by the contractor during the shutdown period to minimize the shutdown hours.

ccc) Performance Guarantee test shall be carried out after successful completion of stabilization period as per laid down procedure. In case of the performance guarantee parameters are not achieved, the vendor shall repair/ rectify/ replace the equipment and demonstrate full compliance to these performance guarantee parameters, within mutually agreed time schedule limited to maximum of 3 months from PG test and

without any cost implication to NALCO. The vendor will get maximum of three chances to comply with performance guarantee parameters. If the vendor fails to demonstrate the PG parameters, the system supplied by the vendor shall be rejected and shall be governed by the relevant contract clauses along with encashment of CPBG.

ddd) The visit of any specialist and other engineers for erection, commissioning stabilization & PG Test shall be an integral part of the contract. No additional remuneration or charges shall be admissible

eee) Appropriate provision of access points like walkway, staircase, ladders etc. for operational and maintenance convenience are to be suitably incorporated in the detailed engineering.

fff) Punch Points : From the date of commencement of erection till the completion of P.G. test, Nalco personnel might have observed some punch points in the system from operation and maintenance point of view. These punch points shall be issued to the vendor/contractor from time to time. The vendor/ contractor shall comply to mutually agreed punch points within a reasonable time on discussion with Nalco personnel and close them before final handing over.

ggg) All correspondence, submission of Bills, Data sheet, documents shall be marked to the designated the Manager-in-charge or his/her authorized representative Compliance to statutory & regulatory requirements during consecution and erection shall be in the scope of EPC contractor.

hhh) 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.

iii) The contractor shall specify the manner for movement/storage of construction material for so that normal operating plant is not affected.

jjj) 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.

kkk) 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.

lll) 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.

mmm) The site mobilization and work at site should start as per the time line mentioned approved Project schedule.

nnn) 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.

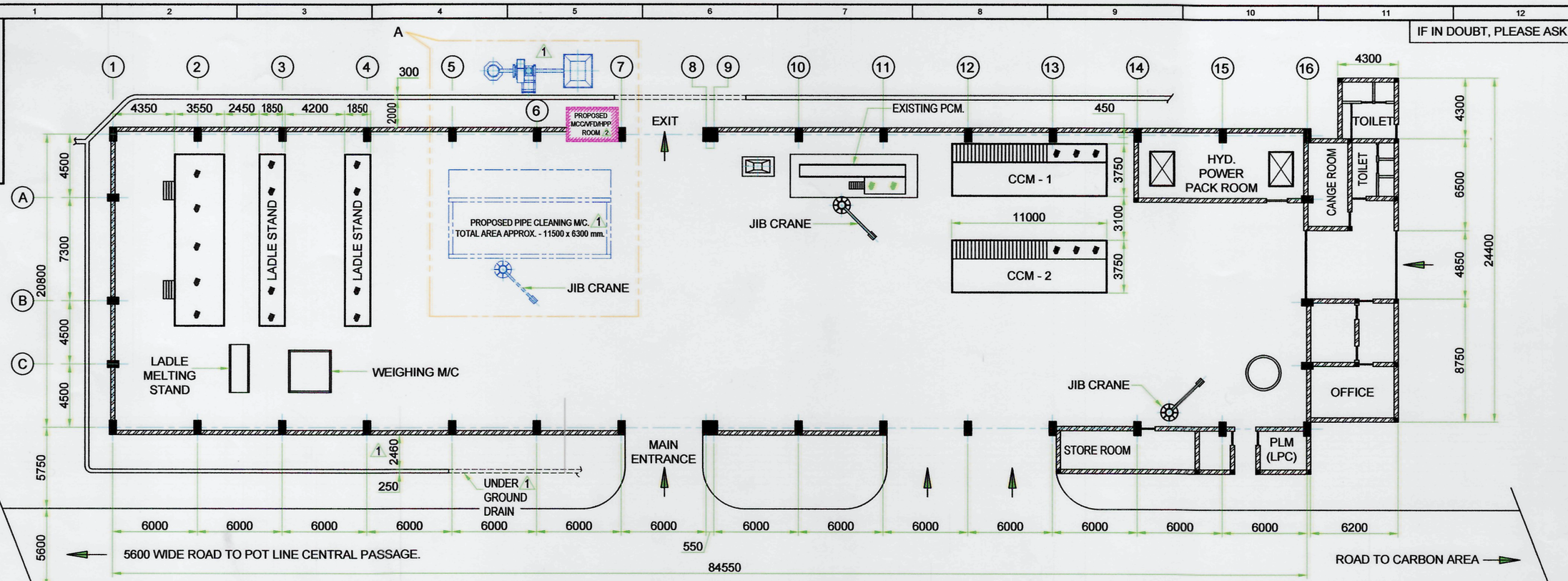
ooo) Notwithstanding anything herein provided and notwithstanding the transference of all risks in respect of the materials to the CONTRACTOR, the ownership in respect of the material shall at all times be and remain with NALCO. An inventory shall be made by the CONTRACTOR of all surplus construction 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.

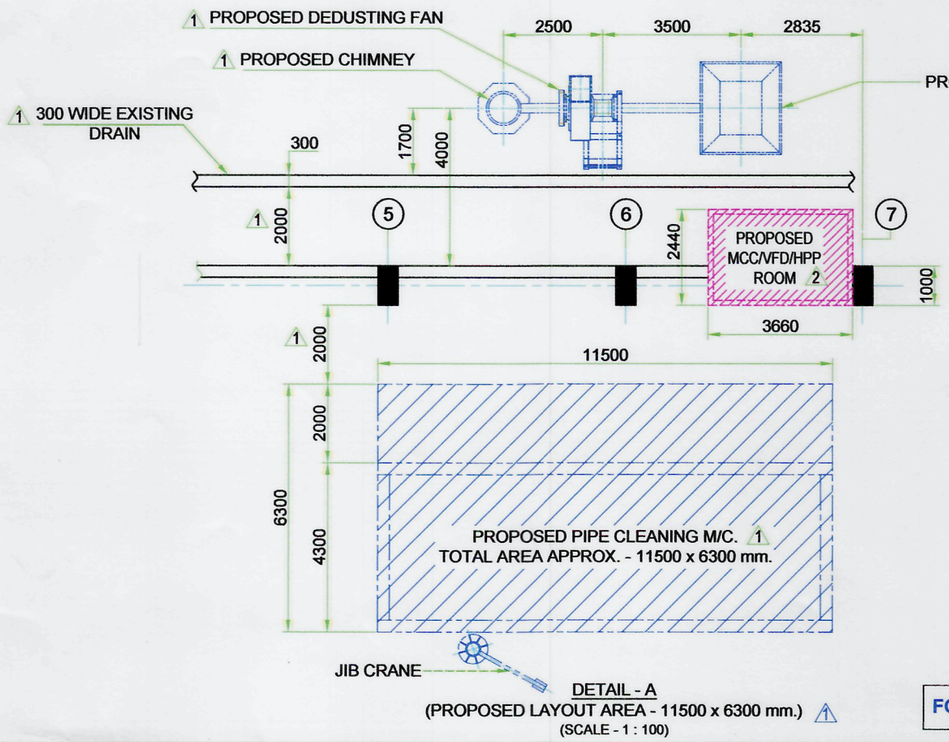
21. TENDER DRAWINGS:

Sl. No	Drawing Title	Drawing No	Rev
1	Proposed Lay out For New Pipe Cleaning Machine in Old LPC Shop, Pot Line	PL/MECH/LAY/A2/11490	2
2	Tapping Spout Intermediate Tube and End Tube For Tapping Ladle, Pot Line	PL/PRJ/SPR/A1/11622	0

PL/MECH/LAY/A2/11490

IF IN DOUBT, PLEASE ASK





DETAIL - A
(PROPOSED LAYOUT AREA - 11500 x 6300 mm.) 1
(SCALE - 1 : 100)

(SCALE - 1 : 200)

LEGEND :-

1 — EXISTING LADLE MELTING MACHINE , WEIGHING MACHINE CCM-1 & 2 , JIB CRANE & OTHER EQUIPMENTS.

1 — PROPOSED AREA FOR PIPE CLEANING MACHINE WITH PROPOSED HOPPER, DEDUSTING FAN & CHIMNEY.

2 — PROPOSED AREA FOR MCC/VFD/HPP ROOM

NOTE:-

- ALL DIMENSIONS ARE IN mm ONLY.

19.04.23 (S. ARYA) 19.04.23 (P. RAJA) 19.04.23 (P. SAHOO) 19/04/2023 19/04/2023

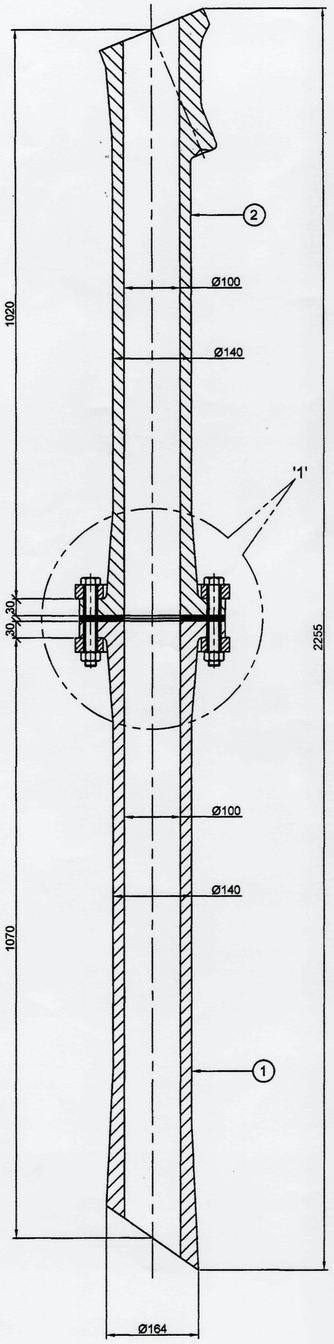
FOR TENDERING PURPOSE ONLY

REV. NO.	DATE	REVISION NOTE	BY.	CHD.	VFD.	APPD.
2	07.04.23	DRAWING REVISED AS MARKED.	SK PRADHAN	A. SAHOO 18.4.23	P. RAJA	B. ARYA
1	21.07.22	DRAWING REVISED AS MARKED.	S. MISHRA	A. SAHOO	M.R. DAS	B. ARYA

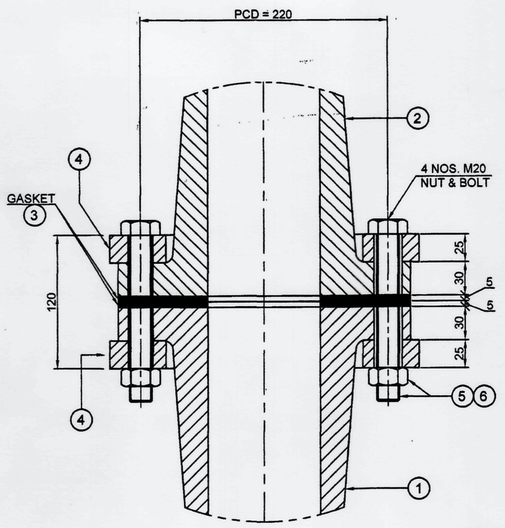
APPD.	B. ARYA	20.10.21	PREPARED BY :- TechFab, FCI ROAD, NALCO NAGAR, ANGUL (ORISSA)	Drg.Code:	1 0 1 5 1 0 3 6 0 2 2	
VFD.	M.R. DAS	16.10.21	DRN.	S. MISHRA	NATIONAL ALUMINIUM CO LTD. SMELTER PLANT, ANGUL-759145	
CKD.	A. SAHOO	16.10.21	CKD.	A. MARANDI	TITLE:- PROPOSED LAYOUT FOR NEW PIPE CLEANING MACHINE IN OLD LPC SHOP.	
			SCALE - AS SHOWN		DRG. No. PL/MECH/LAY/A2/11490	REVISION 1 2

PL/PRJ/SPR/A1/11622

GENERAL ARRANGEMENT



SECTIONAL VIEW
(SCALE - 1 : 5)



DETAIL - '1'
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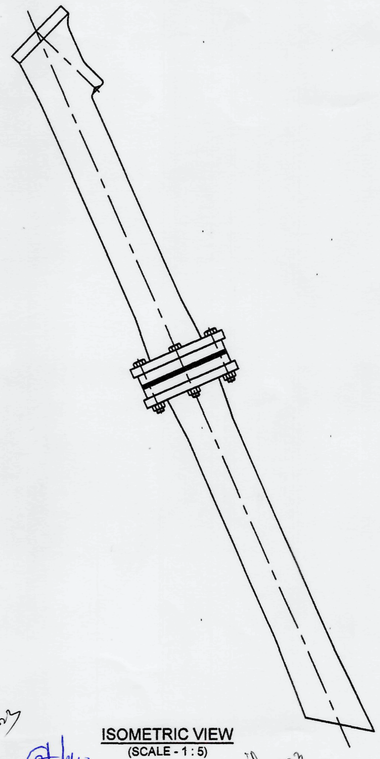
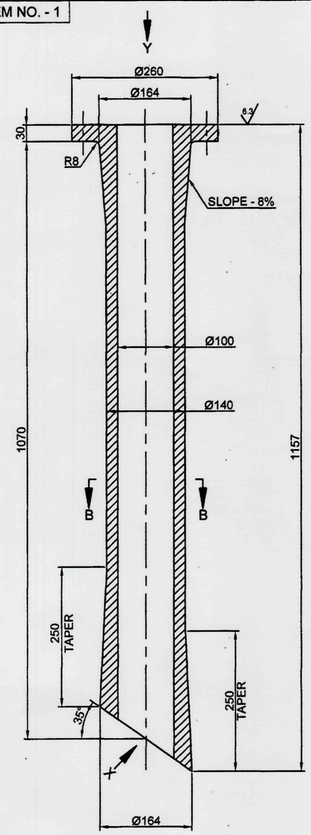
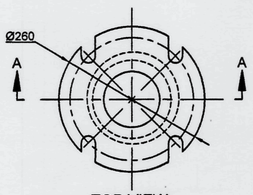


ISOMETRIC VIEW
(SCALE - 1 : 5)

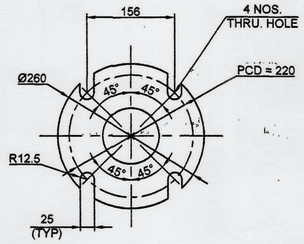
ITEM NO. - 1



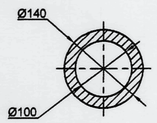
SECTION - AA
(SCALE - 1 : 5)



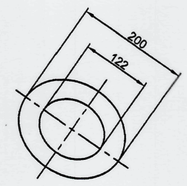
TOP VIEW
(SCALE - 1 : 5)



VIEW - Y
(SCALE - 1 : 5)



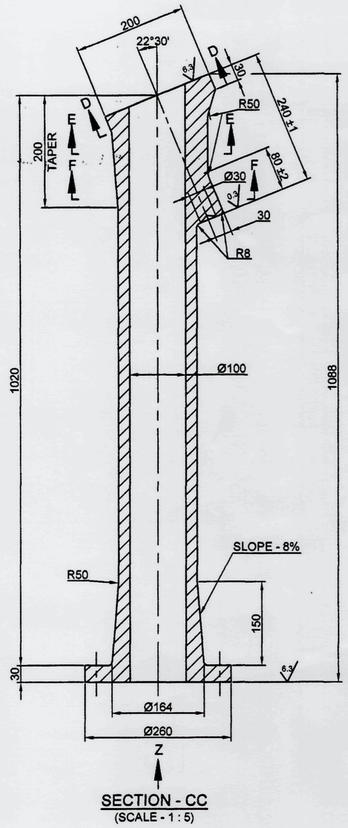
SECTION - BB
(SCALE - 1 : 5)



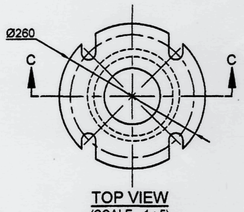
VIEW - X
(SCALE - 1 : 5)

ITEM NO. - 2

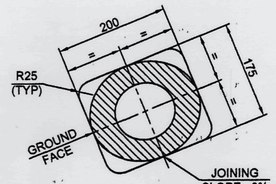
IF IN DOUBT,PLEASE ASK



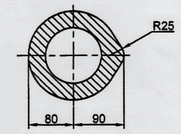
SECTION - CC
(SCALE - 1 : 5)



TOP VIEW
(SCALE - 1 : 5)



SECTION - DD
(SCALE - 1 : 5)



SECTION - EE
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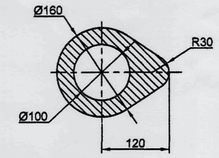

SECTION - FF
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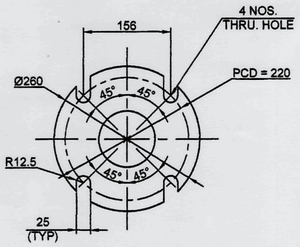
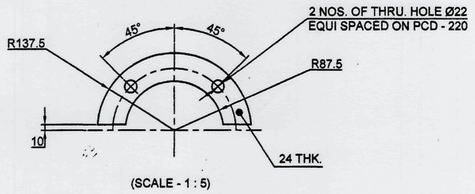


VIEW - Z
(SCALE - 1 : 5)

ITEM NO. - 4



(SCALE - 1 : 5)

FOR TENDERING PURPOSE ONLY

ITEM NO.	DESCRIPTION	QTY.	MATERIAL	REMARKS
6	HEX. NUT - M20	04	CLASS - 12	IS:1363(III) / 2002
5	HEX. HEADED BOLT - M20 x 150 LG.	04	CLASS - 12.9	IS:1363(I)/2002
4	FLANGE - 24 THK.	04	Fe410WA	IS:2062/2008
3	GASKET - 5 THK.	02	ASBESTOS	
2	INTERMEDIATE TUBE - 1088 LG.	01	CAST IRON (Gr.-II, TYPE-C)	IS:3355/1974
1	END TUBE - 1157 LG.	01	CAST IRON (Gr.-II, TYPE-C)	IS:3355/1974

REV.No.	DATE	REVISION NOTE	BY	CKD.	VFD.	APPD.

NOTE- 04 (16)

- ALL DIMENSIONS ARE IN mm ONLY.
- REMOVE ALL SHARP EDGES & BURRS.
- ALLOWABLE DEVIATIONS FOR DIMENSIONS WITHOUT SPECIFIED TOLERANCE SHOULD BE AS PER IS : 2102/1993(PART-1),MEDIUM.

APPD.	B. ARYA	22.04.23
VFD.	B. ARYA	22.04.23
CKD.	A. SAHOO	21.2.23

PREPARED BY :- Indfab, FCI ROAD, NALCO NAGAR, ANGUL (ORISSA)

DRN.	S. MISHRA	
CKD.	A. MARANDI	
SCALE - AS SHOWN		

Drg.Code: 1 0 9 5 0 0 0 1 0 0 1

NATIONAL ALUMINIUM CO LTD.
SMELTER PLANT, ANGUL-759145

TITLE:- TAPPING SPOUT INTERMEDIATE TUBE AND END TUBE FOR TAPPING LADLE, POTLINE.

DRG. No. PL/PRJ/SPR/A1/11622 REVISION 0

A1

19/04/23 (B.ARYA) 19.04.23 (P.RAJA) 19/04/23 (A.SAHOO) 19.04.23 19.04.23