NLC TAMIL NADU POWER LTD.
2X500 MW PROJECT
TUTICORIN, TAMIL NADU

TECHNICAL SPECIFICATION
FOR
FGD-WASTE WATER TREATMENT PLANT

SPECIFICATION NO.: PE-TS-483-164-A001 REV 00

BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

CONTENTS

SECTION	DESCRIPTION	PAGE NO.
	PROJECT INFORMATION	01
SECTION – I	SPECIFIC TECHNICAL REQUIREMENTS	06
SUB SECTION – IA	SPECIFIC TECHNICAL REQUIREMENTS (MECHANICAL)	07
	➢ ANNEXURE I: QUALITY PLAN	34
	➢ ANNEXURE II: SUB VENDORS LIST	49
	➢ ANNEXURE III: FUNCTIONAL GUARANTEES	82
	➢ ANNEXURE IV: DRAWING DOCUMENTS DISTRIBUTION SCHEDULE	86
	➢ ANNEXURE V: DRAWING/DOCUMENTS SUBMISSION SCHEDULE	88
	➢ ANNEXURE VI: REQUIREMENTS OF SPARES, TOOLS & TACKLES	95
	➢ ANNEXURE VII: FORMAT FOR OPERATION AND MAINTENANCE	100
	➢ ANNEXURE VIII: PACKING PROCEDURE	104
	➢ ANNEXURE IX: PROTECTIVE COATING AND PAINTING	136
	➢ ANNEXURE X: SITE STORAGE AND PRESERVATION	167
	➢ ANNEXURE XI: GENERAL TECHNICAL REQUIREMENTS & ENGINEERING SERVICES	181
	➢ ANNEXURE XII: OPERATION AND MAINTENANCE SERVICES	237
	➢ P&ID	243
	➢ DATA SHEET-A	244
	➢ PLOT PLAN	253
SUB SECTION – IB	SPECIFIC TECHNICAL REQUIREMENTS (ELECTRICAL)	254
	➢ ELECTRICAL SCOPE BETWEEN BHEL & VENDOR	257
	➢ QUALITY PLAN FOR MOTORS & CUSTOMER QUALITY ASSURANCE PLAN FORMAT	259
	➢ DATASHEET A AND C FOR LT MOTORS	272
	➢ ELECTRICAL LOAD DATA FORMAT	275
	➢ CABLE SCHEDULE FORMAT	276
	➢ STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (ELECTRIC HOIST)	277
SUB SECTION – IC	SPECIFIC TECHNICAL REQUIREMENTS (CONTROL & INSTRUMENTATION)	278
SECTION – II	GENERAL TECHNICAL REQUIREMENT	293
SUB SECTION – IIA	GENERAL TECHNICAL REQUIREMENT (MECHANICAL)	294
SUB SECTION – IIB	GENERAL TECHNICAL REQUIREMENT (ELECTRICAL)	338
SUB SECTION – IIC	GENERAL TECHNICAL REQUIREMENT (CONTROL AND INSTRUMENTATION)	386
SECTION - III	➢ LIST OF DOCUMENTS TO BE SUBMITTED ALONGWITH BID	510
	➢ SCHEDULE OF DEVIATIONS	511
	➢ SCHEDULE OF PRE BID CLARIFICATIONS	512
	➢ COMPLIANCE CUM CONFIRMATION SCHEDULE	513
	➢ SCHEDULE OF DECLARATION	514

PROJECT INFORMATION

SECTION – 2

GENERAL PROJECT INFORMATION

2.0 GENERAL PROJECT INFORMATION

1	Owner / Purchaser	NLC Tamil Nadu Power Limited (NTPL) (A Joint Venture Between NLC INDIA LIMITED and Tamil Nadu Electricity Board)
2	Project Name	NTPL Tuticorin Thermal Power Project
3	Capacity and Configuration	1000 MW [2 x 500 MW]
4	Owner's Consultant	Development Consultants Private Limited
5	Geographical Location	Latitude $8^0$45'38.09"North Longitude $78^0$10'15.85"East At Tuticorin Taluk in Tuticorin district in the Southern Part of Tamil Nadu along the Bay of Munnar, India
6	Access to site	
6.1	Nearest Airport	Nearest airstrip is located at Pudukottai at a distance of 16.5 km
6.2	Nearest port	Tuticorin sea port is located adjacent to the plant.
6.3	Nearest Railway Station	The nearest railway station is Port Trust Railway Yard at a distance of 1.0 km
6.4	Nearest Town	Nearest town is Tuticorin, which is located 5.5 km away from the plant and nearest city is Pallayamkottai, away from 60 km from the plant.
6.5	Nearest Highway	National Highway No. 7A adjacent to plant
7	Meteorological data	
7.1	Site Elevation	The natural land profile of the site 1.46 m above mean sea level
7.2	Ambient Temperature DBT	
i.	Maximum DBT	36.5 ºC

ii.	Minimum DBT	20.8 ºC
iii.	Performance DBT	27 ºC
7.3	RELATIVE HUMIDITY	
i.	Maximum	82 %
ii.	Minimum	35 %
iii.	Performance	50%
7.4	Earthquake Zone	Zone II
7.5	Predominant Wind direction	East to West
7.6	Wind velocity	Civil/structural design will be done considering IS 875 part 3
7.7	Rainfall	
i.	Annual	437 mm
7.8	Availability of Raw Water	Main source of water of the plant is sea water, which shall be taken from the Bay of Munnar.

VOLUME : II-A

SECTION-II

PROJECT SYNOPSIS AND GENERAL INFORMATION

1.00.00 INTRODUCTION

NLC Tamil Nadu Power Limited (NTPL) is presently operating a thermal power plant having two units of 500 MW capacity each, in Tuticorin, Tamil Nadu.

The Bidder shall acquaint himself with the conditions prevailing at site by a visit to the site, before submission of the bid. The information given here in under is for general guidance and shall not be contractually binding on the Owner. All relevant site data /information as may be necessary shall have to be obtained/ collected by the Bidder.

2.00.00 APPROACH TO SITE

The site is accessed by National Highway No. 7A adjacent to plant. Due South connecting Madurai. The nearest railway station is Port Trust Railway Yard at a distance of 1.0 km. Tuticorin sea port is located adjacent to the plant. Nearest airstrip is located at Pudukottai at a distance of 16.5 km. Nearest town is Tuticorin, which is located 5.5 km away from the plant and nearest city is Pallayamkottai, away from 60 km from the plant.

3.00.00 LAND

The site encompasses about 108 Ha, which is located at Tuticorin Taluk in Tuticorin district in the Southern Part of Tamil Nadu along the Bay of Munnar.
Latitude : $8^0$45’38.09”N
Longitude : $78^0$10’15.85”E

The natural land profile of the site 1.46 m above mean sea level.

4.00.0 SOURCE OF FUEL

The primary fuel for this plant is Coal. The Power plant will use coal from Talabira Mines and imported coal.

The daily coal requirement for 2x500 MW units is about 15360 tonnes (at TMCR). Annual coal requirement for the plant is around 4.48 MTPA.

5.00.00 SOURCE OF WATER

Main source of water of the plant is sea water, which shall be taken from the Bay of Munnar. The existing 2x 500 MW NTPL Tuticorin plant uses sea water based closed cooling system with Natural Draft Cooling Towers (NDCT). The sea water intake system comprises of gravity intake channels of a capacity 15000 m^3/hr. Out of this, around 9000 m^3/hr is fed as cooling tower makeup water through CT makeup pumps (2W+1S). Around 3000 m^3/hr sea water is utilized in the RO plant for utilization as service water, potable water, power cycle makeup and miscellaneous uses. The blow down from the Cooling tower back to sea is around 7000 m3/hr.

6.00.00 ASH DISPOSAL AREA

Fly ash is taken by consumer for further utilization. Balance ash is disposed off by HCSD method to the ash dumping area.

7.00.00 METEOROLOGICAL DATA

7.01.00 For the purpose of equipment design, the following Meteorological data of site (as per IMD Tuticorin) shall be taken into consideration

a)	Ambient temperature	:	36.5 ºC maximum 20.8 ºC minimum
b)	Extreme Ambient temperature	:	36.4 ºC maximum (Annual) 24.1 ºC minimum (Annual)
d)	Relative humidity (i) Maximum (ii) Minimum (iii) Average	:	 82% 35% 57 to 68%
e)	Annual Rainfall	:	437 mm
f)	Wind load	:	In accordance with IS-875, Part-3
g)	Seismic Zone	:	Zone II as per IS: 1893 latest edition.
h)	Altitude	:	1.46 M above MSL

SECTION-I

SPECIFIC TECHNICAL REQUIRMENT

SUB SECTION- I A SPECIFIC TECHNICAL REQUIRMENT-MECHANICAL
SUB SECTION- I B SPECIFIC TECHNICAL REQUIRMENT-ELECTRICAL
SUB SECTION- IC SPECIFIC TECHNICAL REQUIRMENT-CONTROL & INSTRUMENTATION

SUB SECTION- IA

SPECIFIC TECHNICAL REQUIRMENT (MECHANICAL)

1.0 GENERAL

This specification is intended to cover design, engineering, manufacture, fabrication, assembly, inspection & testing at vendor's & sub vendor's works, painting, forwarding, supply and delivery at site including start up and commissioning spares, mandatory spares, operation & maintenance spares, as required, properly packed for transportation, Operation & maintenance service including manpower, supervision, consumables (expect organosulfide, FeCl3,Lime,PE) etc. for operation & maintenance of Effluent treatment plant (For FGD Waste Water) System for a duration of 6 months after commissioning of Effluent treatment plant (For FGD Waste Water) System for the scope defined as per technical specification, loading/unloading / handling and storage at site, in site transportation, assembly, erection and commissioning, trail run, preparation and submission of drawing/documents including "As Built" drawings, site testing, carrying out performance guarantee tests at site and handover in flawless operating condition to end customer the entire Waste Water Treatment Plant complete with all accessories of Waste Water Treatment Plant for 2X500 MW COAL FIRED UNITS,TUTICORIN.

2.0 REFERENCE DOCUMENTS

A.	PE-DG-483-164-A001	:	P & ID FOR FGD WASTE WATER TREATMENT PLANT
B.	DATASHEET – A	:	FOR ABOVE SYSTEM
C.	PY-DG-0-M162-1252-01	:	PLOT PLAN

3.0 SCOPE OF SUPPLY (MECHANICAL)

Bidder to note that Waste water treatment Plant for Flue Gas Desulphurization Unit shall include associated Mechanical, Electrical, Control & instrumentation work. All the work i.e. Mechanical work, C&I, Electrical works (refer electrical, C&I for respective scope), Broad scope of supply has been listed below:-

1) Waste water inlet piping to Gypsum desaturation cum equalization tank complete with piping, fitting and valves.
2) One (1) number Gypsum desaturation cum equalization tank of RCC (RCC work in BHEL scope) construction of required capacity along with agitator, gear box, motor, valves, piping, fittings, instruments and required accessories.
3) Two (2) nos. High Recovery Solid Contact Type Clarifiers of RCC construction (RCC work in BHEL scope) with sampling points at different elevation of clarifiers along with valves, piping, fittings, instruments and required accessories.
4) Clarifiers bridges assemblies, control panel, hand railings, required motors, valves, piping, fittings, instrumentation etc. for two nos. clarifiers.
5) One (1) number Organosulfide reaction tank of RCC (RCC work in BHEL scope) construction of required capacity along with agitator, gear box, motor, valves, piping, fittings, instruments and required accessories.
6) One (1) number Coagulant tank of RCC (RCC work in BHEL scope) construction of required capacity along with agitator, gear box, motor, valves, piping, fittings, instruments and required accessories.
7) Sludge disposal system from clarifiers along with valves, piping, fittings, instruments and required accessories up to sludge collection pit as indicated in P & ID of waste water treatment plant.
8) One (1) no. Sludge Collection Pit of RCC (RCC work in BHEL scope) construction of required capacity along with valves, piping, fittings, instruments and required accessories.
9) Two (2) Air Blowers for air agitation system for thickened sludge pit & sludge collection pit simultaneously with acoustic enclosure, piping, fittings, valves, instrumentation etc.

10) One (1) number Thickener of RCC (RCC work in BHEL scope) construction of required capacity along with valves, piping, fittings, instruments and required accessories.
11) Thickener bridge assembly, control panel, hand railings, required motors, valves, piping, fittings, instrumentation etc.
12) One (1) number Thickened sludge collection tank of RCC (RCC work in BHEL scope) construction of required capacity along with valves, piping, fittings, instruments and required accessories.
13) Centrifuge (1x100%) of required capacity, required motors, valves, piping, fittings, instrumentation etc.
14) One (1) number Treated water storage tank of MS Epoxy Construction of required capacity along with valves, piping, fittings, instruments and required accessories.
15) One (1) number Overhead Tank of RCC (RCC work in BHEL scope) Construction of required capacity along with valves, piping, fittings, instruments and required accessories.
16) Two (2) nos. (1W+1S) screw pump for sludge feeding to thickener with all instrumentation, valves, piping, motors, fittings etc.
17) Two (2) nos. (1W+1S) screw pump for sludge feeding to centrifuge with all instrumentation, valves, piping, motors, fittings etc.
18) Two (2) nos. (1W+1S) Horizontal centrifugal pump for secondary clarifier feed pump with all instrumentation, valves, piping, motors, fittings etc.
19) Two (2) nos. (1W+1S) Horizontal centrifugal pump for disposal of treated water with all instrumentation, valves, piping, motors, fittings etc.
20) One (1) number electrically operated monorail hoist of required capacity along with trailing cable, travelling trolley, control unit and accessories in chemical house.
21) One (1) no. single storey chemical house building to store chemicals, tanks, pumps, etc. The Civil Design & Construction work of Chemical House shall be in the scope of BHEL. However, the chemical tanks (Other than RCC), dosing pumps, transfer pumps, instruments, piping, valves, platforms along with handrails, weighing & handling equipment, ladders, piping supports, puddle pipes, insert plates, angle, edge angles, rungs, auxiliary structures for pipe fixing etc. along with all structural steel, inside the chemical house shall be in the scope of bidder.
22) One (1) no. RCC Construction (RCC work in BHEL scope) Lime Solution dosing Tanks with motorized stirrer, flushing arrangement, instrumentation, valves, fittings and piping up to the of gypsum desaturation cum treated water storage tank and treated water storage tank.
23) Two (2) nos. (1W+1S) screw pump for Lime dosing to gypsum desaturation cum treated water storage tank and treated water storage tank with all instrumentation, flushing arrangement, valves, piping, motors, fittings etc
24) One (1) no. PE Dosing Tank with motorized stirrer, flushing arrangement, instrumentation, valves, fittings and piping up to the Secondary clarifier, thickener & centrifuge.
25) Four (4) nos. (2W+2S) positive displacement pumps for PE Dosing with all instrumentation, valves, piping, motors, fittings etc.
26) One (1) no. motor operated hand pump/electronic pump for unloading of organosulfide and PE from carbonize. Bidder to provide PP or equivalent suitable MOC for organosulfide and PE pump.
27) One (1) no. Organosulfide dosing Tank with motorized stirrer, flushing arrangement, instrumentation, valves, fittings and piping up to the Organosulfide reaction tank

28) Two (2) nos. (1W+1S) positive displacement pumps for organosulife dosing with all instrumentation, valves, piping, motors, fittings etc.
29) One (1) No. $FeCl_3$ storage Tank with unloading hose pipes, instrumentation, valves, piping, fittings etc.
30) Two (2) nos. (1W+1S) horizontal centrifugal pumps for $FeCl_3$ unloading with all instrumentation, valves, piping, motors, fittings etc.
31) One (1) no. $FeCl_3$ dosing Tank with motorized stirrer, flushing arrangement, instrumentation, valves, fittings and piping up to the Coagulation tank
32) Two (2) nos. (1W+1S) positive displacement pumps for $FeCl_3$ dosing with all instrumentation, valves, piping, motors, fittings etc.
33) One (1) nos. Weighing Scale with LED display
34) Mandatory spares. (Refer attached, Annexure-VI/ Subsection-IA).
35) Painting as per Annexure IX/Subsection-IA.
36) Start-up and commissioning spares as required.
37) All piping, valves, instruments as required for the system completion.
38) All motorized valves shall be provided with integral starter.
39) Operating platforms shall be provided for all the structures such as clarifier, sludge chamber, thickener etc. along with ladders and hand railing.
40) All pipes, puddle Pipes, fittings, angle, structural steel etc., hand railing, platforms, and ladders shall be in the scope of bidder. All insert plates, nuts and bolts, counter flanges wherever applicable shall be in the scope of bidder.
41) Edge angle required in a proper shape for edge protection in civil works will be provided by bidder.
42) All auxiliary steel structures (U-clamps, nuts, bolts, channels etc.) for fixing the pipe on the pedestal or trestles shall be in the scope of bidder.
43) Wherever terminal points between BHEL and bidder indicated, bidder shall provide pipes with counter flange.
44) One set of all special tools & tackles of reputed make necessary for proper maintenance or adjustment of the equipment being supplied by the bidder, packed in permanent box.
45) Sufficient numbers of portable type ladders with plate form to be supplied for ease of maintenance.
46) Necessary pipe, piping, fitting, valves, drains, vents, sampling etc. required for the complete FGD WWT Plant. Pipe racks shall be provided by BHEL wherever available. Wherever pipe racks are not available, pipe shall be laid on pedestal (BHEL or vendor's scope as per civil scope sheet). However all auxiliary steel structure (U-clamps, nuts, bolts, channels etc.) for fixing pipes on pedestal or racks for complete pre-treatment plant shall be in bidder's scope.
47) All the sumps, tanks, reservoirs and other water retaining structures shall be provided with access ladders/ rungs from operating platforms/ ground level as the case may be and de-watering pits one for each section. Hand railing will be provided by bidder for safety purpose in all civil structures. Supply and erection of all Hand railing as desired for safety purpose will be in bidder's scope.
48) Supply & Erection of clarifier inlet, outlet and sludge inlet and outlet piping shall be in bidder's scope.
49) Charging platform for all the chemical tanks along with required handrails, accessories etc. Permanent ladder (not rungs) for approaching the top of tanks, valves for All steel inserts plates with lugs, plates, bolts, nuts, sleeves, edge angles and all other embedding components etc as required to grout in civil works and to support/hold the equipment's for opening/maintenance purpose, shall be in bidder's scope.

50) All pipes, fittings etc. required for hand railing, platforms, and ladders shall be in the scope of bidder. All ladders shall be non-civil work. Supply and erection of Hand railing as required for safety purpose will be in bidder's scope. All handrails shall be of 32 mm nominal bore MS pipes (medium class) as per ASTM A 500 or equivalent international standard galvanized using 750 gm. / sq. m of zinc. Hand railing shall be a two-rail system with the top rail 1000 mm above the walkway surface and the intermediate rail 450 mm below the top rail. Handrail post spacing shall be limited to 1500 mm as far as possible but can be proportioned to the length of the opening. In such a case spacing shall not exceed 1850 mm center to center of posts. Hand railing shall be shop fabricated for specific locations and field welded or bolted to the erected structural steel. Railings shall be provided with 100 mm wide and 8 mm thick MS strip at bottom as toe guard all along the length of railing in horizontal plane. For RCC stairs, hand railing with 20 mm square MS bar balustrade with suitable MS flat and Aluminum/ Teakwood handrail shall be provided, unless specifically mentioned otherwise.
51) All channels & brackets, mounting plates as required for mounting of motors, pumps, stirrers, tank etc.
52) All necessary drains, vents, breathers, CO_2 absorbers, seal pots, fume absorbers and sampling points with valves as specified and as required for the complete Water Treatment Packages are in bidder's scope.
53) Two (2) sets of safety equipment [(Personal Protection Equipment (PPE)] comprising PVC protection suits with hoods, rubber boots, face visors and thick PVC gauntlets shall be provided by the bidder. One (1) number safety shower unit with eye wash fountain to protect against any chemical hazard shall also be provided by the bidder.
54) Finish paints for touch up painting of equipment after erection at site in sealed container.
55) All the first fill and one Year's topping requirements or 15% of first fill quantity, whichever is more, of consumable such as greases, oil, lubricants, servo fluids/ control fluids, which will be required to put the equipment covered under the scope of specifications, into successful commissioning/ initial operation and to establish completion of facilities shall be furnished by the Contractor. Suitable standard lubricants as available in India are desired. Efforts should be made to limit the variety of lubricants to minimum.
56) Instrument hook up material shall be in bidder's scope.
57) Electric hoist and chain pulley block as per specification requirement.
58) Grouting material required for fixing of equipment/ items.
59) Wrapping, coating and protection of all the buried pipe shall be as per IS 10221.
60) All other things are also included in scope of supply as specified in other part of the specification including under design criteria and technical details.

4.0 PIPING

Supply and erection of Complete piping indicated in P&ID of Waste Water Treatment Plant is in bidder's scope. In addition, any additional piping required to make the system complete inside Waste Water Treatment Plant area shall be in bidder's scope.

5.0 SCOPE OF SUPPLY (ELECTRICAL)

Complete electrical as per specification / details indicated in Sub Sections IB and IIB.

6.0 SCOPE OF SUPPLY (C&I)

Complete C&I as per specification / details indicated in Sub Sections IC and IIC.

7.0 SCOPE OF SUPPLY (CIVIL)

Complete architectural, structural and civil construction work for Waste Water Treatment Plant is in BHEL Scope. However, bidder shall carry out civil design for Clarifiers, outlet channel and Thickener. For balance, civil input drawings shall be furnished by the bidder during detailed engineering.

8.0 SCOPE OF SERVICES

The bidder's scope also includes following services for scope under this specification:

1) Erection and commissioning, unloading, storage and handling at site.

2) Arrangement of all instruments, reagents, monitoring gadgets for monitoring, & lab facilities to carry out, pre-commissioning, trial run, commissioning, Performance guarantee test & till handover.

3) Monitoring gadgets, instruments and equipment required for maintenance.

4) Minor civil work like chipping of foundation, grouting below base plate for all structures, equipment, grouting of anchor bolts wherever these are not placed in the foundation during casting of foundation itself. Vendor shall ensure to supply all foundation bolts timely so as to facilitate placement of these bolts while casting the foundation.

5) Training of plant Owner's personnel, O&M operators' personnel on plant operation and maintenance.

6) Relevant requirements as per GTR, GCC, ECC & SCC etc

7) Complete grouting for equipment and fixing.

8) All personnel required during maintenance, Commissioning and Performance guarantee test.

9) Trial run for requisite period.

10) Performance guarantee test.

11) Painting shall be as specified in Annexure IX of this technical specification. Bidder to note that paint shed shall be finalized during detailed engineering as per customer & BHEL requirement and any variation in the painting schedule as finally approved by customer shall be taken care by bidder without any commercial and delivery implication.

12) Nonmetallic parts of primary secondary clarifiers & thickener shall be painted for sea worthy application. For details bidder to refer Annexure IX

13) Final touch up paint at site.

14) Operation & maintenance service including manpower, supervision, consumables (expect organosulfide, FeCl3, Lime,PE) etc. for operation & maintenance of Effluent treatment plant (For FGD Waste Water) System for a duration of 6 months after commissioning of Effluent treatment plant (For FGD Waste Water) System for the scope defined as per technical specification, for further details refer annexure-XII.

15) Bidder shall perform the guarantee parameters as per specification requirement to the satisfaction of owner. The exact modalities of verifying guarantee for the parameters indicated in the specification shall be finally as agreed with the owner during detailed engineering & mutually agreed.

16) Any statutory requirement / clearance required for any of the packages from government / local body shall be in bidder's scope.

17) One number Effluent Quality Monitoring System (EQMS) at discharge of FGD WWTP. Required instrumentation is indicated in P & ID.

18) Bidder to attend regular engineering meeting with BHEL and Customer fortnightly in BHEL or Customer office as decided during detail engineering. Vendor will depute his entire concerned engineering representatives along with the project manager for discussion and approval of engineering drawings/ documents during detailed engineering to meet project's various milestones and completion schedule, without any price implication to BHEL and Customer. Meeting can be held at site also.

9.0 TERMINAL POINTS

1) Waste water inlet pipe shall be terminated by BHEL at 20 m from Waste water treatment area. Further Piping from this TP shall be in bidder's scope.

2) 25 NB Instrument air supply at 5 to 7 kg/cm2 (g) – At 20 meter distance from Waste water treatment area. However, distribution and piping inside Waste water treatment area shall be in bidder's scope.

3) 25 NB Service air supply at 5 to 7 kg/cm2 (g) - At 20-meter distance from Waste water treatment area. However, distribution and piping inside Waste water treatment area shall be in bidder's scope.

4) Service water connection (50 NB connections) at 20-meter distance from Waste water treatment area. Piping inside Waste water treatment area for mentioned services will be in bidder's scope.

5) Potable water connection (50 NB connections) at 20-meter distance from Waste water treatment area. Piping inside Waste water treatment area for mentioned services will be in bidder's scope.

6) Treated water pipe shall be terminated by bidder at 20 m from treated water transfer pump discharge header. Further Piping from this TP shall be in BHEL scope.

10.0 EXCLUSIONS

1) All chemicals (lime, organosulfide, $FeCl_3$, PE)

2) Firefighting facilities.

3) AC and Ventilation, However, heat dissipation data for all motors & panels as applicable shall be finished by the bidder during detail engineering for sizing of HVAC equipment.

4) Other exclusions are mentioned in the electrical & C&I parts of this specification.

11.0 QP AND SUB VENDOR APPROVAL

1) The quality assurance plan is enclosed as Annexure-I/ Subsection-IA**.** However requirement of detailed QP, inspection checklist, certificate of conformance etc. for each equipment and sub-vendor shall be finalized during detailed engineering stage; decision of BHEL/customer shall be binding on vendor in this regard. Any changes/additional tests insisted upon by Owner during approval of QAP's shall be accepted by bidder without any commercial and delivery implication to BHEL/Customer. Bidder shall submit the quality plans in BHEL format during detailed engineering stage. Bidder to note further that during detailed engineering all the QAP's/check lists etc. shall be submitted to Customer/BHEL for approval. All inspection & testing etc. shall be carried out accordingly.

2) The sub vendor list enclosed as Annexure-II/Subsection-IA is for bidder's reference and is subject to approval / acceptance by BHEL/ customer. Bidder can propose additional sub vendor with back up documents (experience list, end user certificate as applicable) etc. The same shall subject to BHEL and Customer approval during detailed engineering stage without any technical, commercial & delivery implication to BHEL.

12.0 PERFORMANCE GUARANTEE TEST

The Performance guarantee test shall be as per Annexure-III/Section-I.

13.0 DRAWING/ DOCUMENTS REQUIREMENT

13.0.1 For the Drawings/Documents distribution Procedure, please refer attached Annexure-IV/ Sub Section IA. Bidder has to submit the revised drawing/document along with the compliance sheet indicating enumerate reply to all BHEL and customer comments or observations. Without compliance sheet the submission of the drawings/documents will not be considered and the delay on this account will be solely on bidder's side only. The numbers of soft copies & hard copies of drawing/documents to be submitted by the bidder shall be as per enclosed Annexure-IV/ Sub Section IA.

13.0.2 After award of LOI/LOA, drawing/documents to be submitted by the bidder for BHEL/Customer approval has been indicated in Annexure V/ Sub Section IA. However, any additional drawing/document if found necessary for completion of the engineering, the same shall be submitted by bidder without any commercial & delivery implication to BHEL.

13.0.3 Bidder to note that the successful bidder, during detail engineering, will submit the drg/doc through web based Document Management System in addition to hard copies to be submitted as per the Annexure IV/ Sub Section IA of this specification. Bidder would be provided access to the DMS for drg./doc approval and adequate training for the same. Detailed methodology would be finalized during the kick-off meeting. Bidder to ensure following at their end:

- Internet explorer version – minimum Internet Explorer 7.
- Internet speed – 2 mbps (Minimum preferred).
- Pop ups from our external DMS IP (124.124.36.198) should not be blocked.
- Vendor's internal proxy setting should not block DMS application's link. (http://124.124.36.198/wrenchwebaccess/login.aspx)
- DMS user manuals to be used by BHEL PEM vendors for uploading, viewing, revising, commenting and tracking documents on PEM's DMS have been uploaded on PEM internet website (www.bhelpem.com) under the Vendor session.
- For quick access bidder may refer the link http://bhelpem.com/DMSManuals/DMSManuals.html

14.0 DESIGN/ CONSTRUCTION REQUIREMENTS

14.0.1 Blowers and pumps speed shall be limited to 1500 RPM (max.).

14.0.2 Bidder to select range of operations of pumps shall be 40% to 130% of rated capacity.

14.0.3 Minimum thickness of 6 mm shall be provided for Atmospheric Tanks and Pressure Vessels.

14.0.4 All the tanks shall be provided with vent, overflow, drain and sample connections. Effective capacity for chemical tanks & water retaining structures/ tanks/ sumps means the capacity between the bottoms of the overflow nozzle to the top of the outlet nozzle. Outlet nozzle center line shall be kept at least 200 mm from the Invert Level of the chemical tanks/ water retaining structures/ tanks/ sumps. A minimum free board of 300 mm shall be provided in all the water retaining structures above the maximum water level/ overflow level as the case may be excluding the thickness of the slab / beam thickness if any.

14.0.5 WEIGHING SCALES

a. The weighing scale shall be of platform type, consisting of compound levers, food receptacle in the form of a platform and coupled to a direct reading, dial type indicator.
b. Suitable balancing arrangement shall be provided to take into account daily wear and tear.
c. The platform will be provided with a locking arrangement which will permit placement of the load continuously on it without its weight being transferred to the levers and measuring system. The lock will be released only during taking a reading on the machine.
d. The platform shall be capable of accepting concentrated loading.
e. The weighing scale shall be suitable for weighing miscellaneous chemicals like alum, lime, coagulant aid etc.
f. All graduations in weighing instruments shall consist of notches or uniform lines, sharply defined which may be painted, incised or embossed so that the position of all pointers or sliding poles is easily readable. All number graduations and their subdivision shall be marked by line longer than the minor graduation and the minimum distance between any two considered graduations shall be 1.5 mm. The knife edges shall be of agate or of suitable quality steel. The bearings shall be of suitable quality steel.
g. Knife edges and bearings shall be accurately and firmly secured preferably by shanks and nuts or by bolts and nuts or by set screws. The knife edges and bearings shall be protected against corrosion and dirt. Racks and pinions shall be suitable hard wearing materials and shall be finished smooth.
h. Least account of the dial limits of sensitiveness and greatest error for platform weighing scales shall be as follows: -

Capacity	Least count	Sensitiveness when fully loaded	Greatest error allowed in excess or deficiency when fully loaded	Greatest error allowed in excess or deficiency when quarter of full load is loaded
100 kg	200 gm	10 gm	A weight corresponding to one half of the internal minimum graduation.	Within half the limits of error prescribed for full load.
300 kg	500 gm	60 gm		
500 kg	1 kg	100 gm		
1000 kg	2kg	125 gm		
2000 kg	2kg	250 gm		
3000 kg	2kg	300 gm		

i. Marking sealing and testing shall be provided in line with international standards. The manufacturer shall conduct all test required to ensure equipment conform to the requirements of the applicable codes/ standards. All material test certificates shall be made available to the BHEL & Customer.
j. Certificate of verification local government's controller of weights and measures shall be furnished along with weighing scale.

14.0.6 METERING PUMPS

a. Pumps shall be simplex displacement hydraulically operated diaphragm design, driven by squirrel cage induction motor through suitable speed reduction unit. Maximum pump stroke speed shall not exceed 100 per minute.
b. The stroke shall be continuously adjustable to give a capacity variation 10-100% range while the pumps are running or stopped. Adjustment of capacity shall be done by automatically from remote location and / or manually (micrometric adjusting type) locally for each of the pump as described elsewhere.
c. Capacity variation may be effected by changing eccentricity of the driving crank or by suitable hydraulic circuit. Pump accuracy shall be industry standard + 1% of capacity setting.
d. Pumps shall be provided with an integral relief valve, spring operated, to release pressure when delivery line blockage occurs.
e. Crank case shall be constructed of high quality cast iron which will also house the gear box and guides for cross head.
f. Guided, controlled travel, double-ball check valves or equivalent, shall be provided both on the suction and discharge sides. Suitable gland seal be provided to prevent leakage.

15.0 ADDITIONAL REQUIREMENT

1. Engineering for this project is to be carried out in Integrated Intelligent Engineering environment at BHEL end. For Details Refer Drawings/Documents Requirement & Distribution submission schedule

2. Initial charge of all lubricants & grease.

3. All special tools necessary for proper maintenance or adjustment of the equipment packaged in permanent box. Finish paints for touch-up painting of equipment after erection at site in sealed container.

4. Wherever pipe racks are not available, pipes shall run on pedestals or below ground. All fixing items such as U clamps, nuts, bolts etc. required to lay the pipes on pedestals shall be in bidder's scope of work. Coating, wrapping and protection required for buries pipes shall be in bidder's scope of work.

5. Wherever pipes are running on pipe rack, Bidder will consider 10 m static head + 10% margin, in addition to the losses in straight length and bend in pipes and valves etc. while selection of pump head during detailed engineering.

6. The pumps shall be designed to operate under discharge valve open and close condition.

7. Pump suction valves, re-circulation valves and discharge valves shall be provided with required limit switches for interlock & control.

8. The starting of pumps (wherever applicable) which are provided with forced water lubrication shall be interlocked with the availability of lube water by means of starting of lubrication water pumps, availability of adequate flow, pressure etc. The standby lubrication pump shall be started automatically during inadequate pressure or while tripping of working pump(s).

9. Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.

10. In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion.

11. Bidders shall make Site visit in order to familiarize themselves with existing condition of site before submitting the bid in order to make their offer complete. During detail engineering also, the successful bidder shall be responsible for the correctness of details w.r.t. existing facility at site. Customer approval on any drawing having details of existing facility shall not be cited by the successful bidder a valid reason for any shortcoming in the work by them. BHEL shall also not entertain any cost implication for any lack of input data with regard to site during detail engineering.

12. Final Electrical Load list will be submitted by the successful bidder as per agreed drawing/ doc submission schedule. Thereafter any change in the electrical load list shall be entertained only subject to its feasibility, and BHEL reserves the right to debit the vendor cost of any changes necessitated in the switch gear /MCC on account of changed loads.

13. Electrical scope shall be as per 'Electrical Scope between BHEL and Vendor' enclosed elsewhere in the technical specification. Scope of cables indicated in 'Electrical Scope between BHEL and Vendor' is applicable for control and instrumentation cables also. Screen control cable is meant for electrical as well as signal/ instrumentation cables.

14. The complete system shall be proven and necessary design documentation in support of proveness shall be submitted by the successful bidder in support of the systems, if asked by the customer without any price and delivery implication to BHEL and customer.

15. PRV connection to respective tanks shall be provided by bidder for all dosing (metering/ positive displacement) pumps.

16. All Valve, piping, fitting, and instrument shall be of minimum PN 10/ 150 class rating.

17. Recirculation lines for pumps shall be provided by bidder along with valves, instrumentation, fittings as per system requirement.

18. Wherever CIVIL works is excluded from the bidder's scope, successful bidder shall furnish civil assignment / scope drawings. The corresponding CIVIL drawing prepared by BHEL / CIVIL agency, based on civil assignment drawing of bidder will be furnished to the site for construction. In case any modification is required in the civil work already carried out based on final civil inputs given by vendor, BHEL reserves the right to

debit cost of such rework to vendor".

19. System to be designed to meet all the statutory requirements. Preparation of all necessary drawings/data/ documents for obtaining necessary Approval of statutory authorities like CCOE , IBR , Weight & Measures Department and any other agency/ competent authority ,on behalf of the customer, related to installation of DM plant (if required) is included in bidder's scope. All expenses required to obtain the approval shall also be borne by the successful bidder. Successful bidder shall inform customer well in advance requirement of authority letter along with format for the same. After issuance of authority letter by customer, it will be vendor's responsibility to regularly follow up with the concerned authorities to obtain timely approval from these authorities. Any delay on account of the same, unless any specific information related to above approval to be furnished by customer is delayed by customer, shall be to vendor's account and shall not be used as a reason for extension in contract completion.

20. The MOCs indicated in the Technical Specification, Datasheet and P&IDs for various items/ equipment/ piping/ valves/ fittings are minimum requirement and to be complied by the bidder. However, bidder has to assess it and provide equivalent or better & suitable MOC for wherever applicable, if required.

21. Minor civil work like chipping of foundation, grouting below base plate for all structures, equipment, grouting of anchor bolts wherever these are not placed in the foundation during casting of foundation itself. To the extent possible, vendor shall ensure to supply all foundation bolts timely so as to facilitate placement of these bolts while casting the foundation.

22. Wrapping, coating and protection of all the buried pipe shall be as per IS 10221.

23. Vendor to attend regular engineering meeting with BHEL and customer fortnightly in BHEL or customer office as decided during detail engineering. Vendor will depute all his concerned engineering representative along with the project manager for discussion and approval. Meeting can be held at site also.

24. Bidder to submit BBU during detailed engineering after approval of Basic documents. Incomplete BBU shall not be reviewed by BHEL.

25. Training of plant Owner's personnel, O&M operators' personnel on plant operation and maintenance.

26. Relevant requirements as per GTR, GCC, ECC & SCC.

27. Any statutory requirement / clearance required for the packages from government / local body shall be in bidder's scope. Any change arising out of any new government norms, statutory requirements during the course of execution of the project shall also be complied by the bidder without any commercial implication.

28. Instrument, valves, & piping shown in the flow diagram/ P&IDs are bare minimum requirement. Any additional instrument, valves, and piping required as per system requirement, shall be in the bidders scope.

29. Wherever gravity flow is not possible the bidder shall provide suitable storage & pumping system (2x100%) along with Piping, valves & instrumentation etc to meet the system & process requirement.

30. Service water shall be available near to area at approximately 1.5 to 2.0 Kg/ Cm2. Hence, bidder to take care for cooling/ lubrication of the pumps being supplied by the bidder under this technical specification. If service water pressure requirement is more than available pressure, bidder to consider two (2) nos. cooling pump/lubrication pump.

31. Capacity of monorail hoists, chain pulley block wherever indicated in Datasheet– A are minimum and capacity of such hoists, chain pulley block etc. shall be suitable for handling 125% of maximum weight to be handled during erection and maintenance of the equipments in the pump house, buildings etc. as the case may be.

32. Wherever local instruments for measurement of Flow, Pressure, Level is indicated in the P&ID, Bidder to provide Diaphragm seal type instrument for Chemical (all type and concentration), corrosive, viscous fluids application.

33. Charging platform for all the chemical tanks along with required handrails, accessories etc . Permanent ladder (not rungs) for approaching the top of tanks, valves for All steel inserts plates with lugs, plates, bolts, nuts, sleeves, edge angles and all other embedding components etc as required to grout in civil works and to support/hold the equipment's for opening/maintenance purpose, shall be in bidder's scope.

34. Slings & Lifting lugs shall be provided in all equipment.

35. Provision of laboratory and toilet arrangement (Ladies & Gents) inside chemical house.

36. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.

37. Latest version of all codes and standards to be followed.

38. The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve the vendor from the responsibility of providing such facilities to complete the supply and erection & commissioning of FGD-Waste **Water Treatment.**

39. It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgment is not in full accordance herewith.

40. The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing.

41. The general term and conditions, instructions to tenderer and other attachment referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification are subject to compliance to all attachments referred to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.

42. While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under VOL-III of the specification. In absence of any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of Purchaser / Customer shall prevail and shall be complied by the bidder without any commercial implication on account of the same. Further in case of any missing information in the specification not brought out by the prospective bidders as part of pre-bid clarification, the same shall be furnished by Purchaser/ Customer as and when brought to their notice either by the bidder or by purchaser/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication to BHEL / Customer.

43. Deviations along with cost of withdrawal (positive or negative), if any, should be very clearly brought out clause by clause in the enclosed schedule; otherwise, it will be presumed that the vendor's offer is strictly in line with tender specification & there is no deviation. (Price to be given in sealed envelope only.)

44. In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.

45. The equipment covered under this specification shall not dispatch unless the same have been finally inspected, accepted and shipping release issue by BHEL/Customer.

46. BHEL's/Customer's representative shall be given full access to the shop in which the equipment is being manufactured or tested and all test records shall be made available to him.

16.0 PLANT OPERATION AND CONTROL

Waste Water Treatment Plant shall be controlled from DDCMIS (BHEL Scope) based control system.

The control philosophy of various systems is described below. However, for all the systems, following basic process related interlocks, alarms/ pre-warning signals shall be implemented in the control system as per system requirement.

a) Among the equipment, it shall be possible to select a specific pump or tank or sump for working/standby/ maintenance etc. through control system.

b) Permissive & Interlocks:

(i) Starting & tripping of pumps with respect to liquid level in the respective sump/ tanks or liquid pressure in the suction lines.

(ii) Starting & tripping of agitators with respect to liquid level in the respective sump/tanks.

(iii) Starting & tripping of pumps (which are provided with forced water lubrication) with respect to lubricating water flow (through low pressure/ low flow signal as the case may be).

(iv) Tripping of pumps when the discharge pressure is very high to avoid operation of the pump under shutoff head.

(v) Stopping/ tripping of equipment due to abnormal parameters related to safety of equipment like high vibration, very high bearing lubrication water (and /or oil) temperature to the drive/pumps, very high bearing temperature of the of pump/drive etc. as applicable based on the recommendations of Equipment Supplier.

(vi) Automatic opening of the re-circulation valve to pre-set percentage, in case of failure of opening of pump(s) discharge valve to ensure minimum flow through the pump, as per the recommendation of manufacturer.

(vii) Automatic starting of standby pumps upon failure of starting of selected pump or tripping of running pump as the case may be.

(viii) Capacity of the metering pump shall be controllable from 10-100% continuously by adjusting the stroke length manually by a micro meter dial calibrated for 0–100% of pump capacity integral with the pump.

(ix) Various annunciations related to low level of the chemical tanks & sumps shall be provided.

(x) Alarms/ signals

(xi) Abnormal parameters such as low & high level in tanks/sumps, high pressure at pump discharge, low header pressure, low lubrication water flow to pumps (provided with forced water lubrication system) etc.

(xii) Failure of starting of equipment such as pumps, blowers etc. upon start command.

(xiii) Tripping of equipment due to protection logic.

In addition, the control system shall facilitate the operator to know the status of various equipment (Whether equipment is running or stopped or tripped etc., whether the equipment is selected for operation/ standby duty /maintenance mode etc. as the case may be). Bidder to refer Section IC and IIC for additional requirements.

1.0 SCOPE OF WORK:

Required number of electric hoist / manual hoist of adequate capacity, to meet the erection and maintenance requirements are to be provided for the various areas.

DESIGN CRITERIA

For equipment weighing more than 250 Kg and up to less than 2000 kg with lift less than 10 M, manual hoists (With mono rail/ fixed chain pulley block type as per layout and specific indication elsewhere in this specification) shall be provided. For equipment weighing 2000 kg and more, electric hoists shall be provided. In both the cases if the lifting height is10 m and more, electric hoists shall be provided.

Electric hoist shall be operated from pendent push button. For hand operated hoists, hand chain shall be provided for long travel of trolley and the Hoisting mechanism.

Note;

1. Area, type, capacity mentioned are minimum requirement and shall be finalised during detail engineering without any commercial implication
2. Travel and Lift are layout dependent and shall be finalised during detail engineering without any commercial implication
3. Additional electric/manual hoist required during detail engineering shall be provided as per design criteria given above without any commercial implication.

2.0 SUPPLIES

2.1.0 Design and duty of electric hoist shall be in accordance with IS: 3938 (latest edition). Design and duty of manual hoist shall be in accordance with IS: 3832 (latest edition).

Each electric hoist shall include all necessary items but shall not be limited to the following: -

i. Travelling Trolley
ii. Hoisting mechanism (motor and gear box, wire rope, load hook and hook block)
iii. Electrical equipment (control panel, motor, limit switches)
iv. Flexible trailing cable for motor, brake, limit switches, etc.
v. Painting of hoist.
vi. Power supply thru' DSL including current collector, brackets etc.
vii. O & M Manual, drawings and documents.
viii. Testing of hoist.
ix. Main isolating switch and power cable from 1.5M above ground / operating floor.
x. Any equipment / accessories not specified here but required to make the equipment complete and efficient shall be under bidder's scope of work.
xi. Commissioning spares
xii. Isolating switch
xiii. Maintenance tools & tackles

Each manual hoist shall include all necessary items but shall not be limited to the following:

i. Chain pulley blocks with/without traveling trolleys
ii. Maintenance Tools and Tackles
iii. Painting
iv. Maintenance tools & tackles

2.2.0 Bidder to supply one (1) set of erection & commissioning spares for each capacity hoist along with his main equipment. This shall form part of the main equipment supply.

2.3.0 Services to be provided by the bidder
Packing, forwarding and transportation to site, storage and handling at site.

2.4.0 Erection and Commissioning at site

2.5.0 Functional test (Overload testing, load testing at rated speed, travel and hoisting motion checks as per relevant design standards)

2.6.0 Obtaining clearance and acceptance certificate from the concerned competent authority after site test as applicable. Necessary fees/expenditure as required shall be borne by the supplier.

3.0 Inspection and Testing

As per quality plan approved during detail engineering. Prime inspection agency shall be BHEL. Equipment supplied shall be strictly in accordance with nomenclature & technical specification.

4.0 Runway beam

Shall be supplied by civil contractor

5.0 PAINTING SPECIFICATION

As per painting specification included.

6.0 PACKING

As per packing details specified elsewhere in specification.

7.0 DEMONSTRATION TEST

Hoist along with its drives, controls and other accessories shall be demonstrated for the rated capacity against the rated speed of motions and for the service conditions specified as specified in QAP.

The bidder shall have the full responsibility for the safe and efficient operation of the hoist with associated accessories as a single unit.

If the shop performance tests indicate the failure of any of the components to achieve the guaranteed performance, the deficiency shall be made good at bidder's cost.

Demonstration tests shall be carried out each time after the rectification /modification is carried out.

8.0 TESTING AT SITE

As required for statutory clearance for operating at site with following minimum test i.e., overload and load test.

9.0 DRAWING/DOCUMENT SUBMISSION

The successful bidder shall submit the following drawings / documents during detail engineering for customer's approval /information:

A) MANUAL HOIST (CHAIN PULLEY BLOCK):

Sl. No.	BHEL DRG.NO	DRAWING TITLE
1	PE-V1-483-XXX-A200	Manufacturing Quality Plan
2	PE-V1-483-XXX-A201	GA Drawing for CPB with detail BOM with painting details
3	PE-V1-483-XXX-A202	O & M Manual including erection procedure

B) ELECTRICAL HOIST

Sl. No.	BHEL DRG.NO	DRAWING TITLE
1	PE-V1-483-563-A100	Manufacturing Quality Plan with Sub vendor list
2	PE-V1-483-563-A101	GA Drawing for Electric Hoist, DSL arrangement and painting details
3	PE-V1-483-563-A102	Schematic Circuit Diagram including cable schedule and panel diagram
4	PE-V1-483-563-A103	Mechanism Sizing Calculation
5	PE-V1-483-563-A105	O & M Manual including erection procedure

Notes;

STANDARD NOTES FOLLWOED FOR MAIN PACKAGE SHALL BE APPLICABLE

For submission of required no. of hard copies, please refer main package.

10.0 Inspection and Testing

As per enclosed BHEL standard quality plan. Prime inspection agency shall be BHEL. Equipment supplied shall be strictly in accordance with nomenclature & technical specification. Any additional testing requirement at any stage of inspection deemed necessary by BHEL during detailed engineering shall be carried out without any commercial or technical implication.

11.0. Works Excluded

i. Supply of ISMB monorail.

ii. Purchaser shall provide single point 415V, 3 phase, and 50Hz power feeder at any point of the bay or in the middle of the bay. Vendor shall provide main isolating switch at 1.5 M above the ground / operating floor level and cable required from isolating switch to DSL.

iii. Any other supply required by the bidder shall be arranged by the bidder himself, using suitable transformer as per the specification.

12.0 Deviations

If the offer submitted has got any deviation from the technical stipulations in the tender document, bidder shall tabulate the same in the appropriate “Schedule of Deviations” furnishing full particular of such deviations. Deviations are to be furnished with mention to specific clause number. Reasons / explanations for such deviations shall be furnished. If there are no deviations from the tender document, bidder shall furnish NO DEVIATION CERTIFICATE regarding the same in the schedule of deviation attached with GCC.

13.0 Demonstration Guarantee

Hoist along with its drives, controls and other accessories shall be demonstrated for the rated capacity against the rated speed of motions and for the service conditions specified as specified in QAP. For EH IS 3938 and for CPB IS 3832 to be followed.

The bidder shall have the full responsibility for the safe and efficient operation of the hoist with associated accessories as a single unit.

If the shop performance tests indicate the failure of any of the components to achieve the guaranteed performance, the deficiency shall be made good at bidder’s cost.

Demonstration tests shall be carried out each time after the rectification /modification is carried out.

VOLUME : II-H

SECTION - II

MISCELLANEOUS HOISTS

CONTENT

CLAUSE NO.	DESCRIPTION	PAGE NO.
1.00.00	INTRODUCTION	1
2.00.00	CODES AND STANDARDS	1
3.00.00	SCOPE OF SUPPLY AND SERVICES	2
4.00.00	SPECIFIC PERFORMANCE REQUIREMENTS	2
5.00.00	DESIGN AND CONSTRUCTION	3
6.00.00	INSPECTION AND TESTING	6
7.00.00	DRAWING, DATA AND INFORMATION REQUIRED	7

ATTACHMENT

ANNEXURE-I	LIST OF LOCATIONS FOR MONORAIL HOISTS	8

VOLUME : II-H

SECTION-II

MISCELLANEOUS HOISTS

1.00.00 INTRODUCTION

1.01.00 The hoists will be used for erection and maintenance of various equipment in different buildings under the scope of Flue Gas Desulphurisation Plant Package of existing 2 x 500 MW Tuticorin Thermal Power Station at Tuticorin, Tamil Nadu of NLC Tamil Nadu Power Limited (NTPL).

1.02.00 Hoists are divided into two separate groups - (a) Hand operated and (b) Electric operated. The selection criteria for Electric/manual hoist have been indicated subsequently.

1.03.00 The location and number of hoists is to be finalized during detailed engineering based on selection criteria and layout arrangement. Final arrangement is subject to approval of Owner/Consultant.

1.04.00 Hoists shall be provided in all areas under the scope of this specification (except the areas covered by E.O.T. cranes) where any equipment/ component weighing 250 kg and above is installed, mobile equipment is not accessible to those areas and needs to be handled for maintenance purposes. Number of monorail beams shall be such that the centre line of the hoist and the centre line of equipment to be handled shall be not more than 500 mm.

1.05.00 Monorail hoists shall at least be provided in the areas mentioned in Annexure-I. For areas having space restriction for providing mono rails, fixed type chain pulley blocks suitably fixed on hook is acceptable The list is indicative only and not an exhaustive one.

2.00.00 CODES AND STANDARDS

The design, manufacture and testing of the equipment covered under this specification shall conform to the latest editions of the following Indian Standards:

2.01.00	IS : 3832	:	Specification for Hand Operated Chain Pulley-blocks.
2.02.00	IS : 807	:	Code of Practice for Design, Manufacture, Erection and Testing (Structural Portion) of Cranes and Hoists.
2.03.00	IS : 6216	:	Short link Chain, Grade T(8) for Pulley-blocks & other Lifting Appliances.

2.04.00	IS : 2429 (part -I)	:	Non-calibrated Load Chain for Lifting Purposes.
2.05.00	IS : 15560	:	Point Hook with Shank up to 160 tones - Specification
2.06.00	IS : 3938	:	Specification for Electric Wire Rope Hoists.

and other Indian Standards referred to in the above standards.

3.00.00 **SCOPE OF SUPPLY AND SERVICES**

3.01.00 Scope of work includes supply of the following:

3.01.01 All drive motors and driving gears as necessary.

3.01.02 Limit switches for electrical hoist as necessary.

3.01.03 Trailing cable with all supporting fixtures as necessary for electric hoists.

3.01.04 Pendent control station with all accessories for electric hoists.

3.01.05 Lifting lug, eye bolts etc., for handling hoist parts.

3.01.06 Protection guard as specified.

3.01.07 Lifting hook block assembly for hoists.

3.02.00 For details regarding Scope of Services and works, Lead Specification Volume-IIA of this specification shall be referred.

4.00.00 **SPECIFIC PERFORMANCE REQUIREMENTS**

4.01.00 **Type**

For equipment weighing more than 250 Kg and up to less than 2000 kg with lift less than 10 M, manual hoists (With mono rail/ fixed chain pulley block type as per layout and specific indication elsewhere in this specification) shall be provided.
For equipment weighing 2000 kg and more, electric hoists shall be provided.

In both the cases if the lifting height is10 m and more, electric hoists shall be provided.

4.02.00 **Lifting capacity**

Capacity of each hoist shall be 1.2 times the maximum working load.

4.03.00 **Effort for Mechanical Hoists**

4.03.01 **Hoisting**

Hoisting effort for hoists up to 3 tones capacity shall not be more than 20 kg.

Hoisting effort for hoists above 3 tones capacity shall not be more than 25 kg.

4.03.02 **Trolley Motion**

Effort for trolley motion for hoists upto 3 tonnes capacity shall not be more than 43 Kg.

Effort for trolley motion for hoists above 3 tones capacity shall not be more than 55 Kg.

4.03.03 For Electric operated hoist both hoisting and trolley motion shall be motor operated.

4.04.00 **Lift**

4.04.01 **Lift above operating floor**

Highest position of the hook shall be such that during operation of hoists, the vertical distance between bottom of any equipment handled and top of any permanent structure or equipment in the operating area shall be at least one metre.

4.04.02 **Approach below operating floor**

To be decided by the Bidder for safe and reliable handling of any equipment above 500 Kg below the operating floor.

4.05.00 **Length of monorail hoist**

To be decided by the Bidder depending on the floor and machine layout. The horizontal distance between the centre line of the hoist and centre line of any installed equipment in its operating shall not be more than half metre.

5.00.00 **DESIGN AND CONSTRUCTION**

5.01.00 All parts requiring replacement or lubrication shall be easily accessible without the need for dismantling of other equipment and structures.

Robust construction and ample rating merging which experience has shown to be necessary shall be ensured throughout manufacture.

5.02.00 All components of hoists of identical capacity and duty shall be interchangeable. The hoists of identical capacity and duty shall be identical in all respects unless otherwise required. The hoist design shall be such that these can be quickly removed from one monorail beam and fixed on another beam without disassembling major components.

5.03.00 All machinery and equipment included under this specification must be equipped with safety devices and clearances to comply with recognized standards and specification requirements.

5.04.00 Cast iron parts wherever used, shall conform to IS:210 - FG 260. Also no wood or other combustible materials shall be used.

5.05.00 Defects in material like fractures, cracks, blowholes, laminations, pitting etc. are not allowed. Rectifications of any such flaw are permissible only with the approval of the Purchaser.

5.06.00 Each hoist shall be permanently and legibly stamped with the tag number, manufacturer's name, safe working load, grade of load chain (where applicable), range of lift etc.

5.07.00 Load chain (where applicable) shall be of grade T(8) as per IS:6216 and Hand chain shall be as per IS:2429 (Part-I) grade 30.

5.08.00 Wheels in trolley unit travel shall be single flanged with straight/tapper/barrel shaped tread to suit the monorail. Wheels should be preferably of forged steel construction. Material of construction for wheels of traversing block and hoist gear for hoist used in hazardous areas shall be of non-ferrous material to avoid spark during operation.

5.09.00 All gears shall be hardened and tempered steel with machine out teeth.

5.10.00 **Hoist (Manually Operated)**

5.10.01 Manually operated hoists shall be of spur gear chain pulley block type. It shall be suspended from the trolley by a hook. The design of the hoist shall conform to IS:3832 (Specification for hand operated chain pulley blocks).

The hooks and brakes of hoist shall conform to the requirements stipulated in (a) and (b) below

a) Hooks shall conform to IS:3832. The load hook shall be swiveling type fitted with a locking device.

b) The pulley blocks shall be fitted with an automatic mechanical load brake to prevent self-lowering of load in all working positions. The load brake shall also allow smooth lowering of load without serious overheating.

c) All manually operated hoists, unless stated otherwise, shall be trolley suspended type.

5.10.02 The trolley of hoists shall be manually operated.

5.10.03 The hoists shall be of Mechanism class 2 as per IS:3832.

5.11.00 **Electric Hoist**

5.11.01 Electric hoist shall be electric wire rope trolley suspended type. The design, operation, testing of electric hoist shall conform to IS:3938 (Specification for electric wire rope hoist).

Minimum speed for hoisting shall be 3 m/min. and that of for trolley motion shall be 15 m/min.

5.11.02 Lifting hook shall conform to IS 15560 as applicable.

5.11.03 Wire rope for hoists shall conform to IS-2266.

5.11.04 Electro-mechanical brakes of fail to safety type shall be provided for hoist motion as well as per trolley motion for electrically driven trolley. Load brake shall allow smooth lowering of load and arrangement shall be such as it cannot be released accidentally. Capacity of brake and other relevant data shall conform to IS:3938.

5.11.05 The trolley of the hoists shall be electrically driven.

5.11.06 For other components of hoist such as rope, sheave, drum, bearings, gears etc. stipulations of IS: 3938 shall be followed.

5.11.07 Motor shall be rated for duty S4, CDF 40% and 150 starts per hour. Service class of motor shall be "4" as per IS: 3938. Conditions given in IS:3938 for hoist motor shall be followed over and above the specification of electric motor in Volume II-F.

In case of any contradiction of the aforesaid standard and the motor specification, the conditions, which are more stringent, shall be considered. All the motors shall be suitable for reversing, frequent starting and braking. Motors shall be provided with suitable space heating arrangement.

5.11.08 Hoist shall be designed so that remote control can be effected by means of pendant push button switch from the operating floor. Operation, arrangement etc. of pendant push button switch shall conform to IS: 3938.

5.11.09 Micro-speed attachment in hoist shall be provided if considered necessary by the Bidder.

5.11.10 The hoists shall be of mechanism class 2 as per IS-3938.

5.12.00 Ball and roller bearings of reputed make shall be used throughout.

5.13.00 Suitable lubrication system shall be provided for all gear drives.

5.14.00 **Other Electrical Items**

5.14.01 The cross conductor on monorail for power supply to the hoist shall be of festoon type flexible insulated cable conductors. All fixtures and accessories shall be provided by the Bidder for this purpose.

5.14.02 Necessary insulators, supports, clamps and all other accessories shall be provided as per standard design.

5.14.03 Each hoist shall be provided with a starter panel with protective relays.

5.14.04 One main isolating switch shall be used to cut-off the supply to the hoist assembly.

5.14.05 One main electro-magnetic contactor together with magnetic overload relay (hand reset) for each motor circuit shall be housed in the protection panel.

5.14.06 The operation of overload relay shall interrupt the main magnetic contactor.

5.14.07 Adequate short circuit protection shall be provided for main and individual circuits.

5.14.08 415V ± 10%, 3 Phase, 4 Wire, 50 Hz ± 5%, power supply for the hoist shall be arranged through switch fuse unit mounted at standing height at a convenient location near each hoist. The above switch fuse unit and the connecting cables between switch fuse unit and the cross conductor are included within the scope of this specification.

5.14.09 Transformers to step down the voltage and rectifiers as necessary shall be provided by the Bidder.

5.14.10 All external and internal power, control and auxiliary circuit wiring of the electrical drive and accessories and panels shall be provided. The wiring shall be done with 1100 V grade PVC insulated stranded aluminium conductor cable of suitable size not less than 2.5 sq.mm nominal equivalent copper area of cross-section. All control and auxiliary circuit wiring shall be done with 1100 V grade PVC insulated, 2.5 sq.mm stranded copper conductor. Control wire terminations to the panels shall be made with compression type connectors. Multiway terminal blocks shall be furnished for terminating panel wiring and outgoing cable.

5.14.11 The hoist structure, motor frame and metal cases of all electrical equipment including metal conduit shall be effectively connected to earth. All grounding materials shall be supplied under this specification to grounding risers.

5.14.12 Single speed control shall be used for both hoist and trolley travel in each direction of motion.

5.15.00 Final painting at manufacturer's works shall be provided by the Bidder.

6.00.00 **INSPECTION AND TESTING**

6.01.00 The manufacturer shall conduct all tests required to ensure that the equipment furnished shall conform to the requirements of the specification and in compliance with the requirements of the latest edition of IS: 3832 or equivalent standards for manually operated hoists and shall be as per IS:3938 for electrically operated hoist.

6.02.00 All the mono-rail hoists shall be tested at site as per the stipulation of relevant Indian Standards.

7.00.00 DRAWING, DATA AND INFORMATION REQUIRED

7.01.00 General arrangement drawings incorporating all dimensions information on head rooms, lift, wheel loads, hook suspension arrangement and other relevant data for all the hoists.

7.02.00 Design calculation for selection of electric motor capacities for electric hoist.

7.03.00 Complete list of location, number and capacity of hoists provided.

ANNEXURE-I

QUALITY PLAN

SECTION-11

QUALITY ASSURANCE

11 QUALITY ASSURANCE

Quality System for Inspection & Testing of Plant & Equipment at Manufacturer's Premises

11.1 General

i) Inspection & testing of plant & equipment shall be carried out by NLCIL/NTPL at the works of successful bidder (Contractor/Sub-contractor) during manufacturing and on final product to ensure conformity of the same with acceptable criteria of technical specifications, approved drawings, authenticated manufacturing drawings and reference national / international standards.

ii) This specification is in addition to provisions laid-down elsewhere in Purchaser's Draft Contract and special instructions to tenderers, if any.

iii) Contractor must recognise the importance of quality and follow defined quality programme in all manufacturing and quality control activities of the product. Contractor must define and implement the tasks and controls that shall provide needed assurance in case manufacturing of product is sub contracted either partly or fully and/or for the procured components of the product.

iv) Purchaser/ Consultant reserve the right to verify the quality programme and entire product characteristics to assure the intended and specified quality of the product.

v) The inspection, examination or testing carried out by the purchaser shall not relieve the contractor from any of his obligation under this contract. The inspection procedure shall be discussed and finalised.

11.2 Quality Assurance Plan (QAP)

i) Inspection and test requirements shall be decided with due consideration of factors like safety, duty cycle, operating conditions, equipment life, environmental conditions, place of installation and statutory regulations, as applicable, for a particular equipment.

ii) Detailed QAP shall be prepared by Contractor in consultation with Sub-contractors / Manufacturers to avoid any complication later.

iii) QAP shall clearly indicate the followings:

(a) Range of inspection & tests to be done by Manufacturers and cross checked by Contractor during manufacture of equipment from raw materials to finishing stage.

(b) Suggestive check/ hold points for Purchaser's Inspection and witnessing of tests during the manufacturing and final product inspection.

(c) Inspection documents to be furnished by Contractor/ Manufacturers to Purchaser for reference during inspection.

11.3 Internal Inspection by Contractor / Manufacturer

i) Inspection and tests shall be carried out by Contractor/ Manufacturer in accordance with approved drawings, Tender Specification, Purchase Order, and approved QAP. Contractor/ Manufacturer shall maintain record of each inspection and test carried out and signed documents shall be submitted to purchaser for verification.

ii) Contractor shall carry out their internal inspection & obtain clearance from statutory bodies e.g. IBR, CCE, TAC, Weights & Measures, safety, IE rules etc.However, Purchaser shall carry out inspection as agreed in approved QAP prior to Contractor offering the equipment for statutory clearance.

iii) All the measuring & test instruments shall be calibrated by manufacturers and record of the same shall be maintained for purchaser's scrutiny. Contractor shall ensure use of appropriate calibrated measuring & test instruments during their internal inspection, as well as, make available the same for purchaser's inspection and tests. Calibration standard shall be national standard, if existing. Otherwise, manufacturers' own standard & calibration procedure shall be accepted. Valid calibration certificates traceable to national/ international standards shall be submitted to purchaser during / prior to inspection.

iv) Contractor / Manufacturers shall identify all the inspected equipment/component/raw materials & shall maintain the record of status of inspection viz. inspected & found acceptable, require rectification/rework, rejected etc.

v) The Contractor shall establish and maintain procedures to ensure that product that does not conform to specified requirements, is prevented from inadvertent use or installation. The description of non-conformity that has been accepted subsequently by Designer / Purchaser by concession and/or of repairs, shall be recorded and forms part of the subsequent drawings / schedules relevant to the products.

vi) Repaired and reworked product shall be offered for re- inspection to purchaser along with records of corrective action taken.

vii) Contractor / Manufacturer shall not despatch any equipment till receipt of despatch clearance from purchaser.

11.4 Method of Undertaking Inspection & Testing By Purchaser

11.4.1 Agency Responsible

Inspection/Waiver of equipment shall be undertaken by purchaser.

11.4.2 Method of Issuing Inspection Call to Purchaser

Inspection call shall be given only on readiness of the equipment/ assembly/ sub-assembly and approval of all relevant drawings and QAP. In case, equipment/

assembly/ sub-assembly offered for inspection are found not ready, all the cost of visit of purchaser's engineer shall have to be borne by the Contractor.

11.4.3 Obligations of Contractor

i) Contractor shall provide all facilities and ensure full and free access of the Inspection Engineer of purchaser to the Contractor's or their Sub-Contractor's premises at any time during contract period, to facilitate him to carry out inspection & testing of the product during or after manufacture of the same.

ii) The Contractor shall delegate a Representative / Co-ordinator to deal with purchaser on all inspection matters. Also, Contractor's Representative shall be present during all inspection at Sub-Contractor's works.

iii) The Contractor shall comply with instructions of the Inspection Engineer fully and promptly.

iv) The Contractor / Sub-Contractor shall provide all instruments, tools, necessary testing & other inspection facilities to Inspection Engineer free of cost for carrying out inspection.

v) The cost of testing welds by ultrasonic, radiographic and dye penetration tests etc. in the fabrication workshop shall be borne by the Contractor.

vi) The Contractor shall ensure that the equipment / assembly /component of the plant and equipment required to be inspected, are not dismantled or despatched before inspection.

vii) The Contractor shall not offer equipment for inspection in painted condition unless otherwise agreed in writing by purchaser.

viii) The Contractor shall ensure that the equipment and materials once rejected by the Inspection Engineer, are not re-used in the manufacture of the plant and equipment. Where parts rejected by the Inspection Engineer have been rectified as per agreed procedures laid down in advance, such parts shall be segregated for separate inspection and approval, before being used in the work.

11.4.4 Stamping and issue of inspection documents

i) Inspection Memo

For stage inspection and for rejected items/items which do not conform to Technical specification in one or more quality characteristics requiring rectification/rework, Inspection memo shall be issued in standard form indicating therein the details of observation and remarks. All the non-conformities with respect to specification of the product shall be indicated in the inspection memo for further control by manufacturer.

ii) Inspection Certificate

On satisfactory completion of final inspection and testing, an inspection Certificate in standard form shall be issued by the Inspection engineer for the accepted items.

iii) Inspection Waiver Certificate

For the inspection waiver category of items identified in the approved QAP, Purchaser shall issue Inspection Waiver Certificate.

11.5 General Clauses

i) Inspection& tests carried out by purchaser shall not absolve the responsibility of the Contractor/ Manufacturer to provide acceptable product nor shall it preclude subsequent rejection.

ii) Purchaser reserve the right to inspect any product at any stage of manufacturing without prior notice to Contractor/Manufacturer beyond pre-identified stages & hold points of approved QAP. The inspection mentioned in this clause is meant for Purchaser getting apprised of status of manufacturing and not to obstruct the manufacturing program of the Contractor.

QUALITY ASSURANCE

Items / Components \ Tests/Check	Material Test	WPS/PQR/Welder Qualification	DPT/MPI	Assembly Fit up	Dimension	RT	Hydraulic / Water Fill	Performance Test	Test as per relevant Std/ Appd. Data Sheets	Other Tests	Remarks
1. Horizontal Centrifugal Pumps				Y	Y			Y^1	Y		**LEGENDS:**
1.1. Casing	Y^a		Y^b				Y				Y Applicable
1.2. Impeller	Y^a		Y^b							Y^d	Y^a One per Heat/Heat Treatment batch./Lot
1.3. Shaft	Y^a		Y						Y^c		Y^b On machined surfaces only. Also 100% on Butt Welds & 10% on Fillet Welds.
2. Vertical Pumps				Y	Y			Y^1	Y		Y^c UT shall be done for shafts with Dia 50 mm or above & Plates of Thickness 20 mm or above.
2.1. Casing	Y^a		Y^b				Y				Y^d Dynamic Balancing per ISO: 1940, Grade 6.3 minimum.
2.2. Impeller	Y^a		Y^b							Y^d	
2.3. Shaft	Y^a		Y						Y^c		Y^1 As per HIS, USA.
2.4. Fabricated Parts	Y^a	Y	Y^b			Y^2	Y				Y^2 10% RT to be conducted on butt welds for Thk $\geq$10 mm.
3. Dosing/ Metering Pumps	Y^a						Y	Y^1	Y		Y^3 Seat Leakage Test for actuator operated valves shall be done by closing the valve with job actuator.
4. Gate/ Globe/ Check Valves	Y^a		Y^b		Y		Y	Y	Y	Y^6	Y^4 Tests on Rubber Diaphragms per batch of Rubber mix such as Tensile, Elongation, Hardness, Thickness, Bleed Resistance, Flex Test for 1500 cycles etc. shall be conducted. In addition, Type Test for 50,000 cycles for each type of diaphragm shall also be conducted, if not carried out earlier.
5. Dual Plate Check Valves	Y^a		Y^b		Y		Y	Y	Y	Y^{12}	
6 Diaphragm Valves	Y^a				Y		Y^3		Y	Y^4	
6. Butterfly Valves (Low Pr.)				Y	Y		Y^3	Y		Y^5	Y^5 Seat Leakage Test is required to be done in both directions. Disc strength test as per relevant code shall be carried out.
7.1Body (Cast)	Y^a		Y^b								
7.2Disc (Cast)	Y^a		Y^b								
7.3 Shaft	Y^a		Y^b							Y^c	
8. Plug/ Ball Valves (Low Pr.)	Y^a		Y^b	Y	Y		Y	Y	Y		Y^6 Blue Matching, Wear Travel for Gate Valves, reduced pressure test for check valves shall be conducted per relevant standards.
9. Blowers	Y^a		Y^b	Y	Y		Y	Y	Y	Y^{dc}	
10. Atmospheric Storage Tanks/ Pressure Vessels	Y^a	Y	Y^b	Y	Y	Y^8	Y		Y^c	Y^7	

QUALITY ASSURANCE

Items / Components \ Tests/Check	Material Test	WPS/PQR/Welder Qualification	DPT/MPI	Assembly Fit up	Dimension	RT	Hydraulic / Water Fill	Performance Test	Test as per relevant Std/ Appd. Data Sheets	Other Tests
11. Rubber lining	Y^a				Y				Y	Y^9
12. Reactor Clarifier	Y^a	Y	Y^b	Y	Y				Y	Y^{10}
13. Clariflocculator/ Plate or Tube Settler	Y^a			Y	Y				Y	
14. Hoists & Cranes	Y^a	Y	Y^b	Y	Y	Y^8		Y	Y	
15. Chlorine Tonner	Y^a	Y	Y^b	Y	Y	Y^8	Y			
16. Chlorine Evaporator	Y^a	Y	Y	Y	Y	Y	Y			
17. Chlorinator & injector	Y^a			Y	Y		Y	Y		
18. Agitators /Flash Mixer/ Flocculator	Y^a	Y	Y^b	Y	Y			Y		Y^{10}
19. Pipes	Y^a	Y		Y	Y		Y		Y	
20. Ventilation/Exhaust Fan	Y^a		Y^b	Y	Y			Y^{11}	Y	Y^{dc}

After erection, the complete Piping system along with valves & fittings shall be hydraulically tested.

Remarks

Y' Heat Treatment of the Tank/Vessel shall be done per fabrication code requirement. Welded dished ends shall be stress relieved. Dished ends manufactured by cold working shall be stress relieved as per the requirement of code.

Y^8 RT as per fabrication code requirements. However, dished ends welds, if manufactured by using welded plates shall be subjected to 100% RT.

Y^9 Rubber Lining Mix shall be subjected to Bleed Resistance Test on mould sample. Adhesion Test, Spark Test and Hardness Test for the Rubber lined jobs shall also be conducted.

Y^{10} Gear Boxes shall be checked for smooth No Load Operation at shop to verify noise and vibration levels. Gear Ratio and Kerosene Leak Test shall also be conducted.

Y^{11} One Fan of each type & size shall be routine performance tested as per corresponding code fir air flow, static pressure, total pressure, speed, efficiency, power consumption, noise & temperature rise. Also all Fans shall be subjected to run test of 4 hours during which noise, vibration, temperature rise and current drawn shall be measured.

Y^{12} Blue Matching, reduced pressure test for check valves shall be conducted per relevant standards. Dry cycle test on valve spring for 100000 cycles shall be carried out as type test, if not carried out earlier, for the similar MOC, size and type of spring.

NOTE:- Category of inspection for items / equipment shall be decided by BHEL only during detailed engineering. All the inspection shall be carried out by BHEL or its designated agency only.

Notes:

1. Heat Treatment shall be done as per ASME code.
2. Bleeding Resistance tests shall be done by keeping the sample in 33% HCl, 48% NaOH and DM Water for 72 Hrs.
3. Hydro Test shall be conducted, before Rubber lining.
4. As per code requirements.
5. As per HIS, USA.
6. Hydro test of body before Rubber lining. Seat Leakage test for Actuator operated valves shall be done by closing the Valves with Job Actuator.
7. Tests on Rubber parts such as Diaphragms shall be done per batch of Rubber mix, such as Tensile, Hardness, Adhesion, Spark Test, Bleed Resistance test and Flex test. Life Cycle test for Diaphragms for 50000 cycles etc shall also be done.
8. Hydro Test of Body, Seat & Disc Strength shall be carried out in accordance with latest edition of AWWA C-504 Standard. Proof of Design Test in accordance with latest edition of AWWA C-504 Standard shall also be carried out, if not carried out earlier. Seat Leakage test for Actuator operated valves shall be done by closing the Valves with Job Actuator. Seat leakage test shall be carried out in both directions.
   a) One per Heat/Heat Treatment batch/Lot
   b) On machined surfaces only.
   c) UT shall be done for shafts with Dia 50 mm or above.
9. For all other Misc. items, refer Table on LP piping.
10. Quality requirements specified here if contradicting as specified elsewhere in this chapter, then stringent quality requirements shall be followed by the bidder for all items without any price and delivery implications to BHEL/customer.
11. Quality requirements mentioned here in this annexure for different mechanical, electrical and C&I items are bare minimum, if any other quality requirements required for these items as per BHEL & customer during detail engineering the same shall be accepted and provided by bidder without any price and delivery implication to BHEL & customer.

		MANUFACTURERS NAME & ADDRESS		STANDARD QUALITY PLAN				PROJECT					
		AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE				WIRE ROPE ELECTRIC HOIST	
						REV	0	CONTRACT No					
						DATE		CONTRACTOR				BHEL	
						PAGE	1 of 4						
Sl.No	COMPONENT & OPERATIONS	CHARACTERISTICS	CATEGORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
									D*	M	C	N	
1	2	3	4	5	6	7	8	9		**	10		11
1.0	**RAW-MATERIALS**												
1.1	a) STRUCTURAL MATERIAL b) RAW MATERIAL FOR HOIST AND GEAR BOX HOUSEING, TROLLEY PLATE (AS APPLICABLE)	MECH. , CHEM. PROPS	MA	CHEMICAL COMPOSITION AND TENSILE STRENGTH	1 / lot	APPD. DRG./ DATA SHEET	APPD. DRG./ DATA SHEET	Mill.s TC	√	V	V	V	Test shall be carried out in absence of mill TC
1.2	GEARS, SHAFT/AXLES, WHEELS	MECH , CHEM. PROPS	MA	CHEMICAL COMPOSITION, HARDNESS (DURING IN-PROCESS)	I / LOT	APPD. DRG./ DATA SHEET	APPD. DRG./ DATA SHEET / IS:3938	LAB. REPORT / MANUFACTURER'S TEST CERTIFICATE	√	P	V	V	In case the items are not manufactured in-house, the manufacturer's test certificate shall be submitted for chemical composition
		U.T FOR DIA/THK > 50mm	CR	NDT	100%	ASTM A 388	NOTE 4	IR	√	P	V	V	
1.3	WIRE ROPE	Dimensional CHECK	MI	Dia.	100%	APPD. DRG./ DATA SHEET	APPD. DRG./ DATA SHEET	MTC	√	P	V	V	
		BREAKING LOAD CAPACITY	CR	BREAKING LOAD	100%	APPROVED DRG/DATA SHEET / IS: 2266	APPROVED DRG/DATA SHEET AND / IS:2266	MTC	√	P	V	V	
1.4	HOOKS	PHYS./ MECH. , CHEM. PROPS.	MA	CHEMICAL COMPOSITION, HARDNESS	I / LOT	APPROVED DRG/DATA SHEET / IS:3938 / IS:15560	APPROVED DRG/DATA SHEET / IS:3938 / IS:15560	MTC	√	P	V	V	
		U.T IF SHANK DIA > 50mm	CR	NDT	100%	ASTM A 388	NOTE 1	IR	√	P	W	V	**SHANK PORTION ONLY**
		PROOF LOAD CAPACITY	CR	PROOF LOAD TEST	100%	APPROVED DRG/DATA SHEET / IS:3938 / IS:15560	APPROVED DRG/DATA SHEET / IS:3938 / IS:15560	IR	√	P	W	V	
		DP AFTER PROOF LOAD	CR	NDT	100%	ASTM E-165	NO CRACKS	IR	√	P	V/W	V	
2.0	**IN-PROCESS**												
2.1*	WELDING PROCEDURE SPECIFICATION	CORRECTNESS	MA	SCRUTINY	100%	IS:7307 / ASME SEC IX	IS:7307 / ASME SEC IX	FORMAT OF IS / ASME SEC IX		P	V	V	
2.2*	PROCEDURE & WELDER QUALIFICATION	WEDLING PARAMETRES	MA	PHYS. TESTS/RT	100%	IS:7310 / ASME SEC IX	IS:7310 / ASME SEC IX	AS PER ASME SEC IX	√	P	W	W	IN CASE OF LLOYDS / EIL / TPL QUALIFIED WELDERS AVAILABLE, REQUALIFICATION OF WELDER IS NOT REQUIRED
			LEGNDS										
			* RECORDS INDENTIFIED WITH 'TICK'(√) SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION										
			** M: MANUFACTURER/SUBCONTRACTOR										
MANUFACTURER/ SUB CONTRACTOR		CONTRACTOR	C: CONTRACTOR NOMINATED INSPECTION AGENCY(BHEL) N: CUSTOME										
			INDICATE 'P' PERFORM"W" WITNESS AND "V" VERIFICATION AS APPROPRIATE " CHP" CUSTOMER SHALL IDENTIFY IN COLUMN"N"										
SIGNATURE							REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY &SEAL					

		MANUFACTURERS NAME & ADDRESS		STANDARD QUALITY PLAN				PROJECT					
		AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE				WIRE ROPE ELECTRIC HOIST	
						REV	0	CONTRACT No					
						DATE		CONTRACTOR				BHEL	
						PAGE	1 of 4						
Sl.No	COMPONENT & OPERATIONS	CHARACTERISTICS	CATEGORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
									D*	M	C	N	
1	2	3	4	5	6	7	8	9		**	10		11
2.3*	WELD SET UPS	DIMENSIONS	MA	MEAS. , VISUAL	100%	WPS, APPD. DRG.	WPS, APPD. DRG.	IR		P	V		
2.4*	WELDMENTS –FINAL RUN	SURFACE DEFECTS	MA	PT	100%	IS:3658 / ASTME:165	ASME SEC. VIII DIV. I	IR	√	P	**V**	V	
2.5	**TRUNION / TROLLEY WHEELS**, GEARS PINION	SURFACE & INTERNAL FLAWS (**FOR DIA. / THICKNESS >50MM)**	MA	PT / **UT**	100%	ASTME:165	NO LINEAR DEFECTS / **NOTE-4**	IR	√	P	W	V	
2.6	NDT OF LOAD BEARING BUTT WELDS (**IF ANY)**	WELD QUALITY OF a)Butt weld on tension 100% RT and 100% DPT b)Butt weld oncompression 10% RT and 100% DPT c)Butt weld on rope drum 100%	CR	PT & RT	100%	ASME SEC. VIII DIV. I	ASME SEC. VIII DIV. 4 . CLUW-51 FOR RT APPENDIX -8 FOR PT	IR AND FILM	√	P	V	V	FILMS TO BE REVIEWED BY BHEL & Customer. DPT SHALL BE CHP FOR Customer & BHEL
2.7	**GEAR BOXES**												
	COMPLETE ASSEMBLY	OVERALL DIMENSIONS	MA	MEAS.	100%	MFG. DRG.	MFG. DRG.	IR	√	P	V		
	Gear shall be checked for reduction ratio, backlash & contact pattern.	CHECK FOR OIL LEAKAGE, VIBRATION, NOISE TEMP. RISE	MA	NO LOAD RUNNING FOR TWO HOURS	100%	MFG. DRG.	MFG. STD.	- DO -	√	P	V	V	
2.8	**ELECTRICALS**												
1	MOTORS	ROUTINE TESTS		ROUTINE TESTS	100%	IS 325	IS 325	DO	√	P	V	V	
2	RESISTANCES (IF APPLICABLE)	TEMPERATURE RISE	MA	VERTIFICATION OF MNFRS' TEST CERT.	100%	IS:3938, RELV. ISS	IS:3938, RELV. ISS	MTC.	√	P	V	V	
3	CONTROLLER, LIMIT SWITCHES (IF APPLICABLE)	ROUTINE TESTS	MA	ROUTINE TEST	100%	IS:6975/TECH. SPEC.,	IS:6875/TECH. SPEC.,	MTC.	√	P	V	V	Rating and make to be verified.
4	BRAKES	ROUTINE TESTS	MA	ROUTINE TEST	100%	TECH. SPEC. / IS:15560	IS:3938/TECH. SPEC.	MTC.	√	P	V	V	
5	BRAKE DRUM (IF APPLICABLE)	VERIFICATION OF HT CHARTS, HARDNESS (IF APPLICABLE)	MA	VISUAL, HARDNESS TEST	100%	APPD. DRGS./TECH. SPC.	APPD. DRGS./TECH. SPEC.	HT. CHART /IR	√	P	V	V	
6	CONTACTOR	ROUTINE TESTS	MA	ROUTINE TEST	100%	IS:2959 AND TECH. SPEC., IS:6547 / IS:3938	IS:2959 AND TECH. SPEC., IS:6547 / IS:3933	IR	√	P	V	V	Rating and make to be verified.
			LEGNDS										
			* RECORDS INDENTIFIED WITH 'TICK'(√) SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION										
			** M: MANUFACTURER/SUBCONTRACTOR										
MANUFACTURER/ SUB CONTRACTOR		CONTRACTOR	C: CONTRACTOR NOMINATED INSPECTION AGENCY(BHEL) N: CUSTOME										
			INDICATE 'P' PERFORM"W" WITNESS AND "V" VERIFICATION AS APPROPRIATE " CHP" CUSTOMER SHALL IDENTIFY IN COLUMN"N"										
SIGNATURE							REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY &SEAL					

		MANUFACTURERS NAME & ADDRESS		STANDARD QUALITY PLAN				PROJECT					
		AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE					WIRE ROPE ELECTRIC HOIST
						REV	0	CONTRACT No					
						DATE		CONTRACTOR					BHEL
						PAGE	1 of 4						
Sl.No	COMPONENT & OPERATIONS	CHARACTERISTICS	CATEGORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
									D*	M	C	N	
1	2	3	4	5	6	7	8	9		**	10		11
7	CONTROL PANEL, PENDANT SWITCH	* FIXING OF COMPONENTS WIRING MARKING CONTINUITY * FUNCTIONAL TEST * IR & H.V. TEST * IP - PROTECTION TEST * PAINT SHADE, THICKNESS, SHEET	MA	VISUAL	100%	APPD.DRG. WIRING DIAGRAM,	APPD. DRG. WIRING DIAGRAM,	IR	√	P	V	V	BOUGHT OUT ITEMS AS PER BHEL / CUSTOMER APPROVAL LIST
8	CABLES	TYPE AND ROUTINE TESTS	MA	TYPE & ROUTINE TESTS	100%	AS PER TECH. SPEC. IS:1554/IS:9968- PART - I / IS:694 / RELEVANT IS FOR FRLS CABLES	AS PER TECH. SPEC. IS:1554/IS:9968-PART - I / IS:694	MNFRS' TEST CERT.	Ö	P	V	V	
3.0	FINAL INSPECTION												
3.1	COMPLETELY ASSEMBLED HOIST	1. COMPLETENESS, CORRECTNESS, OVERALL DIMENSIONS	MA	VISUAL, MEAS	100%	APPD. DRG.	APPD. DRG.	MNFRS' TEST CERT.	√	P	W	V	
3.2	ASSEMBLED HOIST PERFORMANCE	1. LOAD TEST	CR	LOAD TEST at SWL	100%	IS:6547 / IS:3938	IS:6547 / IS:3938	MNFRS' TEST CERT.	√	P	W	V	
		2. HOISTING & LOWERING SPEED, PERFORMANCE OF CONTROLLERS SWITCHES CONTRACTORS, RELAYS AND OTHER CONTROL DEVICES CORRELATIONS OF CIRCUITS AND INTERLOCKS AND SEQUENCES OF OPERATION	CR	MEAS & VISUAL	100%	IS:6547 / IS:3938, TECH SPEC.	TECH SPEC.	MNFRS' TEST CERT.	√	P	W	V	
		3. OPERATION OF ALL PROTECTIVE DEVICES	CR	VISUAL	100%	TECH SPEC	TECH SPEC.	MNFRS' TEST CERT.	√	P	W	V	
3.3	OVER LOAD TEST	1. OVER LOAD	CR	TEST AT 125 % OF SWL	100%	IS:6547/IS:3938	IS:6547/IS:3938	IR	√	P	W	V	
4	PAINTING												
1	PRIMER & FINISHING AND SHADE	1. TO RELEVANT IS	MI	CORRECTNESS OF MFG. TEST CERT.	EACH CONSIGNMENT	DRG. & DATA SHEET & RELV. IS SPEC.	DRG. & DATA SHEET & RELV. IS SPEC.	MNFRS' TEST CERT.		P	V		
	NOTE:												
	*** 1.0 Clause from 2.1 to 2.4 shall be applicable for load bearing welded joints.**												
	2.0 Back Wall Echo shall be adjusted to 100% of Full Screen Height in sound (Defect Free) Area. Defect Echo Height more than 20% of Screen Height shall be treated as unacceptable. Back Wall Echo shall not be less than 80% of Screen Height in any case.												
			LEGNDS										
			* RECORDS INDENTIFIED WITH 'TICK'(√) SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION										
			** M: MANUFACTURER/SUBCONTRACTOR										
MANUFACTURER/ SUB CONTRACTOR		CONTRACTOR	C: CONTRACTOR NOMINATED INSPECTION AGENCY(BHEL) N: CUSTOME										
SIGNATURE			INDICATE 'P' PERFORM"W" WITNESS AND "V" VERIFICATION AS APPROPRIATE " CHP" CUSTOMER SHALL IDENTIFY IN COLUMN"N"				REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY &SEAL					

	MANUFACTURER'S NAME & ADDRESS :	**MANUFACTURING QUALITY PLAN** **ITEM :** Chain Pulley Block **QP No.:** PE-TS-XXX-XXX-A001 **REV**.:0, **Date.:, PAGE**: 1 OF 4	**PROJECT :** **PACKAGE : CHAIN PULLEY BLOCKS** **VOL IIB, SEC C**

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY M	AGENCY C	AGENCY N	REMARKS
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.			11.
1	**RAW MATERIAL & B/OUT ITEMS:**											
1.1	HOOKS	DIMENSIONS,	MA		One sample	IS: 15560	IS: 15560	MTC	P	V	V	UT FOR SHANK DIA 50MM AND ABOVE
		CHEMICAL COMPOSITION, MECHANICAL, PHYSICAL PROPERTIES	MA	LAB ANALYSIS	PER LOT	Material specification as per approved drawings		T.C.	P	V	V	
		IDENTIFICATION & COMPLIANCE WITH TC.	MA	VISUAL	100%	HOOK TC FROM COMPETENT AUTHORITY		IR	P	V	V	
		INTERNAL DEFECTS	MA	UT	100%	ASTM A-388 (REFER NOTE 1)		TC	P	V	V	
		PROOF LOAD TEST	MA	REVIEW	100%	IS 15560		TC	P	V	V	
		NDT AFTER PROOF LOAD	MA	DPT	100%	ASTM E-165	NO RELEVANT IDENTIFICATION	TC	P	V	V	
1.2	LOAD CHAIN	- DIMENSIONS	MA	MEASUREMENT	100 %	IS: 6216 &	IS: 6216 &	IR	P	V	V	
		- BREAKING STRENGTH	MA	-TENSILE TEST	1/LOT	APPD. DRGS.	APPD. DRGS.	MTC	P	V	V	
		- PROOF LOAD	MA	-TENSILE TEST	100%			MTC HT	P	V	V	
		-HEAT TREATMENT	MA	REVIEW	100%			CHART	P	V	V	
		-GRADE	MA	REVIEW	1/BATCH			MTC	P	V	V	
1.3	RAW MATL. FOR GEAR/ RATCHET PAWL / RATCHET WHEEL	CHEMICAL COMPOSITION, MECHANICAL PROPERTIES	MA	LAB ANALYSIS	ONE SAMPLE PER LOT	MATERIAL SPECIFICATION AS PER	MATERIAL SPECIFICATION AS PER	MTC	P	V	V	TC or inspection report for components

	LEGEND:	FOR CUSTOMER USE	
MANUFACTURER / CONTRACTOR SUB-CONTRACTOR	** M : MANUFACTURER / SUB-CONTRACTOR C : BHEL / NOMINATED INSPECTION AGENCY. N : CUSTOMER INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION		
SIGNATURE		REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL

	MANUFACTURER'S NAME & ADDRESS :	**MANUFACTURING QUALITY PLAN** **ITEM :** Chain Pulley Block **QP No.:** PE-TS-XXX-XXX-A001 **REV**.:0, **Date.:, PAGE**: 2 OF 4	**PROJECT :** **PACKAGE : CHAIN PULLEY BLOCKS** **VOL IIB, SEC C**

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
									M	C	N	
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.			11.
						APPROVED DRAWING	APPROVED DRAWING					shall be given.
		INTERNAL DEFECTS	MA	UT	10%	ASTM A-388 (REFER NOTE 1)		IR	✓	P	V	V	
1.4.	LOAD CHAIN WHEELS	- CHEMICAL COMPOSITION MECHANICAL PROPERTIES	MA MA	CHEMICAL MECHANICAL PROPERTIES	ONE SAMPLE PER LOT	APPD. DRG.	APPD. DRG.	MTC	✓	P	V	V	
1.5	BEARINGS	MAKE, TYPE, CATALOGUE NO.	MA	VISUAL	RANDOM	APP DRG / MFR"S CATALOGUE	APP DRG / MFR"S CATALOGUE	IR	✓	P	V	V	
1.6	HAND CHAIN WHEEL	CHEMICAL MECHANICAL PROPERTIES	MA	CHEMICAL MECHANICAL PROPERTIES	ONE SAMPLE PER LOT	AS PER DRAWING	AS PER DRAWING	MTC	✓	P	V	V	
1.7	HAND CHAIN	GRADE/ DIMENSION	MA	GRADE DIMENSION	100 %	AS PER DRAWING	AS PER DRAWING	MTC	✓	P	V	V	
1.8	TROLLEY GEARS, PINION,WHEELS, AXLE	CHEMICAL & MECHANICAL	MA	LAB ANALYSIS,	100%	APPVD DRGS	APPVD DRGS	IR/TC	✓	P	V	V	
2	**IN PROCESS**											
2.1	RATCHET PAWL / RATCHET WHEEL	-HARDNESS	MA	HARDNESS	100%	IS:3832 / APPD DRG.	IS:3832/ APPD. DRG.	IR	✓	P	V	V	

	LEGEND:	FOR CUSTOMER USE	
MANUFACTURER / CONTRACTOR SUB-CONTRACTOR	** M : MANUFACTURER / SUB-CONTRACTOR C : BHEL / NOMINATED INSPECTION AGENCY. N : CUSTOMER INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION		
SIGNATURE		REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL

	MANUFACTURER'S NAME & ADDRESS :	**MANUFACTURING QUALITY PLAN** **ITEM :** Chain Pulley Block **QP No.:** PE-TS-XXX-XXX-A001 **REV**.:0, **Date.:, PAGE**: 3 OF 4	**PROJECT :** **PACKAGE : CHAIN PULLEY BLOCKS** **VOL IIB, SEC C**

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
									M	C	N	
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.			11.
		-SURFACE CRACK	MA	DPT	100 %	ASTM E165	NO DEFECT	IR	✓	P	V	V	
2.2	GEARS AND PINIONS AFTER MACHINING	SURFACE HARDNESS HEAT TREATMENT, SURFACE CRACK, CASE DEPTH	MA	HARDNESS HT CHART, DPT FOR SURFACE CRACK	RANDOM ASTM E 165 FOR DPT	MFG STANDARD NO DEFECT	MFG STANDARD	IR IR	✓ ✓	P P	V V	V V	
3.0	**FINAL INSPECTION**												
3.1	COMPLETE ASSEMBLY	OVERALL DIMENSION	MA	MEASUREMENT	100 %	IS:3832 /APPD DRG	IS:3832 /APPD DRG	IR	✓	P	W	V	
		PROOF LOAD TEST	CR	LOAD TEST	100%	-DO-	No cracks, flaws & other defects	IR	✓	P	W	V	
		LIGHT LOAD TEST	MA	LOAD TEST	100%	IS 3832	IS 3832	IR	✓	P	W	V	
		HEIGHT OF LIFT	MA	MEASUREME NT	100%	-DO-	-DO –	IR	✓	P	W	V	
		SWIVELING OF HOOK	MA	VISUAL	100 %	-DO-	-DO-	IR	✓	P	W	V	
		EFFORT	MA	PULL ON CHAIN	100%	-DO-	-DO-	IR	✓	P	W	V	
3.2	PAINTING	-CLEANING	MA	VISUAL	AT RANDOM	APPROVED	APPROVED	IR		P	--	--	
		- SHADE & DFT OF PAINT (Blue / Black)	MI	VISUAL	AT RANDOM	DRAWING/ SPECIFICATION	DRAWING/ SPECIFICATION	IR		P	W	-	

	LEGEND:	FOR CUSTOMER USE	
MANUFACTURER / CONTRACTOR SUB-CONTRACTOR	** M : MANUFACTURER / SUB-CONTRACTOR C : BHEL / NOMINATED INSPECTION AGENCY. N : CUSTOMER INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION		
SIGNATURE		REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL

	MANUFACTURER'S NAME & ADDRESS :	**MANUFACTURING QUALITY PLAN** **ITEM :** Chain Pulley Block **QP No.:** PE-TS-XXX-XXX-A001 **REV**.:0, **Date.:, PAGE**: 4 OF 4	**PROJECT :** **PACKAGE : CHAIN PULLEY BLOCKS** **VOL IIB, SEC C**

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
									M	C	N	
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.			11.
3.3	NAME PLATE	VERIFICATION	MA	VISUAL	100%			IR		P	V	--	
3.4	PACKING	-VERIFICATION	MI	VISUAL	100%	SPECS.	SPECS.	IR		P	--	-	
3.5	REVIEW OF QA DOCUMENTATION	VERIFICATION	MA	VISUAL	100%	APPD. QP	APPD. QP		✓	V	V	V	

CR – CRITICAL, MA – MAJOR , MI – MINOR

NOTE 1: BACK WALL ECHO SHALL BE ADJUSTED TO 100% OF FULL SCREEN HEIGHT IN SOUND (DEFECT FREE) AREA. DEFECT ECHO HEIGHT MORE THAN 20% OF SCREEN HEIGHT SHALL BE TREATED AS UNACCEPTABLE. BACK WALL ECHO SHALL NOT BE LESS THAN 80% OF SCREEN HEIGHT IN ANY CASE.
NOTE 2: RECORDS IDENTIFIED WITH TICK SHALL BE ESSENTIALLY INLCUDED IN QA DOCUMENTATION.

	LEGEND:	FOR CUSTOMER USE	
MANUFACTURER / CONTRACTOR SUB-CONTRACTOR	** M : MANUFACTURER / SUB-CONTRACTOR C : BHEL / NOMINATED INSPECTION AGENCY. N : CUSTOMER INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION		
SIGNATURE		REVIEWED BY	NAME & SIGN OF APPROVING AUTHORITY & SEAL

ANNEXURE II

SUB-VENDOR LIST

LIST OF MAKES OF SUB-VENDOR ITEMS

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
1.	PRESSURE VESSELS	GLOBAL STRUCTURES & COMPOSITE LTD	-	
		JASMINO POLYMERTECH	TALOJA	
		SYSCON ENGINEERS	AMBERNATH	
		S.V. FABRICATORS	NAVI MUMBAI	
		SPARK FABRICATORS / STEELCON	-	
		ANUP ENGINEERING	AHMEDABAD	
		MURTHAL TANKS & VESSELS	SONEPAT	
		TITAN ENGG.	DURGAPUR	
		RISHI INDUSTRIES	BAHALGARH	
		UNIVERSAL HEAT EXCHANGERS	-	
		ATS CHEM	SALEM/HOSUR	
		CHEM PROCESS SYSTEM	SANAND	
		PROGEN	CHENNAI	
		CRYSTAL ENGINEERING	HOSUR	
		ISHAN EQUIPMENTS	VADODARA	
2.	ATMOSPHERIC/ STORAGE TANKS	GLOBAL STRUCTURES & COMPOSITE LTD	-	
		JASMINO POLYMERTECH	TALOJA	
		SYSCON ENGINEERS	AMBERNATH	
		S.V. FABRICATORS	NAVI MUMBAI	
		SPARK FABRICATORS / STEELCON	-	
		ANUP ENGINEERING	AHMEDABAD	
		MURTHAL TANKS & VESSELS	SONEPAT	
		TITAN ENGG.	DURGAPUR	
		RISHI INDUSTRIES	BAHALGARH	
		UNIVERSAL HEAT EXCHANGERS	-	
		ATS CHEM	SALEM/HOSUR	
		CHEM PROCESS SYSTEM	SANAND	
		PROGEN	CHENNAI	
		CRYSTAL ENGINEERING	HOSUR	
		ISHAN EQUIPMENTS	VADODARA	
3.	RUBBER LINING (AT SHOP)	TEMSEC	KOLKATA	
		RISHI INDUSTRIES	SONEPAT	
		CORI ENGINEERS	CHENNAI	
		POLY RUBBER	MUMBAI	
		INDUSTRIAL LINING	VADODARA	
		ARUL RUBBERS	CHENNAI	
		JASMINO POLYMERTECH	TALOJA	

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		WESTERN RUBBER	NAVI MUMBAI	
		ELASTOMER LINNING	AMBERNATH	
		EMKAY RUBBER	MUMBAI	
4.	AIR BLOWERS (TWIN LOBE TYPE)	SWAN PNEUMATIC	NOIDA	
		EVEREST TRANSMISSION	NEW DELHI	
		KAY INTERNATIONAL	NEW DELHI / SONEPAT	
		EVEREST BLOWER	BAHADURGARH	
		KULKARNI POWER TOOLS	KOLHAPUR/ PUNE	
5.	METERING PUMPS	VK PUMPS	NASIK	
		MILTON ROY INDIA	CHENNAI	
		SWELLORE	AHMEDABAD	
		POSITIVE METERING PUMPS	NASIK	
		METACHEM	MUMBAI	
6.	AGITATOR	REMI PEOCESS PLANT & M/C	MUMBAI	
		FIBRE & FIBRE	MUMBAI / SILVASA	
		CEECONS	CHENNAI	
		STANDARD ENGINEERS	MUMBAI	
7.	HORIZONTAL CENTRIFUGAL PUMPS	BEST AND CROMPTON ENGG LTD.	CHENNAI	
		BHARAT PUMPS & COMPRESSORS LTD	ALLAHABAD	
		FLOWMORE LTD.	GURGAON	
		FLOWSERVE INDIA CONTROLS PVT. LTD.	COIMBATORE	
		JYOTI LTD.	VADODARA	
		KIRLOSKAR BROTHERS LTD	PUNE	
		WILO MATHER & PLATT PUMPS PVT. LTD.	PUNE	
		V-FLO PUMPS & SYSTEMS CO. LTD.,	BEIJING-CHINA	
		WPIL LIMITED	KOLKATA	
		VARAT PUMP AND MACHINERY PVT. LTD.	HOWRAH	
		SINTECH PRECISION PRODUCT LTD.	GHAZIABAD	
		MAXFLOW PUMPS INDIA PVT. LTD.	GURUGRAM	
8.	VERTICAL CENTRIFUGAL PUMPS	BHARAT PUMPS & COMPRESSORS LTD	ALLAHABAD	
		FLOWMORE LTD.	GURGAON	
		FLOWSERVE INDIA CONTROLS PVT. LTD.	COIMBATORE	
		JYOTI LTD.	VADODARA	
		WILO MATHER & PLATT PUMPS PVT. LTD.	PUNE	
		SULZER PUMPS INDIA LTD.	THANE	
		WPIL LIMITED	KOLKATA	

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
9.	SCREW PUMP	UT PUMP		
		ROTO PUMPS		
		TUSHACO		
10.	HORIZONTAL CENTRIFUGAL PUMPS (RUBBER LINED)	KISHORE PUMPS	PUNE	
		SU MOTORS	MUMBAI	
11.	NON METALLIC (PP/FRP) HORIZONTAL CENTRIFUGAL PUMPS	ENGINEERS COMBINE	THANE	
		ANTICORROSIVE	VALSAD	
		LEAK PROOF PUMPS PVT. LTD. (RAJEDIA)	-	
12.	MISC. PUMP VERTICAL TURBINE TYPE	KBL	PUNE	
		M&P	PUNE	
		WPIL	GHAZIABAD	
		KISHORE PUMPS	PUNE	
		FLOWMORE	SAHIBABAD	
13.	BATTERY CHARGER FOR PLC	AMARA RAJA POWER SYSTEMS LIMITED	TRIPUTI	
		CHHABI ELECTRICALS PVT.LTD.	JALGAON	
		CHLORIDE POWER SYSTEMS & SOLUTIONS LIMITED	KOLKATA	
		DUBAS ENGG PVT LTD	BANGALORE	
		HBL POWER SYSTEMS LTD	HYDERABAD	
		JEMA ENERGY	SPAIN	FOR STATIC SCR TYPE FULL WAVE FULLY CONTROL TYPE
		MASS-TECH CONTROLS PVT.LTD.	MUMBAI	
		STATCON POWER CONTROLS LTD	NOIDA	
14.	UNDER BED NOZZLE	JONSONS SCREEN	AUSTRALIA/ IRELAND	
15.	COATING & WRAPPING MATERIAL TAPE	IWL LTD.	CHENNAI	
		MP TAR PRODUCT	BHILAI	
		PORWAL INDUSTRIES	RAIPUR	
		RUSTECH	KOLKATA	
		STP	JAMSHEDPUR	
16.	HEATER	ESCORTS	FARIDABAD	
		RACOLDS	FARIDABAD	
17.	CLARIFIER/ THICKENER MECHANISM	CLEAR WATER	DELHI	
		TRIVENI	NOIDA	
		PBJ ASSOCIATE	PUNE	
18.	CENTRIFUGE	HUMBOLT	-	
		HILLER	-	
19.	CAST IRON GATE/GLV/NRV/SRV	A.V. VALVES LTD	AGRA	
		ATAM VALVES PVT. LTD.	JALANDHAR	
		FLUIDLINE VALVES COMPANY PVT.LTD.	GHAZIABAD	

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		G.M. DALUI AND SONS PVT.LTD.	HOWRAH	
		H.SARKER AND COMPANY	HOWRAH	
		LEADER VALVES LTD.	JALANDHAR	
		VENUS PUMPS AND ENGG. WORKS	KOLKATA	
20.	**BALL VALVE (MANUAL /PNEUMATIC/ ELECTRIC) CLASS 150**	A.V. VALVES LTD	AGRA	
		AKAY INDUSTRIES PVT.LTD.	DHARWAD	
		BELGAUM AQUA VALVES PVT. LTD.	BELGAUN	
		ASIAN INDUSTRIAL VALVES & INSTRUMENTS.	CHENNAI	
		ATAM VALVES PVT. LTD.	JALANDHAR	
		DEMBLA VALVES LTD.	THANE	
		M/S GM ENGINEERING	RAJKOT	
		HAWA VALVES (INDIA) PVT. LTD.	NAVI MUMBAI	
		INTERVALVE (INDIA) LTD.	PUNE	
		LEADER VALVES LTD.	JALANDHAR	
		MICROFINISH VALVES PVT LTD.	HUBLI	
		NILON VALVES PRIVATE LIMITED	AHMEDABAD	
		SURYA VALVES AND INSTRUMENTS MFG CO.	CHENNAI	
		UNIFLOW	CHENNAI	
		VALTECH INDUSTRIES	MUMBAI	
		VAAS AUTOMATION PVT. LTD.	NEW DELHI	
		WEIR BDK VALVES- A UNIT OF WEIR INDIA PVT. LTD.	NEW DELHI	
21.	**ELECTRIC MOTOR**	CROMPTON GREAVES	AHMEDNAGAR	
		LAXMI HYDRAULICS PVT. LTD	BANGALORE / HUBLI*	
		RAJINDRA ELECT INDUSTRIES	FARIDABAD* / BANGALORE	
		GE-POWER		
		BHARAT BIJLEE	MUMBAI	
		SIEMENS	MUMBAI	
		NGEF	BANGALORE	
		KIRLOSKAR ELECTRIC CO LTD.		
		ASEA BROWN BOVERI		
		MARATHON	KOLKATA	
22.	**BUTTER-FLY VALVE**	ADVANCE VALVES PVT. LTD.	NOIDA	
		FLUIDLINE VALVES COMPANY PVT.LTD.	GHAZIABAD	
		INSTRUMENTATION LTD.	PALAKKAD	
		INTERVALVE (INDIA) LTD.	PUNE	
		R AND D MULTIPLES (METAL	MUMBAI	

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		CAST) PVT LTD		
		SURYA VALVES AND INSTRUMENTS MFG CO.	CHENNAI	
		PENTAIR VALVES AND CONTROLS INDIA PRIVATE LIMITED	NAVI MUMBAI	
		UPADHAYA VALVES MANUFACTURERS PRIVATE LIMITED,	KOLKATA	
		VENUS PUMPS AND ENGG. WORKS	KOLKATA	
		WEIR BDK VALVES- A UNIT OF WEIR INDIA PVT. LTD.	NEW DELHI	
23.	**DIAPHRAGM VALVE (MANUAL / PNEUMATIC) CLASS 150**	WEIR BDK	HUBLI	
		CRANE FLOW PROCESS	SATARA	
		PROCON	MUMBAI	
		MAJESTIC VALVES (LABLINE)	-	
		HAWA ENGINEERS	AHMEDABAD	
24.	**DUAL PLATE CHECK VALVES**	ADVANCE VALVES PVT. LTD.	NOIDA	
		FLUIDLINE VALVES COMPANY PVT.LTD.	GHAZIABAD	1. DUAL PLATE CHECK VALVE CI - CLASS 150 & UP TO 600NB, 2. DUAL PLATE CHECK VALVE CCS - CLASS 150 & UP TO 500NB
		R AND D MULTIPLES (METAL CAST) PVT LTD	MUMBAI	
		VENUS PUMPS AND ENGG. WORKS	KOLKATA	CI ,CCS & STAINLESS STEEL SPRING ASSISTED DUAL PLATE CHECK VALVES UPTO 700 NB AND 150 CLASS RATING.
25.	**Y-TYPE STRAINER**	OTOKLIN GLOBAL BUSINESS LIMITED	MUMBAI	
		GRAND PRIX	NEW DELHI	
		JAYPEE	NEW DELHI	
		GREAVES COTTON	MUMBAI	
		MULTITEX FILTRATION ENGINEERS LIMITED,	NEW DELHI / NOIDA	
		FILTERATION ENGINEERS (I) PVT. LTD	MUMBAI	
		FLUIDNYE	-	
		SUNGOV ENGINEERING PVT. LTD.	DELHI	
		GRAND PRIX	FARIDABAD	
		JAYPEE INDUSTRIES PVT. LTD.	DELHI	

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		BHATIA ENGINEERING CO.	DELHI	
26.	RUBBER FLAP TYPE CHECK VALVES	ASHVIK VALVES	-	
		FLOW WAY VALVES	-	
		BDK	-	
		MAJESTIC VALVES (LABLINE INST)	-	
		ADVANCE VALVES	-	
27.	SOLENOID VALVES	ROTEX	-	
		AVCON	-	
28.	PRESSURE GAUGE/ DIFFERENTIAL PRESSURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	KOLKATA	
		ASHCROFT INDIA PVT LTD.	GUJARAT	
		BOSE PANDA INSTRUMENTS PVT.LTD.	KOLKATA	
		FORBES MARSHALL (HYD) LTD.	HYDERABAD	
		GAUGE BOURDON INDIA PVT. LTD.	MUMBAI	
		H.GURU INDUSTRIES	KOLKATA	
		H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	BANGALORE	
		BAUMER TECHNOLOGIES INDIA PVT. LTD.	MUMBAI	
29.	CHAIN PULLEY BLOCK	ARMSEL MHE PVT. LTD	BANGALORE	
		CENTURY CRANE ENGINEERS PVT. LTD.	FARIDABAD	
		HERCULES HOISTS LTD.	RAIGAD	
		LIFTING EQUIPMENTS AND ACCESSORIES	DELHI	
		TUOBRO FURGUSON (INDIA) PVT LTD	KOLKATA	UPTO 10 TONNE.
		TRACTEL TIRFOR INDIA PVT. LTD.	FARIDABAD	
		TECHNO INDUSTRIES	AHMEDABAD	
		ARMSEL MHE PVT. LTD	BANGALORE	
		ALPHA SERVICES	BHIWADI	
		CONSOLIDATED HOISTS PVT LTD	PUNE	UPTO 20 TONNES
		CENTURY CRANE ENGINEERS PVT. LTD.	FARIDABAD	
		EDDY CRANES PVT. LTD.	MUMBAI	CAPACITY UPTO 10 TONS. BOIS BHEL APP.SUB-VENDORS.
		GRIP ENGINEERS PVT. LTD.,	FARIDABAD,	
		GLOBAL TECHNOLOGIES	HYDERABAD	
		HERCULES HOISTS LTD.	RAIGAD	
		LIFTING EQUIPMENTS AND ACCESSORIES	DELHI	
		MANGLA HOISTS PVT LTD	NEW DELHI	

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		MEEKA MACHINERY PVT. LTD.	AHMEDABAD	
		REVA INDUSTRIES LTD.	FARIDABAD	UPTO 25.0 T CAPACITY.
		ROCKWELL HOISTO CRANES PVT. LTD.	BAHADURGARH	
		SAFEX ENERGY PVT. LTD.	AHMEDABAD	
		TUOBRO FURGUSON (INDIA) PVT LTD	KOLKATA	UPTO 15 TONNES.
		TECHNO INDUSTRIES	AHMEDABAD	
30.	ELECTRIC HOIST	ARMSEL MHE PVT. LTD	BANGALORE	
		ALPHA SERVICES	BHIWADI	
		CONSOLIDATED HOISTS PVT LTD	PUNE	UPTO 20 TONNES
		CENTURY CRANE ENGINEERS PVT. LTD.	FARIDABAD	
		EDDY CRANES PVT. LTD.	MUMBAI	CAPACITY UPTO 10 TONS. BOIS BHEL APP.SUB-VENDORS.
		GRIP ENGINEERS PVT. LTD.,	FARIDABAD,	
		GLOBAL TECHNOLOGIES	HYDERABAD	
		HERCULES HOISTS LTD.	RAIGAD	
		LIFTING EQUIPMENTS AND ACCESSORIES	DELHI	
		MANGLA HOISTS PVT LTD	NEW DELHI	
		MEEKA MACHINERY PVT. LTD.	AHMEDABAD	
		REVA INDUSTRIES LTD.	FARIDABAD	UPTO 25.0 T CAPACITY.
		ROCKWELL HOISTO CRANES PVT. LTD.	BAHADURGARH	
		SAFEX ENERGY PVT. LTD.	AHMEDABAD	
		TUOBRO FURGUSON (INDIA) PVT LTD	KOLKATA	UPTO 15 TONNES.
		TECHNO INDUSTRIES	AHMEDABAD	
31.	CONTROL VALVE	SPX CORPORATION, USA	AHMEDABAD	
		CONTROL COMPONENT INC.	CALIFORNIA	
		DRESSER VALVE INDIA PVT. LTD	COIMBATORE	
		DAUME REGELARMATUREN GMBH,	GERMANY	
		EMERSON PROCESS MANAGEMENT CHENNAI LIMITED	CHENNAI	
		WEIR VALVES & CONTROLS UK LTD.	U.K	
		HOLTER REGELARMATUREN GMBH & CO.KG	GERMANY	
		INSTRUMENTATION LTD.	KERALA	
		KOSO INDIA PRIVATE LIMITED,	NASHIK	
		LESLIE CONTROLS, INC	USA	

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		MIL CONTROLS LTD.	KERALA	
		METSO SINGAPORE PTE. LTD.,	SINGAPORE	
		PARCOL S.P.A	ITALY	
		R.K.CONTROL INSTRUMENTS PVT. LTD.	THANE	
		RINGO VALVULAS S.L,	SPAIN	
		SHENJIANG VALVE CO. LTD.	CHINA	
		VALVITALIA S.P.A. ,	ITALY	
		WALDEMAR PRUSS ARMATURENFABRIK GMBH	GERMANY	
32.	PRESSURE/DP/VACUUM SWITCH	INDFOSS	GHAZIABAD	
		SOR	USA	
		DRESSOR	USA	
		DELTA CONTROL	UK	
		TRAFAG	RANIPET	
		GIC(GAUGES BOURDON)	PANVEL	
		ASHCROFT INDIA PVT LTD.	USA/GERMANY	
		SWITZER	CHENNAI	
33.	TEMPERATURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	KOLKATA	
		ASHCROFT INDIA PVT LTD.	GUJARAT	
		BUDENBERG GUAGE CO.LTD.	UK	
		FORBES MARSHALL (HYD) LTD.	HYDERABAD	
		GOA INSTRUMENTS INDUSTRIES PVT.LTD.	GOA	
		GOA THERMOSTATIC INSTRUMENTS PVT.LTD.		
		GAUGE BOURDON INDIA PVT. LTD.	MUMBAI	
		H.GURU INDUSTRIES	KOLKATA	
		H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	BANGALORE	
		BAUMER TECHNOLOGIES INDIA PVT. LTD.	MUMBAI	
34.	LEVEL GAUGE (F&B, TUBULAR, REFLEX)	SBEM		
		CHEMTROL		
		PUNE TECHTROL		
		SIGMA		
		V AUTOMAT		
		GENERAL INSTRUMENTS		
35.	ROTAMETER	EUREKA INDUSTRIAL EQUIPMENTS PVT.LTD.	PUNE	
		FLOW STAR ENGINEERING PVT. LTD.,	FARIDABAD	
		FLOWTECH INSTRUMENTS SERVICRS	VADODARA	
		INSTRUMENTATION ENGINEERS PVT LTD	TELANGANA	
		SCIENTIFIC DEVICES	NAVI MUMBAI	

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		(BOMBAY) PVT LTD,		
		TANSA EQUIPMENTS PVT.LTD	MUMBAI	
36.	LEVEL SWITCH-CONDUCTIVITY TYPE	BLISS ANAND PVT. LTD.	GURGAON	
		FLOWTECH INSTRUMENTS SERVICRS	VADODARA	
		HI-TECH SYSTEMS & SERVICES LTD.	KOLKATA-	VENDOR SHALL SOURCE IMPORT CONTENTS OF LEVEL SWITCH (CONDUCTIVITY TYPE) FROM LEVELSTATE SYSTEMS LTD., UNITED KINGDOM.
		LEVCON INSTRUMENTS PVT. LTD.	KOLKATA	
		RAMAN INSTRUMENTS PVT.LTD.	MUMBAI	VENDOR SHALL SOURCE IMPORT CONTENTS OF LEVEL SWITCH (CONDUCTIVITY TYPE) FROM MOBREY MEASUREMENT, AN OPERATING UNIT OF MORBEY LTD., SLOUGH, BERKSHIRE, UNITED KINGDOM.
		SIGMA INSTRUMENTS CO.	MUMBAI	
		SOR INC.	USA	
		SAPCON INSTRUMENT PVT LTD.	INDORE	
		V. AUTOMAT & INTRUMENTS (P) LTD.	NEW DELHI	
37.	LEVEL SWITCH (ALL TYPES)	LEVCON		
		CHEMTROLS SAMIL (INDIA) PVT LTD.		
		SWITZER		
		WAAREE (BAUMER INSTRUMENTS)		
		V AUTOMAT		
		PUNE TECHTROL		
38.	MAGNETIC FLOW METER	ABB	-	
		WAAREE (BAUMER INSTRUMENTS)	-	
		EUREKA	-	
		EMERSON	-	
		YOKOGAWA	-	

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		HACH (POTENSE)	-	
		KROHNE MARSHALL	-	
39.	FLOW ELEMENT - NOZZLE	HYDROPNEUMATICS PVT. LTD.	GOA	
		INSTRUMENTATION LTD.	PALAKKAD	
		MICRO PRECISION PRODUCTS PVT. LTD.	FARIDABAD	
		MINCO (INDIA) FLOW ELEMENTS PVT. LTD.	GOA	
		STAR-MECH CONTROLS (I) PVT.LTD.	PUNE	
		SEIKO FLOW CONTROL GMBH	AUSTRIA	
40.	FLOW ELEMENT - ORIFICE	FLOW STAR ENGINEERING PVT. LTD.,	FARIDABAD	
		HYDROPNEUMATICS PVT. LTD.	GOA	
		INSTRUMENTATION LTD.	PALAKKAD	
		INSTRUMENTATION ENGINEERS PVT LTD	HYDERABAD	
		MICRO PRECISION PRODUCTS PVT. LTD.	FARIDABAD	
		MINCO (INDIA) PRIVATE LIMITED	GOA	
		STAR-MECH CONTROLS (I) PVT.LTD.	PUNE	
		CHEMTROLS INDUSTRIES PVT.LTD	THANE	
		DYNAFLUID VALVES AND FLOW CONTROLS(P) LTD.	BELGAUM	
		ELECTRONET EQUIPMENTS PVT. LTD	PUNE	
		MINCO (INDIA) FLOW ELEMENTS PVT. LTD.	MAPUSA	
		SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	NAVI MUMBAI	
		TANSA EQUIPMENTS PVT.LTD	MUMBAI	
41.	FLOW TRANSMITTERS (ALL TYPES)	E & H	-	
		KHRONE MARSHALL	-	
		EMERSON	-	
		ABB	-	
		HONEYWELL	-	
		YOKOGAWA	-	
42.	LEVEL TRANSMITTERS (ALL TYPES)	EMERSON	-	
		E & H	-	
		ABB	-	
		HONEYWELL	-	
		V AUTOMAT	-	
		YOKOGAWA	-	
		SIEMENS	-	
		KROHNE MARSHALL	-	

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
43.	PRESSURE TRANSMITTERS (ALL TYPES)	EMERSON	USA/PAWANE	
		LAXONS AUTOMATION	DAMAN	
		YIL	BANGALORE	
		SIEMENS	THANE	
		FUJI	CHINA	
		YOKOGAWA	JAPAN	
		HONEYWELL	USA/PUNE	
44.	TEMPERATURE TRANSMITTERS	EMERSON	-	
		E & H	-	
		ABB	-	
		HONEYWELL	-	
		V AUTOMAT	-	
		YOKOGAWA	-	
		SIEMENS	-	
		FORBES MARSHALL	-	
45.	PH TRANSMITTERS	EMERSON	-	
		YOKOGAWA	-	
		HONEYWELL	-	
		ABB	-	
		HACH	-	
		FORBES MARSHALL	-	
46.	ANALYSERS (ALL TYPES)	ABB	-	
		EMERSON	-	
		YOKOGAWA	-	
		HONEYWELL	-	
		HACH POLYMETRON	-	
		SIEMENS	-	
		FORBES MARSHALL	-	
47.	PROGRAMMABLE LOGIC CONTROLLER	GE INTELLIGENT PLATFORMS PRIVATE LIMITED	BANGALORE	
		HONEYWELL AUTOMATION INDIA LIMITED ,	PUNE	
		ROCKWELL AUTOMATION INDIA LTD	SAHIBABAD	
		SIEMENS LIMITED	MUMBAI	
		SCHNEIDER ELECTRIC INDIA PVT.LTD.	NEW DELHI	
48.	UPS	HITACHI-HIREL	GANDHINAGAR	
		APC	BANGALORE	
		DELTA	GURGAON	
		EMERSON	MUMBAI	
		DB POWER	PUNE	
		APLAB	MUMBAI	
49.	INSTRUMENT FITTINGS	AURA INCORPORATED	NEW DELHI	
		ASTEC VALVES & FITTINGS PVT. LTD.,	MUMBAI	

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		ARYA CRAFTS & ENGINEERING PVT. LTD.	MUMBAI	
		COMFIT & VALVE PVT. LTD.	GUJARAT	
		FLUIDFIT ENGINEERS PVT. LTD.	MUMBAI	
		FLUID CONTROLS PVT. LTD.	MUMBAI	
		HP VALVES & FITTINGS INDIA PVT. LTD.	CHENNAI	
		PRECISION ENGINEERING INDUSTRIES	MUMBAI	
		PANAM ENGINEERS,	MUMBAI	
		PERFECT INSTRUMENTATION CONTROL (INDIA) PVT. LTD.	MUMBAI	
		VIKAS INDUSTRIAL PRODUCTS	NOIDA	
50.	**JUNCTION BOX**	AJMERA INDUSTRIAL & ENGINEERING WORKS	MUMBAI	
		FLEXPRO ELECTRICALS PVT. LTD.	GUJARAT	METAL TYPE JUNCTION BOX ONLY
		K.S.INSTRUMENTS PVT.LTD.	BANGALORE	
		SUCHITRA INDUSTRIES	BANGALORE	
		SHRENIK & COMPANY,	AHMEDABAD	
51.	**CABLE GLAND**	COMET	-	
		DOWELL	-	
		CHETNA	-	
52.	**CABLE LUGS**	ELECTRO BILLETS	-	
		COMET	-	
		DOWELL	-	
		CHETNA	-	
53.	**MS PLATES**	SAIL		
		ESSAR STEEL		
		TISCO		
		RINL		
		JINDAL		
		LLOYD		
		ISPAT		
		INDIAN IRON & STEEL CO. LTD		
54.	**CS PIPE (ASTM A 106 GR. B)**	INDIAN SEAMLESS METAL TUBES	AHMEDABAD	UPTO 150 NB
		MAHARASHTRA SEAMLESS	RAIGAD	UPTO 350 NB
55.	**MS PIPES**	SAIL	ROURKELA	
		JINDAL	GHAZIBAD/HISSAR	
		SURYA ROSHNI	BAHADUR GARH	
		TATA TUBE	JAMSHEDPUR	
		PSL	CHENNAI/VIZAG/KUTCH/DAMAN	

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		LALIT PROFILE	THANE	
		SAMSHI PIPES INDUSTRIES	VADODARA	
		MUKUT PIPES	RAJPURA	
		INDUS TUBES	G B NAGAR	
		MANN IND	INDORE	
		SURENDRA ENGG	RAJPURA	
		PRATIBHA PIPES & STRUCTURE PVT LTD	THANE	
		JCO GAS PIPE	CHINDWARA	
		NUKAT TANKS AND VESSELS	TARAPUR	
		DADU PIPES	SIKRANDRABAD	
		GOOD LUCK TUBES	SIKANDRABAD	
		ADVANCE STEEL TUBES	SAHIBABAD	
		BIHAR TUBES	SIKANDRABAD	
		HI TECH PIPES	SIKANDRABAD	
		RATNAMANI	KUTCH/AHMEDABAD/CHHATRAL	
		MAHARASHTRA SEAMLESS	RAIGAD	
		WELSPUN	ANJAR/BHARUCH	
56.	**SS PIPES/ TUBES**	APEX TUBES	BEHROR (ALWAR)	
		RATNAMANI	CHATTRAL	
		REMI	TARAPUR	
		PRAKASH STEELAGE	-	
57.	**POWER/CONTROL/INSTRUMENT CABLE**	CORDS CABLE	BHIWADI	
		RADIANT CABLES	HYDERABAD	
		POLYCAB	DAMAN	
		KEI	BHIWADI	
		NICCO	KOLKATA	
		RAVIN CABLES	PUNE	
		INCAB	PUNE	
		HVPL	FARIDABAD	
		TORRENT CABLE	NADIAD	
		HAVELLS	ALWAR	
		PARAMOUNT	KHUSHKHERA	
		SRI RAM CABLES	BHIWADI	
		THERMOCABLES	HYDERABAD	
		TORRENT CABLE	NADIAD	
		UNIVERSAL CABLES	SATNA	
		GEMSCAB	BHIWADI	
		DELTON	FARIDABAD	
58.	**SAFETY SHOWER**	UNICARE	-	
		MOHAN INDUSTRIES	-	
		SUPER SAFETY SERVICES	-	
59.	**FRP TANKS & FITTINGS**	GLOBAL COMPOSITE	-	

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		EPP	-	
		DEEPA COMPOSITE	-	
		COROSEAL INDUSTRIES	-	
		CHEMICAL PROCESS & EQUIPMENT PVT LTD	-	
		J.R FIBRE INDUSTRIES PVT LTD	-	
		POLYPLAST	-	
60.	EJECTOR	ESSEM TECHNOLOGIES	-	
		RATNA PRASAD	-	
61.	LOCAL CONTROL PANEL	INDUSTRIAL SWITCHGEAR & CONTROL	-	
		POSITRONICS	-	
		DELTA CONTROL	-	
		L & T	-	
		GE POWER	-	
		PYROTECH	-	
		C& S	-	
62.	TANK (FRP)	INDUSTRIAL SERVICE	KOLKATA	
		SUNRISE	BARODA	
		GANDHI & ASSOCIATES	AHMEDABAD	
		MODERN EQUIPMENTS	CHENNAI	
		EAGLE PLAST	PUNE	
		OMEGA PLAST	MUMBAI	
63.	STROKE CONTROLLER	V K PUMPS	NASIK	
		METACHEM	MUMBAI	
		SWELORE	AHMEDABAD	
		MILTON ROY INDIA	CHENNAI	
64.	SAFETY VALVES/RELIEF VALVES	METACHEM	MUMBAI	
		KEYSTONE	BARODA	
		V K PUMPS	NASIK	
		MILTON ROY	CHENNAI	
65.	DUPLEX STRAINER	JAYPEE INDUSTRIES PVT. LTD.	NEW DELHI	
		MULTITEX FILTRATION ENGINEERS LIMITED,	NEW DELHI	
		OTOKLIN GLOBAL BUSINESS LIMITED	MUMBAI	
		SUNGOV ENGINEERING PVT. LTD.	CHENNAI	
66.	ORIFICE PLATE	MICRO PRECISION	FARIDABAD	
		INSTRUMENTAION LTD	PALGHAT	
		CARLO DYNAMICS	HYDERABAD	
67.	STEEL GATE/GLOBE/NR VALVES	A.V. VALVES LTD	AGRA	
		ATAM VALVES PVT. LTD.	JALANDHAR	(1) CARBON STEEL GATE VALVES & NON

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
				RETURN VALVES: 15 NB TO 50 NB (#800) & 65 NB TO 300 NB (#150) (2) CARBON STEEL GLOBE VALVES: 15 NB TO 50 NB (#800) & 65 NB TO 200 NB (#150)
		FLUIDLINE VALVES COMPANY PVT.LTD.	KAUSHAMBI	
		M/S GM ENGINEERING	RAJKOT	
		INTERVALVE (INDIA) LTD.	PUNE	A) STEEL GATE VALVES: UPTO 50NB, #800 AND 65NB TO 150NB, #150 B) STEEL GLOBE VALVES: UPTO 50NB, #800 AND 65NB TO 100NB, #150 C)SUPPLIER NOT REGISTERED FOR NR VALVES
		LEADER VALVES LTD.	JALANDHAR	
		NITON VALVE INDUSTRIES PVT LTD	MUMBAI	
		NSSL LIMITED.	NAGPUR	
		STEEL STRONG VALVES (I) PVT.LTD.	NAVI MUMBAI	LIMITED TO RANGES & CLASSES AS AVAILABE IN VD FILE.
		VENUS PUMPS AND ENGG. WORKS	KOLKATA	CC/CSS-GATE-BBT-UPTO600NB CL UPTO300,GATE-PSBT UPTO250NB CL 1500,GLV-BBT-UPTO300NB CL UPTO600,SCNRV-BBT-UPTO600NB CL UPTO150,SCNRV-BBT-UPTO300NB CL 300,SCNRV-PSBT-UPTO150NB CL UPTO900
		VALTECH INDUSTRIES	MUMBAI	CAST CARBON & ALLOY STEEL - VALVE/RATING/SI

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
				ZE-GV/150/900,GV/300/400, GV/600/300 , GV/GLV/NRV/900/250 , GLV/300/300,GLV/150/350/ , SCNRV/150/700, SCNRV/300/350, SCNRV/600/250.
		V.K. VALVES PVT. LTD.,	JALANDHAR	
		WEIR BDK VALVES- A UNIT OF WEIR INDIA PVT. LTD.	NEW DELHI	
68.	SLUICE GATE	H SARKAR	KOLKATA	
		JASH ENGINEERING	-	
		YASHWANT INDUSTRIES	-	
69.	3 WAY VALVE	HI TECH	AHMEDABAD	
		ADVANCE VALVES PVT.LTD	NOIDA	
		BDK	HUBLI	
		FOURESS ENGG.INDIA LTD.	MUMBAI	
		FLUIDLINEVALVES COMPANY PRIVATE LTD.,	MUMBAI	
		INSTRUMENTATION LTD.	PALAKAD	
		KIRLOSKAR BROTHERS LTD.	PUNE	
		VENUS PUMP & ENGG. WORKS	KOLKATA	
		SURYA VALVES AND INSTRUMENTS MANUFACTURING COMPANY	CHENNAI	
		STAFFORD CONTROLS LIMITED	PUNE	
		MICON VALVES (INDIA) PVT.LTD	MUMBAI	
70.	PLUG VALVE(MANUAL)	BDK	HUBLI	
		HAWA ENGINEERS / MARCK & CARE	-	
		MICON VALVES	-	
		MICON VALVES (INDIA) PVT.LTD	MUMBAI	
71.	FITTINGS (CS/SS)	M.S. FITTINGS	KOLKATA	
		METAL LLOYDS	MUMBAI	
		TRUE FORGE	FARIDABAD	
		TUBE PRODUCTS	BARODA	
		NL HAZRA	KOLKATA	
		GUJRAT INFRA PIPES	BARODA	
		EDWARDS	USA	
		PIPEFIT ENGINEERS	BARODA	

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		SIDDARTH & GAUTAM	FARIDABAD	
		EBY	MUMBAI	
72.	FLANGES (SS/CS)	PRADEEP METALS LTD	MUMBAI	
		TUBE PRODUCT INCOROPORATION	BARODA	
		MS FITTINGS	KOLKATA	
		HAWA ENGINEERING	-	
		ALIANCE PIPE & PLANGES	KOLKATA	
		JAI AMBE	MUMBAI	
73.	PIPE & FILLTING (PP,HDPE,PVC & CPVC)	GEROGE FISHCHER	DELHI	
		ASTROL PLYTECHINC LTD	AHMEDABAD	
		JAIN IRRIGATION	-	
		ORIPLAST	-	
74.	VALVES (GATE/GLOBE/NRV/BALL)- (PP,HDPE,PVC & CPVC)	GEROGE FISHCHER IPING SYSTEMS PVT LTD	DELHI	
		ASTROL PLYTECHINC LTD	AHMEDABAD	
		JAIN IRRIGATION	-	
		ORIPLAST	-	
75.	AIR FILTER REGULATOR	SHAVO NORGEN	-	
		PLACKA INSTRUMENTS	-	
76.	FILTER MEDIA	GLOBAL ABSORBENT	KOLKATA	
		BHARAT MINERALS		
77.	DC LEAD ACID / NI-CD BATTERIES	AMCO SAFT INDIA LTD	BANGALORE	NI-CD BATTERIES ONLY
		EXIDE INDUSTRIES LTD	NEW DELHI	LEAD ACID BATTERIES ONLY.
		HBL POWER SYSTEMS LTD	HYDERABAD	NI/CD AND TUBULAR TYPE FOR LEAD ACID
		HOPPECKE BATTERIEN GMBH & CO.KG,	GERMANY	
78.	DC LEAD ACID BATTERIES	EXIDE INDUSTRIES LTD	NEW DELHI	
		HBL POWER SYSTEMS LTD	HYDERABAD	TUBULAR TYPE
		HOPPECKE BATTERIEN GMBH & CO.KG,	GERMANY	
79.	DC NI CD BATTERIES	AMCO SAFT INDIA LTD	BANGALORE	
		HBL POWER SYSTEMS LTD	HYDERABAD	
		HOPPECKE BATTERIEN GMBH & CO.KG,	GERMANY	
80.	SIGHT FLOW INDICATORS	B.K.EQUIPMENTS PVT.LTD.	CHENNAI	
		BLISS ANAND PVT. LTD.	GURGAON	
		FLOWTECH INSTRUMENTS SERVICRS	VADODARA	
		INSTRUMENTATION ENGINEERS PVT LTD	TELANGANA	

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		SIGMA INSTRUMENTS CO.	MUMBAI	
		SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	NAVI MUMBAI	
		TELACE EQUIPMENT PVT.LTD.	CHENNAI	
81.	PAINT	ASIAN PAINTS (I) LTD.		
		BERGER PAINTS INDIA LTD		
		GOODLASS NEROLAC		
		JENSON & NICHOLSON (I) LTD		
		CDC CARBOLINE (I) LTD.		
		SHALIMAR PAINTS LTD.		
		ADDISON PAINTS LTD		
		GRAND POLYCOAT		
		BOMBAY PAINTS		
		HEMPLE PAINTS (SINGAPORE)		
		JOTUN PAINTS		
82.	PNEUMATIC ACTUATOR	PROCON ENGINEERS	-	
		TYCO	-	
		CRANE PROCESS	-	
		BDK	-	
		INTERVALVE	-	
		BRAY CONTROL	-	
83.	MOTORISED ACTUATOR	ROTARK	-	
		AUMA	-	
		LIMITORK	-	
84.	UF MEMBRANE	DOW	-	
		HYFLUX	-	
		GE	-	
		MEMBRANE HITECH	-	
85.	RO MEMBRANE	DOW CHEMICALS – FILMYECH	USA	
		HYDRANAUTICS	USA	
		KOCH MEMBRANE- FLUID SYSTEM	USA	
		TOREY	JAPAN	
86.	RO PRESSURE TUBES (FRP)	PENTAIR WATER	GOA	
87.	MBR MEMBRANE	KOCH		
		GE		
		TOREY		

NOTE:

1. THE SUB VENDOR LIST ENCLOSED AS ANNEXURE-II/SUBSECTION-IA IS FOR BIDDER'S REFERENCE AND IS SUBJECT TO APPROVAL / ACCEPTANCE BY BHEL/ CUSTOMER. BIDDER CAN PROPOSE ADDITIONAL SUB VENDOR WITH BACK UP DOCUMENTS (EXPERIENCE LIST, END USER CERTIFICATE AS APPLICABLE) ETC. THE SAME SHALL SUBJECT TO BHEL AND

CUSTOMER APPROVAL DURING DETAILED ENGINEERING STAGE WITHOUT ANY TECHNICAL, COMMERCIAL & DELIVERY IMPLICATION TO BHEL.

BIDDER TO PROPOSE SUB VENDOR WITHIN 4 WEEKS OF PLACEMENT OF LOI. THEREAFTER NO REQUEST FOR ADDITIONAL SUB-VENDOR SHALL BE ENTERTAINED.

2. INSPECTION CATEGORY WILL BE INTIMATED AFTER AWARD OF CONTRACT BY BHEL/CUSTOMER. HOWEVER, THE SAME WILL BE ADHERED BY THE BIDDER WITHOUT ANY COMMERCIAL AND DELIVERY IMPLICATION TO BHEL/ CUSTOMER.

3. INSPECTION CATEGORY FOR MANDATORY SPARES SHALL BE SAME AS MAIN EQUIPMENT AND QAP OF MAIN EQUIPMENT SHALL BE APPLICABLE FOR SPARES ALSO

SUB-VENDOR LIST FOR C&I ITEMS

Sl No	Package Code	Package Name	Supplier Name	Supplier Communication Address	Supplier Works Address	Tech Limit	Fin Limit
1	145-04000-A	CONTROL VALVE	SAMSON CONTROLS PVT. LTD.	Mr. Atul raje-MD D 281, MIDC Ranjangaon Ta Shirur Pune Phone- 02067246600 Pincode : 412220 Email : sales@samsoncontrols.net	Works-1-> Others D 281, MIDC Ranjangaon -Pune-MAHARASHTRA India Phone- 02067246600,8554997963 FAX : Pincode : 412220 Email : sales@samsoncontrols.net		
2	145-04000-A	CONTROL VALVE	FORBES MARSHALL ARCA PVT.LTD.	A-34/35 , MIDC ESTATE, H-BLOCK, PIMPRI, PUNE, Phone- 020-27442020, Pincode : 411018 Email : mnadgaundi@forbesmarshall.com	Works-1->Mr. Sanjeev Shinde A-34/35 MIDC Estate,H Block, Pimpri, -Pune-MAHARASHTRA India Phone- 9323176406 FAX : 020-27442040 Pincode : 411018 Email : sshinde@forbesmarshall.com	No technical limit exists except for feed control valve. For feed control valves, approved up to sub-critical power plants of 600 MW rating	
3	145-04000-A	CONTROL VALVE	INSTRUMENTATION LTD.	KANJIKODE WEST, PALALKKAD, PALAKKAD Phone- 2566127-130,2567128 Pincode : 678623 Email : icvldil@gmail.com;fa2@ilpgt.com	Works-1->D.SASIDHARAN, AGM(Works&PPC) KANJIKODE WEST, -PALAKKAD-KERALA INDIA Phone- 0491-2566536 FAX : 0491-2566135 Pincode : 678623 Email : sasidharan@ilpgt.com		
4	145-04000-A	CONTROL VALVE	Koso India Private Limited,	H 33 & 34, MIDC, Ambad, Nashik, Phone- 09650233433 Pincode : 422010, Email : jetmal.gour@koso.co.in	Works-1->P.J.ASHOK KUMAR/SEEMA ANAND Control Valve Division, H-33&34, MIDC, Ambad, -Nashik-MAHARASHTRA India Phone- 91 944 744 3198 FAX : 0491 - 5269914 Pincode : 422010 Email : pja@koso.co.in Works-2->+P.J.ASHOK KUMAR/SEEMA ANAND J-1,MIDC,Ambad -Nashik-MAHARASHTRA India Phone- 91 944 744 3198 FAX : 0491 - 5269914 Pincode : 422010 Email : pja@koso.co.in		
5	145-04000-A	CONTROL VALVE	KSB MIL CONTROLS LTD.	Mr.Jacob Cherian/Mr.Geo Jolly Meladoor, Annamanada P.O. MALA, Thrissur Phone- 0480-2695700 Pincode : 680741 Email : biju.simon@ksb.com	Works-1->Mr.Biju Simon/Mr.Jose Paul Meladoor, Annamanada, -Thrissur-KERALA INDIA Phone- 9447555500 FAX : 91 480 2890952 Pincode : 680741 Email : jose.paul@ksb.com		
6	145-04000-A	CONTROL VALVE	SUZHOU DELAN ENERGY SCIENCE & TECHNOLOGY CO., LTD.	No 566 Fangqiao Road Caohu Industrial Park, Xiangcheng Economic Development Zone, Suzhou Phone- 008618012776062 Pincode : 215143 Email : jeanielei@delan-valve.com	Works-1->Mr. Zong Xin CEO No 566 Fangqiao Road Caohu Industrial Park,Xiangcheng E. Z. -Suzhou-Foreign Country CHINA Phone- 008618012776062 FAX : Pincode : 215143 Email : jeanielei@delan-valve.com		
7	145-04000-A	CONTROL VALVE	R.K.CONTROL INSTRUMENTS PVT. LTD.	PLOT NO.A-250, OPP.POLICE STATION, WAGLE INDUSTRIAL ESTATE, THANE Phone- 25820943/2331 Pincode : 400604 Email : rkcipl@vsnl.com ; rkcinpvt@bol.net.in	Works-1->SAVITH KUMAR PLOT NO. A-250, OPP.POLICE STATION,WAGLE INDUSTRIAL ESTATE, THANE -THANE-MAHARASHTRA INDIA Phone- 022-'66060942 FAX : 022-25820801 Pincode : 400 604 Email : rkadmin@rkcipl.co.in	For subcritical power plant up to 150MW	
8	145-04000-A	CONTROL VALVE	Mascot Valves Pvt. Ltd.	166-167 GIDC Naroda Ahmedabad Phone- 0792282 1619 Pincode : 382330 Email : dom.sales@mascotvalves.com	Works-1->Varun Patel Dir 166-167 ,GIDC Naroda -Ahmedabad-GUJARAT India Phone- 0792282 1619 / 3369 FAX : Pincode : 382330 Email : dom.sales@mascotvalves.com		
9	145-04000-A	CONTROL VALVE	Valvitalia S.P.A. ,	Mr. Salvatore Ruggeri Via Tortona 69, Rivanazzano (Pavia) Phone- +39-03839459875 Pincode : 27055 Email : dario.torluccio@valviatalia.com	Works-1->Mr. Salvatore Ruggeri Via Tortona 69,Rivanazzano (Pavia) -- Italy Phone- +39-03839459875 FAX : Pincode : 27055 Email : dario.torluccio@valviatalia.com; diego.poletti@valvitalia.com; sales@bhgassociates.com		

SUB-VENDOR LIST FOR C&I ITEMS

Sl No	Package Code	Package Name	Supplier Name	Supplier Communication Address	Supplier Works Address	Tech Limit	Fin Limit
10	145-04000-A	CONTROL VALVE	BOMAFA SPECIAL VALVE SOLUTIONS PVT LTD	Mr. K.M. Anklesaria/ R. M. Anklesaria Plot No: 285/2, Panchratna Estate, Near Ramol Bridge, Vatva Ahmedabad Phone- 079-40083825 Pincode : 382445 Email : info@bomafa-india.com	Works-1->Mr. K.M. Anklesaria/ Mr. R.M. Anklesaria Dir Plot No: 285/2, Panchratna Estate, Near Ramol Bridge, Vatva, -Ahmedabad-GUJARAT INDIA Phone- 079-40083825 FAX : Pincode : 382445 Email : info@bomafa-india.com		
11	145-04000-A	CONTROL VALVE	DRESSER VALVE INDIA PVT. LTD	Mr. Raj Raman/Mr. Rajkumar Moria S.F. No: 608,Chettipalayam Road, Echanari Post, Coimbatore Phone- +91-98451 19085 Pincode : 641021 Email : Anoop.Ramachandran@ge.com	Works-1->Mr. Anoop Ramchandran S.F. No: 608,Chettipalayam Road, Echanari Post, -Coimbatore-TAMIL NADU INDIA Phone- +919500978296 FAX : +91 4223011200 Pincode : 641021 Email : Anoop.Ramachandran@ge.com		
12	145-04000-A	CONTROL VALVE	Severn Glocon India Pvt. Ltd.	F96 & F97, Sipcot Industrial Park, Irungattukottai, Chennai, Phone- 044-47104200, Pincode : 602117, Email : info@severnglocon.co.in,	Works-1->Mr. K.Kaushik, F96 & F97, Sipcot Industrial Park,Irungattukottai, -Chennai-TAMIL NADU India Phone- 044-47104200, FAX : 044-47100073, Pincode : 602117, Email : info@severnglocon.co.in		
13	145-04000-A	CONTROL VALVE	EMERSON PROCESS MANAGEMENT CHENNAI LIMITED	147, KARAPAKKAM VILLAGE, CHENNAI Phone- 23722184, 23716242 Pincode : 600096 Email : jatinder.singh@emerson.com	Works-1->Mr. Rangarajan (Head - Lean and Manufact 147,Karapakkam Village, -Chennai-TAMIL NADU India Phone- 0444903 4395 FAX : Pincode : 600097 Email : Rangarajan.M@emerson.com		
14	145-04000-A	CONTROL VALVE	WALDEMAR PRUSS ARMATURENFABRIK GMBH	Mr. Winfried Dremhel Schulenburgerlandstrasse 261, Hannover Phone- +49-511279260 Pincode : 30419 Email : dremhel@pruss.de; vogel@pruss.de	Works-1->Mr. Winfried Dremhel CEO Schulenburgerlandstrasse 261, -Hannover- GERMANY Phone- +49-511279260 FAX : Pincode : 30419 Email : dremhel@pruss.de		
15	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	SWITZER PROCESS INSTRUMENTS PVT. LTD.	Mr. V S Jayaprakash, 128, SIDCO North Phase, Ambattur Estates CHENNAI Phone- 044-26252017/2018 Pincode : 600050 Email : sales@switzerprocess.co.in	Works-1->C S Shankar 127, Sidco North Phase, Ambattur Estates, -CHENNAI-TAMIL NADU INDIA Phone- 8754491904 FAX : 044-26248849 Pincode : 600050 Email : cservice@switzerinstrument.com		
16	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	DRESSER INDUSTRIES INC.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 02764-233682 Pincode : 382729 Email : Nishit.patel@ashcroftindia.com			
17	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	Barksdale GmbH, Germany	Michael Weileder Dorn Assenheimer, Strasse 27 Reichelsheim Phone- +91-9999107840 Pincode : D-61203 Email : msingh@barksdale.de			
18	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	GENERAL INSTRUMENTS CONSORTIUM	Mr. Amarendra Kulkarni 194/195, Gopi Tank Road, Off. Pandurang Naik Marg, Mahim Mumbai Phone- 9323195251 Pincode : 400016 Email : amarendra@general-gauges.com			
19	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com	Works-1->Mr. Hitesh Parmar/Mr. Hitesh Parmar Plot No.2306, Phase II, GIDC Chhatral, -Kalol-GUJARAT INDIA Phone- 9327359227 FAX : 02764-233440 Pincode : 382729 Email : hitesh.parmar@ashcroftindia.com		

SUB-VENDOR LIST FOR C&I ITEMS

Sl No	Package Code	Package Name	Supplier Name	Supplier Communication Address	Supplier Works Address	Tech Limit	Fin Limit
20	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	INDFOS INDUSTRIES LIMITED	B-20-21, INDUSTRIAL AREA, MEERUT ROAD, GHAZIABAD Phone- 0120-2712016 Pincode : Email : mktg@indfos.com			
21	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	INDFOS (INDIA) LIMITED	MR.L.C.VENKATRANGAN/MR.B.KANNAN New No.17, II Floor, Adwave Towers, Dr.Sevalia Shivaji Salai, T.Nagar Chennai Phone- +91 44 24353407 Pincode : 600017 Email : delhi@indfos.com			
22	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com	Works-1->LARRY DEGARMO/ ROY STUMBOUGH 14685 W. 105TH STREET, LENEXA -KANSAS- USA Phone- 913-888-0767 FAX : 913-888-0767 Pincode : 66215 Email : rstumbough@sorinc.com		
23	145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	Kaustubha Udyog,	S.No. 36/1/1, Sinhgad Road, Vadgaon Khurd, Near Lokmat Press, Pune, Phone- 020-24393577, Pincode : Email : pressure@vsnl.com,			
24	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INDUSTRIES	Mr. G. D. Hazra/Mr. P. K. Mitra 10 B, HO-CHI-MINH SARANI, KOLKATA Phone- 033 2282 2463 / 1637 Pincode : 700071 Email : mguru@vsnl.net	Works-1->NA NA -- Phone- FAX : Pincode : Email :		OVERALL PENDING ORDER VALUE (EXCLUDING VALUE OF ORDERS ALREADY EXECUTED) FOR ALL PACKAGES FOR WHICH VENDOR IS REGISTERED SHALL NOT EXCEED RS. 1.0 CRORE
25	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA Phone- 24757784,22472509 Pincode : 700020 Email : anidel@bol.net.in	Works-1->Mr. Gautam Mukherjee Kusumba,Sonarpur Station Road,P.O. -Narendrapur, -Kolkata-WEST BENGAL INDIA Phone- 9836878855 FAX : 033-24342748 Pincode : 700103 Email : gkm_ani@hotmail.com		
26	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	BOSE PANDA INSTRUMENTS PVT.LTD.	Mr. Partha Bose 44, Saheed Hemanta Kumar Bose, Sarani, Kolkata Phone- +91 33 2548 7220 Pincode : 700074 Email : parthabosebpi@gmail.com; bosepanda@vsnl.net	Works-1->Mr. Partha Bose 44, Saheed Hemanta Kumar Bose,Sarani, -Kolkata-WEST BENGAL India Phone- +91 33 2548 7220 FAX : +91 33 2548 0429, Pincode : 700074 Email : parthabosebpi@gmail.com bosepanda@vsnl.net		

SUB-VENDOR LIST FOR C&I ITEMS

Sl No	Package Code	Package Name	Supplier Name	Supplier Communication Address	Supplier Works Address	Tech Limit	Fin Limit
27	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com	Works-1->Mr. Hitesh Parmar/Mr. Hitesh Parmar Plot No.2306, Phase II, GIDC Chhatral, -Kalol-GUJARAT INDIA Phone- 9327359227 FAX : 02764-233440 Pincode : 382729 Email : hitesh.parmar@ashcroftindia.com		
28	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	32,INDUSTRIAL SUBURB YESWANTHAPUR BANGALORE Phone- 080-23370300, Pincode : 560022 Email : info@hgurusouth.com	Works-1->Shikha Hazra/ Shyamal Hazra 32, Industrial Suburb,Yeshwanthpur -BANGALORE-KARNATAKA INDIA Phone- 080-23370300 FAX : 080-23379890 Pincode : 560022 Email : shikhahazra@hgurusouth.com		
29	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com	Works-1->Mr. Shyam Warilani/Mr. V Suresh Babu Plot No 34 À GIDC À Phase 1, -VAPI-GUJARAT INDIA Phone- +91 11 4161 7111 FAX : 022 2687 3613 Pincode : 396 195 Email : pbajaj@baumer.com		
30	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	FORBES MARSHALL (HYD) LTD.	MR SAILESH PATALAY/MR. M K SRINIVASAN PLOT NO.A-19/2, & T-4/2, IDA, NACHARAM, HYDERABAD Phone- 9849913704 Pincode : 500 076 Email : mksrinivasan@forbesmarshall.com	Works-1->MR G.SRINIVASAN/MR ANUJ MALPANI PLOT NO:A-19/2 & T-4/2,I.DA. NACHARAM , -HYDERABAD-TELANGANA INDIA Phone- 09866550762 FAX : 040 27152193 Pincode : 560076 Email : gshrinivasan@forbesmarshall.com		
31	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com.	Works-1->Gauge Bourdon India Pvt. Ltd., Plot No-4, 5, 6,Jawahar Co-operative Industrial Estate, -Kalamboli Taluka Panvel-MAHARASHTRA India Phone- 022-27421095, FAX : 022-27421901, Pincode : 410209, Email : info@general-gauges.com		
32	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	Nesstech Instruments Private Limited	26/2, G Type, Global Industrial Park Near Nahuli Railway Crossing, Valvada Vapi Phone- 9920576002 Pincode : 396105 Email : sales@nesstech.co.in	Works-1-> Others 26/2, G Type, Global Ind. Park Near Nahuli Railway Crossing, -Vapi-GUJARAT INDIA Phone- 9920576002 FAX : Pincode : 396105 Email : sales@nesstech.co.in, bkapadia@nesstech.co.in		
33	145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com	Works-1->Scientific Center, Others By-Pass Junction,Near Kalsekar College kausa, mumbra,Thane -Mumbai-MAHARASHTRA INDIA Phone- 022-25491409,9892230623 FAX : Pincode : 400612 Email : sdbpl@vsnl.com		
34	145-14000-A	TRANSMITTERS	YOKOGAWA INDIA LIMITED,	PLOT NO.96, ELECTRONICS CITY COMPLEX, HOSUR ROAD, BANGALORE, Phone- 080-41586000, Pincode : Email : uday.shankar@in.yokogawa.com.	Works-1-> PLOT NO.96, ELECTRONICS CITY COMPLEX, HOSUR ROAD, -BANGALORE-KARNATAKA INDIA Phone- 080-41586000, FAX : 080-28521442, Pincode : Email : uday.shankar@in.yokogawa.com		
35	145-14000-A	TRANSMITTERS	ABB INDIA LIMITED	MR. RAJIV GOVIL 14, MATHURA ROAD, FARIDABAD Phone- 09971085678 Pincode : 121003 Email : vipin.swami@in.abb.com		PRESSURE TRANSMITTER, DP TRANSMITTER and TEMP TRANSMITTER	

SUB-VENDOR LIST FOR C&I ITEMS

Sl No	Package Code	Package Name	Supplier Name	Supplier Communication Address	Supplier Works Address	Tech Limit	Fin Limit
36	145-14000-A	TRANSMITTERS	V. AUTOMAT & INTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com	Works-1->Mr. BHAGWAN SINGH/ Mr. NANDAN SINGH F-61, OKHLA INDL.AREA,PHASE-I -NEW DELHI-DELHI INDIA Phone- 011-47627200 Extn. 3 FAX : 011- 26819440 Pincode : 110 020 Email : production@vautomat.com	a)DISPLACEMENT TYPE TRANSMITTERS. b)PRESSURE AND DP TRANSMITTERS	
37	145-14000-A	TRANSMITTERS	Pune Techtrol Pvt. Ltd.	N.P.Khatan/Sudhakar Badiger S-18, MIDC Bhosari, Pune Phone- 9850560042 Pincode : 411 026 Email : ho@punetechtrol.com		Only for capacitance Type Level Transmitter	
38	145-14000-A	TRANSMITTERS	TOSHNIWAL INDUSTRIES PVT. LTD.,	Industrial Estate, Makhupura, Ajmer, Phone- 9352009000, Pincode : 305002, Email : info@tipl.com,	Works-1-> Khasra No.: 218-230& 235, Industrial Estate,Makhupura, -Ajmer-RAJASTHAN India Phone- 9887865856, FAX : 0145-2695174, Pincode : 305002, Email : rajeev.gupta@tipl.com		
39	145-14000-A	TRANSMITTERS	SBEM PVT. LTD.	MR.N.K. BEDARKAR/MR. VISHWANATH KARANDIK 39, ELECTRONIC CO.OP. ESTATE, PUNE SATARA ROAD PUNE, Phone- 912041030100 Pincode : 411009 Email : newdelhi@sbem.co.in	Works-1->MR. MOHAN PADWAL 691/A/2,BIBWEWADI INDL ESTATE -PUNE-MAHARASHTRA INDIA Phone- 918600042374 FAX : 912024215670 Pincode : 411037 Email : wm@sbem.co.in	FOR CAPACITANCE TYPE.	
40	145-14000-A	TRANSMITTERS	Endress + Hauser (India) Pvt. Ltd.,	Mr. Prakash Vaghela 215-216, DLF Tower 'A', Jasola District Centre, New Delhi, Phone- 9717593001, Pincode : 110025, Email : prakash.vaghela@in.endress.com.	Works-1-> M-171 to 173, MIDC, Waluj, -Aurangabad-MAHARASHTRA India Phone- 9881000474, FAX : 0240-2555179, Pincode : 431136, Email : Narendra.Kulkarni@wetzer.endress.com	"Except Displacement Type Level Transmitters"	
41	145-14000-A	TRANSMITTERS	Moore Industries International Inc.	Leonard.W. Moore/ Matt Moren 16650 Schoenborn St. North Hills Phone- +1 818 830 5548 Pincode : 91343 Email : mmoren@miinet.com	Works-1->Matt Moren/Gina Cruz 16650 Schoenborn St., North Hills -CALIFORNIA- USA Phone- +1 818 894 7111, ext FAX : +1 818 830 5588 Pincode : 91343 Email : gcruz@miinet.com		
42	145-14000-A	TRANSMITTERS	PANAM ENGINEERS	Mr. Santosh Shukla 203, Jaisingh Business,Parsiwada, Sahar road,Andheri(East), Mumbai, Phone- 9892179529, Pincode : 400099, Email : santosh@panamengineers.com	Works-1->Mr. Santosh Shukla Others R-628,TTC Industrial Area, MIDC Rabale, -Navi Mumbai-MAHARASHTRA India Phone- 9821350761, FAX : 022-27695559, Pincode : 400701, Email : sales@panamengineers.com	For Pressure and Diff. Pressure transmitter	
43	145-14000-A	TRANSMITTERS	Honeywell Automation India Limited	Mr. Ritwij Kulkarni 917, INTERNATIONAL TRADE TOWER, NEHRU PLACE, NEW DELHI Phone- 9890200584 Pincode : 110019 Email : rajesh.chaudhary@honeywell.com	Works-1->Mr.Kedar Tillu 53, 54, 56 & 57,Hadapsar Industrial Estate -PUNE-MAHARASHTRA INDIA Phone- 9665034625 FAX : 020 66039905 Pincode : 411013 Email : kedar.tillu@honeywell.com		
44	145-14000-A	TRANSMITTERS	EMERSON PROCESS MANAGEMENT (INDIA) PVT.LTD.	Mr. Amit Paithankar/Vikram Raj Singh 206-210,BALARAMA BUILDING 2ND FLR. BANDRA EAST MUMBAI Phone- 9619121500 Pincode : 400051 Email : vikramraj.singh@emerson.com	Works-1->Kalpesh Chandan/Hrishikesh Aghor Plot No. A 145/4 TTC IND AREA,MIDC, PAWANE, -NAVI MUMBAI-MAHARASHTRA INDIA Phone- 9619688001 FAX : 022-66736000 Pincode : 400 705 Email : Kalpesh.chandan@emerson.com		

SUB-VENDOR LIST FOR C&I ITEMS

Sl No	Package Code	Package Name	Supplier Name	Supplier Communication Address	Supplier Works Address	Tech Limit	Fin Limit
45	145-14000-A	TRANSMITTERS	SMART INSTRUMENTS LTD, BRAZIL	Agents: Digital Electronic Ltd. 74/11 'C' Cross Road MIDC Andheri (East) MUMBAI Phone- 28208477 Pincode : 400093 Email : corp@delbby.rpgms.ems.vsnl.net.in		LD-301 & T-301 TRANSMITTER FROM M/S SMART EQUIPMENTS BRAZIL.	
46	145-14000-A	TRANSMITTERS	SIEMENS LIMITED	Dr. Armin Bruck/Sandeep Mathur 130, Pandurang Budhkar Marg Worli Mumbai Phone- 0124 383 7377 Pincode : 400018 Email : ankit.varshney@siemens.com	Works-1->Ankit Varshney Kalwa Works, Thane-Belapur Road, Thane, -MUMBAI-MAHARASHTRA INDIA Phone- FAX : Pincode : 400708 Email :		
47	145-14000-A	TRANSMITTERS	NIVO CONTROLS PVT. LTD.	Mr. Praveen Toshniwal 104-115, Electronic Complex, Indore Phone- 0731-4081305 Pincode : 452010 Email : sales@nivocontrols.com	Works-1->Mr. Praveen Toshniwal 104-115, Electronic Complex, -Indore-MADHYA PRADESH India Phone- 0731-4081305 FAX : 0731-255075 Pincode : 452010 Email : sales@nivocontrols.com	For Capacitance type only	
48	145-21000-A	DIFFERENTIAL PRESSURE SWITCH	SOR INC.	LARRY DEGARMO/Avdhesh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdhesh@sherman-india.com			
49	145-25000-A	JUNCTION BOX	K.S.INSTRUMENTS PVT.LTD.	S Raghavan No. 72, 3rd Main, 1st Stage Industrial Suburb, Yeshwanthpur Bangalore Phone- 9880385770 Pincode : 560022 Email : sales1@ksinstruments.net			
50	145-25000-A	JUNCTION BOX	SUCHITRA INDUSTRIES	NO-2,OPP-27 AECS LAYOUT 2ND STG REJAMAHALVILAS EXTN 2ND STG BANGALORE Phone- Pincode : Email : suchitra.industriesblr@gmail.com	Works-1->B. Srinivas Suchitra Industries, Opp No 53, Muneshwara Black Devinagar, Lottagal hal -BANGALORE-KARNATAKA INDIA Phone- 080-23511247 FAX : Pincode : 560094 Email : suchitra_industries@yahoo.com		
51	145-25000-A	JUNCTION BOX	Shrenik & Company,	Mr. Mitesh Shah/Mr. Pulin Shah 39 A/3 ,Panchratna Industrial Estate, Sarkhej-Bavla Road Ahmedabad Phone- 9825024921 Pincode : 382213 Email : sales@pustron.com, pulin@sumip.com	Works-1->Mr.Pulin Shah/ Mr. Kaloesh Parmar 39 A/3 ,Panchratna Industrial Est,Sarkhej-Bavla Road, Changodhar -Ahmedabad-GUJARAT INDIA Phone- 98250 80339 1 FAX : 079-26932424 Pincode : 382213 Email : sales@sumip.com		
52	145-25000-A	JUNCTION BOX	FLEXPRO ELECTRICALS PVT. LTD.	Mr. Dineshbhai Zaveri C-1/ 27&37, GIDC, Kabilpore, Navsari Phone- 02637-265140,265003 Pincode : 396424 Email : flexpro@flexproltd.com	Works-1->Mr. Dineshbhai Zaveri CEO C-1/ 27&37, GIDC, Kabilpore, -Navsari-GUJARAT INDIA Phone- 02637-265140,265003 FAX : 02637-265308 Pincode : 396424 Email : flexpro@flexproltd.com	Metal type junction box only	
53	145-25000-A	JUNCTION BOX	AJMERA INDUSTRIAL & ENGINEERING WORKS	JIGNESH MAHENDRA AJMERA DENA BANK BLDG.,SHREE NAGESH INDL. ESTATE,STATION ROAD, MUMBAI Phone- 022 67973578 Pincode : 400 088 Email : ajmera@ajmera.net, jmajmera@yahoo.com	Works-1->JIGNESH MAHENDRA AJMERA DENA BANK BLDG., SHREE NAGESHINDL. ESTATE,STATION ROAD, -MUMBAI-MAHARASHTRA INDIA Phone- 022 67973578 FAX : Pincode : 400 088 Email : ajmera@ajmera.net		

SUB-VENDOR LIST FOR C&I ITEMS

Sl No	Package Code	Package Name	Supplier Name	Supplier Communication Address	Supplier Works Address	Tech Limit	Fin Limit
54	145-32000-A	INSTRUMENTS TUBE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com	Works-1->S.R.SINGH/ NAVEEN SINGH B - 2, SECTOR - 6, -NOIDA-UTTAR PRADESH INDIA Phone- 0120-4352940 FAX : 0120-4352940 Pincode : 201301 Email : naveensingh@vsnl.com		Over all financial limit for ordering as Rs.30 lacs (Rs.Thirty Lacs). The registration category & the financial limit may be reviewed after survey in March 2009 and approval thereof. Registered w.e.f. 22.01.2009.
55	145-32000-A	INSTRUMENTS TUBE FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone-(022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com	Works-1->Mr. Tansen Choudhari/Mr. Mahesh Darekar Shed No.8, Lonavla Indl.Co-op.Estate Ltd,Nagargaon, -Lonavla-MAHARASHTRA INDIA Phone- 9823951347 FAX : (02114) 271132 Pincode : 410 401 Email : factory@hyd-air.com		
56	145-32000-A	INSTRUMENTS TUBE FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com	Works-1->ALEX BAPTIST/ K. SRINIVAS 7. SIDHAPURA INDUSTRIAL ESTATE,SV ROAD, GOREGAON(WEST) -MUMBAI-MAHARASHTRA INDIA Phone- 022-42631700 FAX : 022-40035259 Pincode : 400 062 Email : srinivas@precision-engg.com		
57	145-32000-A	INSTRUMENTS TUBE FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com			
58	145-38000-A	INSTRUMENTS PIPE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com	Works-1->S.R.SINGH/ NAVEEN SINGH B - 2, SECTOR - 6, -NOIDA-UTTAR PRADESH INDIA Phone- 0120-4352940 FAX : 0120-4352940 Pincode : 201301 Email : naveensingh@vsnl.com		Over all financial limit for ordering as Rs.30 lacs (Rs.Thirty Lacs).
59	145-38000-A	INSTRUMENTS PIPE FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone-(022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com	Works-1->Mr. Tansen Choudhari/Mr. Mahesh Darekar Shed No.8, Lonavla Indl.Co-op.Estate Ltd,Nagargaon, -Lonavla-MAHARASHTRA INDIA Phone- 9823951347 FAX : (02114) 271132 Pincode : 410 401 Email : factory@hyd-air.com		
60	145-38000-A	INSTRUMENTS PIPE FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com			
61	145-38000-A	INSTRUMENTS PIPE FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com	Works-1->ALEX BAPTIST/ K. SRINIVAS 7. SIDHAPURA INDUSTRIAL ESTATE,SV ROAD, GOREGAON(WEST) -MUMBAI-MAHARASHTRA INDIA Phone- 022-42631700 FAX : 022-40035259 Pincode : 400 062 Email : srinivas@precision-engg.com		
62	145-45000-A	INSTRUMENT FITTINGS	HP VALVES & FITTINGS INDIA PVT. LTD.	S. Harichandran/P.S. Pandi B-11, Mugappair Industrial Estate, CHENNAI Phone- 044 26252537 Pincode : 600037 Email : sales@hpvalvesindia.com	Works-1->S. Harichandran/ P.S. Pandi B-11, Mugappair Industrial Estate, -CHENNAI-TAMIL NADU INDIA Phone- 044-25252537 FAX : 044-26252538 Pincode : 600037 Email : sales@hpvalvesindia.com		

SUB-VENDOR LIST FOR C&I ITEMS

Sl No	Package Code	Package Name	Supplier Name	Supplier Communication Address	Supplier Works Address	Tech Limit	Fin Limit
63	145-45000-A	INSTRUMENT FITTINGS	Perfect Instrumentation Control (India) Pvt. Ltd.	MD Hussain Shaikh/Shahanawaz Khan Gala No. 168, Loheki Chwal,216/ 218, Maulana Azad Rd. Nagpada Junction Mumbai Phone- 91-9324383121 Pincode : 400008 Email : shahanawaz.khan@perfectinstrumentation.com	Works-1->Shahanawaz Khan Vishweshwar Ind. Premises Co-op Soc. Ltd,F-18/19, Pradhikaran,Bhosadi MIDC -PUNE-MAHARASHTRA INDIA Phone- 020-30694134 FAX : 022-23013010 Pincode : 411026 Email : shahanawaz.khan@perfectinstrumentation.com		
64	145-45000-A	INSTRUMENT FITTINGS	Arya Crafts & Engineering Pvt. Ltd.	Mr.Sanjay Brahman/Mr.Shyam Vazirani 102, Vora Industrial Estate No.4 Navghar, Vasai Road (E) Dist.Thane, Mumbai Phone- +91-250-2392246 Pincode : 401210 Email : arya@aryaengg.com			
65	145-45000-A	INSTRUMENT FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com	Works-1->ALEX BAPTIST/ K. SRINIVAS 7. SIDHAPURA INDUSTRIAL ESTATE,SV ROAD, GOREGAON(WEST) -MUMBAI-MAHARASHTRA INDIA Phone- 022-42631700 FAX : 022-40035259 Pincode : 400 062 Email : srinivas@precision-engg.com		
66	145-45000-A	INSTRUMENT FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com			
67	145-45000-A	INSTRUMENT FITTINGS	Comfit & Valve Pvt. Ltd.	Mr. Jeetu Jain/Mr. Vinay Sosa Survey No. 23/1, Part 2, Ahmedabad-Mehsana Highway Laxmipura, Nandasan Phone- 02764-267036/37 Pincode : 382705 Email : marketing@com-fit.com	Works-1->Miss Sonal Pithadia/Miss Pavan Chavda Survey No. 23/1, Part 2, Ahmedabad-Mehsana Highway, Laxmipura -Nandasan-GUJARAT INDIA Phone- 8460848087 FAX : 2764-267036/37 Pincode : 382705 Email : domestic@com-fit.com		
68	145-45000-A	INSTRUMENT FITTINGS	FLUIDFIT ENGINEERS PVT. LTD.	Mr. Abbas Bhola Potia Building No. 2, Office No. 3,292, Bellasis Road,Mumbai Central (East) Mumbai Phone- 9920044113 Pincode : 400008 Email : ab@fluidfitengg.com	Works-1->Mr. Abbas Bhola Unit No. 16, Supreme Industrial Estate,Kaman Bhiwandi Road,Devdal, -Vasai East-MAHARASHTRA India Phone- 9920044113 FAX : 07303178243 Pincode : 401208 Email : ab@fluidfitengg.com		
69	145-45000-A	INSTRUMENT FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com	Works-1->S.R.SINGH/ NAVEEN SINGH B - 2, SECTOR - 6, -NOIDA-UTTAR PRADESH INDIA Phone- 0120-4352940 FAX : 0120-4352940 Pincode : 201301 Email : naveensingh@vsnl.com		Over all financial limit for ordering as Rs.30 lacs (Rs.Thirty Lacs).
70	145-45000-A	INSTRUMENT FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Moochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com	Works-1->Mr. Tansen Choudhari/Mr. Mahesh Darekar Shed No.8, Lonavla Indl.Co-op.Estate Ltd,Nagargaon, -Lonavla-MAHARASHTRA INDIA Phone- 9823951347 FAX : (02114) 271132 Pincode : 410 401 Email : factory@hyd-air.com		

SUB-VENDOR LIST FOR C&I ITEMS

Sl No	Package Code	Package Name	Supplier Name	Supplier Communication Address	Supplier Works Address	Tech Limit	Fin Limit
71	145-45000-A	INSTRUMENT FITTINGS	PANAM ENGINEERS	Mr. Santosh Shukla 203, Jaisingh Business,Parsiwada, Sahar road,Andheri(East), Mumbai, Phone-9892179529, Pincode : 400099, Email : santosh@panamengineers.com	Works-1->Mr. Santosh Shukla Others R-628,TTC Industrial Area, MIDC Rabale, -Navi Mumbai-MAHARASHTRA India Phone- 9821350761, FAX : 022-27695559, Pincode : 400701, Email : sales@panamengineers.com		

Notes :-

i) The above sub-vendor list is tentative & for reference only. However Sub-Vendor List is subject to BHEL/ end user approval without any commercial/ delivery implication.

ii) New Sub-Vendor if proposed by Vendor during contract stage shall be subject to BHEL/ end user approval without any commercial/ delivery implication.

A.1 MAKES OF CHAIN PULLEY BLOCK AS PER LIST BELOW:

Package Name	Vendor Name
CHAIN PULLEY BLOCK	UNIVERSAL HOIST-O-FABRIK
	CENTURY CRANE ENGINEERS PVT. LTD.
	BAKELITE ELECTRICAL MFG. CO. PVT. LTD.
	TRACTEL TIRFOR INDIA PVT. LTD.
	BRADY & MORRIS ENGINEERING CO. LTD.
	TUOBRO FURGUSON (INDIA) PVT LTD
	TECHNO INDUSTRIES

A.2 MAKES OF SUB VENDORS ITEMS AS APPLICABLE TO MANUAL HOIST:

Sl no.	ITEM	MAKES
1.0	STEEL	SAIL/IISCO/TATA STEEL / JINDAL
2.0	HOOKS	STEEL FORGINGS/ KARACHIWALA/SMRITI/NASIK FORGE.
3.0	STEEL FORGINGS	CHOWDHARY/WESTERN INDIA FORGINGS/ HINDUSTAN STEEL FORGINGS/ RUBY FORGINGS OR AS APPROVED BY BHEL.
4.0	BRAKES	OEM

B.1 MAKES OF ELECTRIC HOIST AS PER LIST BELOW:

1. MANGLA HOISTS PVT LTD
2. BRADY & MORRIS ENGINEERING CO. LTD.
3. S CRANE ENGINEERING WORKS
4. J.D.HOISTS & CRANES PVT. LTD.
5. UNIVERSAL HOIST-O-FABRIK
6. CENTURY CRANE ENGINEERS PVT. LTD.
7. REVA INDUSTRIES INDIA PRIVATE LIMITED
8. CONSOLIDATED HOISTS PVT LTD
9. EDDY CRANES PVT. LTD.
10. TRACTEL TIRFOR INDIA PVT. LTD.
11. GRIP ENGINEERS PVT. LTD.,
12. SMACO ENGINEERING PVT. LTD.
13. ALPHA SERVICES
14. TECHNO INDUSTRIES

B.2 MAKES OF SUB VENDORS ITEMS AS APPLICABLE TO ELECTRIC HOIST:

S.NO.	ITEM	STANDARD MAKES	REMARKS
1	STEEL	SAIL /TISCO / JINDAL/ ESSAR	
2	HOOKS	Steel Forging & Engg. Co., Kolkata/ SIMRITI FORGING/ Karachiwala (up to 25T)	
3	GEAR COUPLINGS	ALLIANCE / FLEX-TRANS (formerly known as HICLIFF) / OEM / NUTECH/ SAHARA	
4	WIRE ROPE	USHA MARTIN / FORT WILLIAMS/ Bharat Wire Ropes.	
5	BEARINGS	SKF/ FAG/ TATA / NBC	

6	MOTORS	SIEMENS / NGEF (up to 15KW) / CROMPTON / KIRLOSKAR / BHARAT BIJLI / MARATHON/ ABB/LHP	
7	BRAKES	ELECTROMAG /SPEED-O- CONTROL / BCH (for DCEM Brakes only) / Kakku	
8	CONTACTOR	SIEMENS / L&T /SCHNEIDER (Earlier TELE MECHANIQUE) / BCH	
9	OVER LOAD RELAYS	SIEMENS / L&T / ABB / SCHNEIDER (Earlier TELE MACHANIQUE)	
10	HRC FUSES	SIEMENS / L&T/ ENGLISH ELECTRIC / GE Power / Eaton (Bussmann)/ABB	
11	ISOLATING SWITCH	SIEMENS/ L&T/ CONTROL & SWITCH GEAR/ABB	
12	SWITCH FUSE UNITS	SIEMENS/ L&T/ CONTROL & SWITCH GEAR/ ABB	
13	TIME DELAY RELAYS	SIEMENS/ L&T/ ABB/ BCH/ SCHNEIDER (Earlier TELE MACHANIQUE)	
14	TRANSFORMERS	INDCOIL / LOGICSTAT/ KAPPA / AUTOMATIC ELECTRIC / PRECISE ELECTRICALS / SILKAAN ELECTRIC MFG. CO. LTD. / SOUTHERN ELECTRIC/NEC	
15	CABLE LUGS (HEAVY DUTY)	DOWELLS / UML ENGINEERS, KOLKATA / JAINSON	
16	CABLES		
a)	PVC Power Cables	APAR INDUSTRIES LTD., CORDS CABLE INDUSTRIES LTD., Diamond Power Infrastructure Ltd, GOYOLENE FIBRES (INDIA) PVT.LTD, GOVIND CABLE INDUSTRIES, GUPTA POWER INFRASTRUCTURE LIMITED,, Havells India Limited, KEI INDUSTRIES LTD., KRISHNA ELECTRICAL INDUSTRIES LTD., KEC INTERNATIONAL LIMITED, MANSFIELD CABLES COMPANY LTD., NICCO CORPORATION LTD., PARAMOUNT COMMUNICATIONS LTD., POLYCAB WIRES PVT. LTD., RADIANT CORPORATION PRIVATE LIMITED, RAVIN CABLES LIMITED, SUYOG ELECTRICALS LTD., SRIRAM CABLES PVT. LTD., Scot Innovation Wires and Cables Pvt. Ltd., Sam Cables & Conductors (P) Ltd., THERMO CABLES LTD.,	
b)	PVC Control cables	Advance Cable Technologies (P) Ltd., APAR INDUSTRIES LTD., CMI LTD., CORDS CABLE INDUSTRIES LTD., CRYSTAL CABLE INDUSTRIES LTD, DELTON CABLES LTD, Diamond Power Infrastructure Ltd, ELKAY TELELINKS LTD,	

		GEMSCAB INDUSTRIES LTD., GOVIND CABLE INDUSTRIES, GUPTA POWER INFRASTRUCTURE LIMITED,, Havells India Limited, Incom Cables (P) Ltd.,KEI INDUSTRIES LTD., KRISHNA ELECTRICAL INDUSTRIES LTD., KEC INTERNATIONAL LIMITED, MANSFIELD CABLES COMPANY LTD., NICCO CORPORATION LTD., PARAMOUNT COMMUNICATIONS LTD., POLYCAB WIRES PVT. LTD., RAVIN CABLES LIMITED, SUYOG ELECTRICALS LTD., SPECIAL CABLES PVT. LTD, Scot Innovation Wires and Cables Pvt. Ltd., Sam Cables & Conductors (P) Ltd., SPM POWER & TELECOM PVT. LTD,TORRENT CABLES LTD., THERMO CABLES LTD., TIRUPATI PLASTOMATICS PVT. LTD., UNIVERSAL CABLES LTD.	
c)	Trailing Cables	Nicco / Universal / Incab / ICL / KEI/ APAR INDUSTRIES LTD/ CMI LTD/ KEI INDUSTRIES LTD./ SUYOG ELECTRICALS LTD.	
d)	XLPE Power Cables	APAR INDUSTRIES LTD., CORDS CABLE INDUSTRIES LTD., CRYSTAL CABLE INDUSTRIES LTD, Diamond Power Infrastructure Ltd, GEMSCAB INDUSTRIES LTD., GOVIND CABLE INDUSTRIES, GUPTA POWER INFRASTRUCTURE LIMITED,, Havells India Limited, KEI INDUSTRIES LTD., KRISHNA ELECTRICAL INDUSTRIES LTD., KEC INTERNATIONAL LIMITED, MANSFIELD CABLES COMPANY LTD., PARAMOUNT COMMUNICATIONS LTD., POLYCAB WIRES PVT. LTD., RAVIN CABLES LIMITED, SUYOG ELECTRICALS LTD., SPECIAL CABLES PVT. LTD, Scot Innovation Wires and Cables Pvt. Ltd., SRIRAM CABLES PVT. LTD.,TORRENT CABLES LTD., THERMO CABLES LTD., TIRUPATI PLASTOMATICS PVT. LTD.,	
e)	XLPE Control cables	APAR INDUSTRIES LTD., CABLE CORPORATION OF INDIA LTD., CRYSTAL CABLE INDUSTRIES LTD., Diamond Power Infrastructure Ltd, GEMSCAB INDUSTRIES LTD., Havells India Limited, KEI INDUSTRIES LTD., KRISHNA ELECTRICAL INDUSTRIES LTD., KEC INTERNATIONAL LIMITED, PARAMOUNT COMMUNICATIONS LTD., POLYCAB WIRES PVT. LTD., RADIANT CORPORATION PRIVATE LIMITED, RAVIN CABLES LIMITED, SUYOG ELECTRICALS LTD., SRIRAM CABLES PVT. LTD., TORRENT CABLES LTD., UNIVERSAL CABLES	

		LTD.	
17	Cable gland	COMMET / SUNIL&CO./ ARUP ENGINEERING / JAINSON / DOWELL	
18	PUSH BUTTONS	SIEMENS / L&T / BCH / Schneider	
19	Limit Switches	Speed-o-control / Electromag	
20	Pendent Push button station	OEM	
21	Indicating Lamps	Tecknic / BCH / Siemens / Standard	
22	MCB	MDS / Indo Copp / Standard / Siemens / L&T/ ABB/ Schneider	
23	Panels	OEM / RITTAL / PYROTECH	
24	Resistance boxes	Enapros / OEM	
25	VVVF	YASKAWA/ ABB / SIEMENS/ SCHNIEDER/ FUJI ELECTRIC/ MITSUBISHI ELECTRIC	
26	Shrouded DSL	Susheel/ Stromag	
27	LOAD CELL	IPA, Sartorius	
28	GEAR BOX	OEM/ ELECON ENGINEERS/ SHANTI GEARS/ PBL*/ NAW*/ NORD*/ SEW*/ BONGFILIOLI*	* = Applicable for Geared Motors only
29	RAIL	JSPL / SAIL	

NOTE:

No other make will be acceptable, until and unless specifically got approved by BHEL/Customer / Customer's consultant during detail engineering only. Acceptance/non acceptance of same shall not have any impact on manufacturing, delivery schedule and on cost of the hoists.

ANNEXURE-III

FUNCTIONAL GUARANTEES

PERFORMANCE GUARANTEES

1. GENERAL

The term "Performance Guarantees" wherever appears in the Technical Specifications shall have the same meaning and shall be synonymous to "Functional Guarantees". Similarly, the term "Performance Tests" wherever appears in the Technical Specifications shall have the same meaning and shall be synonymous to "Guarantee Test(s)".

1.1 GENERAL REQUIREMENTS

1.1.1 The Bidder shall guarantee that the equipment offered shall meet the ratings and performance requirements stipulated for various equipment covered in these specifications.

1.1.2 All costs associated with the tests including cost associated with the supply, calibration, installation and removal of the test instrumentation shall be included in the contract price.

1.1.3 It is the responsibility of the Bidder to perform the Performance Guarantee / Acceptance test as specified in this section. The performance tests shall be performed using only the normal number of Owner supplied operating staff. Bidder, vendor or other sub-Bidder personnel shall be used only for instructional purposes or data collection. At all times during the Performance Tests the emissions and effluents from the Plant shall not exceed the Guaranteed Effluent Limits.

1.1.4 It shall be responsibility of the Bidder to make the system ready for the performance guarantee tests.

1.1.5 **Test Instrumentation, Flow Measurement and their Calibration**

All instruments required for performance testing shall be of the type and accuracy required by the code and prior to the test, the Bidder shall get these instruments calibrated in an independent test Institute approved by the Owner. All test instrumentation required for performance tests shall be supplied by the Bidder and shall be retained by him upon satisfactory completion of all such tests at site. All calibration procedures and standards shall be subject to the approval of the Owner. The protecting tubes, pressure connections and other test connections required for conducting guarantee test shall conform to the relevant codes.

Tools and tackles, thermos wells (both screwed and welded) instruments/devices including flow devices, matching flanges, impulse piping & valves etc. and any special equipment, required for the successful completion of the tests, shall be provided by the Bidder free of cost.

1.1.6 The Performance test shall be carried out as per the agreed procedure. The PG test procedure including demonstration tests shall be submitted for approval. After the conductance of Performance test, the Bidder shall submit the test evaluation report of Performance test results to Owner promptly but not later than one month from the date of conductance of Performance test. However, preliminary test reports shall be submitted to the Owner after completing each test run.

1.1.7 The P&G test procedures shall be submitted for equipment's/ system & subsystem under Bidder's scope for all Guarantees mentioned below, as per latest International codes / standard including correction curves, meeting the specification requirements

along with sample calculations & detailed activity plan of preparation (including test instrumentation), conductance and evaluation of Guarantees.

1.1.8 The Bidder shall submit for Owner's approval the detailed Performance Test procedure containing the following:

- Object of the test
- Various guaranteed parameters & tests as per contract.
- Method of conductance of test and test code.
- Duration of test, frequency of readings & number of test runs.
- Method of calculation.
- Instrument list consisting of range, accuracy, least count, and
- location of instruments.
- Scheme showing measuring points.
- Sample calculation
- Acceptance criteria.
- Any other information required for conducting the test.

1.1.9 **Test Reports**

After the conductance of Performance test, the Bidder shall submit the test evaluation report of Performance test results to Owner promptly but not later than one month from the date of conductance of Performance test. Preliminary test reports shall be submitted to the Owner after completing each test run. Four (4) hard copies and two (2) soft copies on CD-ROM of each test report of final conducted test on each equipment/plant/system shall be submitted to Owner for approval.

1.1.10 In case during performance guarantee test(s) it is found that the equipment/system has failed to meet the guarantees, the Bidder shall carry out all necessary modifications and/or replacements to make the equipment/system comply with the guaranteed requirements at no extra cost to the Owner and re-conduct the performance guarantee test(s) with Owner's consent. In case the specified performance guarantee(s) are still not met by the Bidder even after modification and/or replacement but are achieved within the Acceptable Shortfall Limit Owner will accept the equipment/system/plant after levying the liquidated damages.

1.2 FUNCTIONAL GUARANTEE

1.2.1 **NOISE**

All the plant, equipment and systems covered under this specification shall perform continuously without exceeding the noise level over the entire range of output and operating frequency as specified in elsewhere in tender specification.

Noise level measurement shall be carried out using applicable and internationally acceptable standards. The measurement shall be carried out with a calibrated integrating sound level meter meeting the requirement of IEC 651 or BS 5969 or is 9779. Sound pressure shall be measured all around the equipment at a distance of 1.0 m horizontally from the nearest surface of any equipment/ machine and at a height of 1.5 m above the floor level in elevation.

1.3 TECHNICAL GUARANTEE:

1.3.1 INLET WASTE WATER ANALYSIS:

S.No	Description	Unit	Value
1)	Temperature	ºC	51
2)	pH		5 to 8
3)	Total suspended solids	mg/l	30000
4)	TDS	mg/l	35000-40000
5)	H^+	mg/l	7.59E-06
6)	Na^+	mg/l	2373.9
7)	K^+	mg/l	0
8)	Ca^{++}	mg/l	2920.7
9)	TO-Mg	mg/l	3027.68
10)	Mg^{++}	mg/l	2947.5
11)	Mn^{++}	mg/l	40
12)	Al^{+++}	mg/l	1.00
13)	NH_4^+ (AS N)	mg/l	0
14)	Cl^-	mg/l	20000
15)	Br^-	mg/l	0.00
16)	NO_3^- (AS N)	mg/l	166.78
17)	NO2- (AS N)	mg/l	4.67
18)	$S_2O_6^{--}$	mg/l	80.1
19)	SO_4^{--}	mg/l	5500
20)	HSO_4^-	mg/l	0.61
21)	TOTAL SO_4	mg/l	2264.23
22)	F^-	mg/l	17.99
23)	TOTAL F	mg/l	215
24)	B	mg/l	0.00
25)	COD	mg/l	615
26)	TOTAL N	mg/l	295

1.3.2 TREATED WASTE WATER OUTLET QUALITY:

Minimum Guarantees to be demonstrated by bidder have been included below. However, Bidder to meet outlet guarantee parameters as per the latest MOEF, State pollution control board norms and Local authority requirement in totality

S.No	Description	Unit	Value
1	pH		6.5 – 8.0
2	TSS	Mg/l	100 (max.)

ANNEXURE-IV

DRAWING DOCUMENTS DISTRIBUTION SCHEDULE

DRAWING DOCUMENTS DISTRIBUTION SCHEDULE

Documents:	**PEM-Engineering**
Documents for approval	8
Documents for information	8
Schedules, diagrams, lists, tables, calculation, specifications and other documents	8
Final as-built drawings	
CD-ROMs of final as-built drawings	10
Final as-built drawings (hard copy)	14
Final O&M manuals	18
CD-ROMs of Final O&M Manuals	10
Detailed project time schedules	5

Note:

- Quantity of prints may change during detailed engineering stage based on BHEL / Customer requirement. However, the same will be adhered by the bidder without any delivery/commercial implication to BHEL.
- All the drawing documents along with the O&M manual (of all the revisions) are necessarily to be submitted in soft copies in addition to hard copies.
- Bidder to submit soft copies of all the drawing and document along with quality plans for BHEL review and approval.
- All the drawings shall be prepared on computer auto cad and other documents (like datasheet etc.) on MS office software. Bidder not complying to the requirement shall not be considered. For the execution of the contract regular meeting (generally once in 15 days or as per project requirement) is required.
- Bidder has to come for meeting with the concerned dealing persons as per BHEL or customer requirement in a short notice.
- Bidder to submit instrument schedule, cable schedule and valve schedule in MS- Excel format during detailed engineering.
- Bidder to also furnish the auto cad copy / MS-word (as applicable) of the following documents after award of contract. However, any other auto cad copy/MS-Excel/MS-word of any other document as per the insistence of BHEL / customer will also be submitted by the bidder without any delivery/commercial implication to BHEL.
    - P&IDs.
    - Equipment lay out of the FGD waste water treatment area
    - Equipment Cable tray layout for FGD waste water treatment area
    - Equipment earthing layout for FGD waste water treatment area
    - Civil scope drawings.
    - Piping lay out drawing for FGD waste water treatment area

ANNEXURE-V

DRAWING /DOCUMENT SUBMISSION SCHEDULE

After award of LOI/LOA, following minimum drawing/documents shall be submitted by the bidder for BHEL/Customer approval. However, any additional drawing/document if found necessary for completion of the engineering, the same shall be submitted by bidder without any commercial & delivery implication to BHEL.

For the Drawings/Documents Submission Procedure, please refer following Annexure-A. Bidder has to submit the revised drawing/document along with the compliance sheet indicating enumerate reply to all BHEL and customer comments or observations. Without compliance sheet the submission of the drawings/documents will not be considered and the delay on this account will be solely on bidder's side only. The number of drawing/documents to be submitted by the bidder shall be as per enclosed Annexure-V.

Every revised submission incorporating comments shall be resubmitted within 7 days.

BHEL shall provide observation / approval within 15 days from the date of document submission by bidder.

Bidder to note that drawings submitted shall be complete in all respects with revised drawing submitted incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. Engineering meeting shall be held fort nightly, for which the bidder shall depute his concerned engineers along with project manager to PEM office or at customer office without fail.

Bidder to note that drawings submitted shall be complete in all respects with revised drawing submitted incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account.

MASTER DOCUMENT LIST				
S. No.	**DOCUMENT / DRAWING NO.**	**DRAWING / DOCUMENT TITLE FOR WASTE WATER TREATMENT PLANT**	**SCHEDULE OF SUBMISSION FROM LOI (IN WEEKS)**	**SIZE**
MECHANICAL				
1	PE-V0-483-164-A001	P&ID FOR WASTE WATER TREATMENT PLANT*	4	A1
2	PE-V0-483-164-A002	LAYOUT OF WASTE WATER TREATMENT PLANT*	6	A1
3	PE-V0-483-164-A003	PROCESS DESIGN & SIZING CALCULATIONS, PRESSURE DROP CALCULATIONS FOR WWTP*	4	A4
4	PE-V0-483-164-A004	SUB VENDOR LIST AND INSPECTION CRITERIA*	4	A4
5	PE-V0-483-164-A005	CONTROL WRITE UP*	6	A4
6	PE-V0-483-164-A006	TECHNICAL DATA SHEET AND GA DRG OF VERTICAL/HORIZONTAL SCREW PUMPS	10	A4
7	PE-V0-483-164-A007	TECHNICAL DATA SHEET AND GA DRG OF HORIZONTAL CENTRIFUGAL PUMPS	10	A4
8	PE-V0-483-164-A008	TECHNICAL DATA SHEET AND GA DRG FOR METERING PUMPS	8	A4
9	PE-V0-483-164-A009	TECHNICAL DATA SHEET AND GA DRG OF BLOWERS	8	A4
10	PE-V0-483-164-A010	GA DRAWING OF ATMOSPHERIC TANKS	10	A3

11	PE-V0-483-164-A011	MECAHNICAL GA DRAWING OF CLARIFIER	10	A3
12	PE-V0-483-164-A012	MECHANISM OF CLARIFIERS	10	A3
13	PE-V0-483-164-A013	DATASHEET AND GA DRG OF SAFETY ITEMS	10	A4
14	PE-V0-483-164-A014	DATASHEET AND GA DRG OF AGITATORS	10	A4
15	PE-V0-483-164-A015	DATASHEET AND GA DRG OF BUTTERFLY VALVE	10	A4
16	PE-V0-483-164-A016	DATASHEET AND GA DRG OF DIAPHRAGM VALVE	10	A4
17	PE-V0-483-164-A017	DATASHEET AND GA DRG OF BALL VALVE	10	A4
18	PE-V0-483-164-A018	DATASHEET AND GA DRG OF PRV	10	A4
19	PE-V0-483-164-A019	DATASHEET AND GA DRG OF GATE VALVE	10	A4
20	PE-V0-483-164-A020	DATASHEET AND GA DRG OF NRV	10	A4
21	PE-V0-483-164-A021	VALVE SCHEDULE	10	A4
22	PE-V0-483-164-A022	PIPING SCHEDULE	10	A4
23	PE-V0-483-164-A023	PAINTING SCHEDULE	10	A4
24	PE-V0-483-164-A024	CIVIL INPUT DRAWING OF CHEMICAL HOUSE	12	A1
25	PE-V0-483-164-A025	CIVIL INPUT DRAWING OF CENTRIFUGE SHED	12	A1
26	PE-V0-483-164-A026	CIVIL INPUT DRAWING OF FOUNDATION OF EQUIPMENT OUTSIDE OF CHEMICAL HOUSE	12	A1
27	PE-V0-483-164-A027	DATASHEET AND GA DRG OF THICKNER	10	A4/A1
28	PE-V0-483-164-A028	DATASHEET AND GA DRG OF CENTRIFUGE	10	A4
29	PE-V0-483-164-A029	MECHANICAL GA DRG OF RCC SUMPS INSIDE WWT AREA	12	A1
30	PE-V0-483-164-A030	PIPING LAYOUT INSIDE WWT AREA ALONG WITH DETAILS OF SUPPORTS	18	A1
31	PE-V0-483-164-A031	YARD PIPING LAYOUT ALONG WITH DETAILS OF SUPPORTS	18	A1
32	PE-V0-483-164-A032	PG TEST PROCEDURE FOR WWT	20	A4
33	PE-V0-483-164-A033	O& M MANUAL	20	A4

ELECTRICAL

34	PE-V0-483-164-A101	ELECTRICAL LOAD LIST	8	A4
35	PE-V0-483-164-A102	DATASHEET OF MOTORS	12	A4
36	PE-V0-483-164-A103	CABLE TRAY/TRENCH & CONDUIT ROUTING DIAGRAM INCLUDING JB LOCATION OF INSIDE AND OUTSIDE WWT	14	A1
37	PE-V0-483-164-A104	EARTHING LAYOUT OF INSIDE AND OUTSIDE WWTP	14	A1
		CONTROL AND INSTRUMENTATION		
38	PE-V0-483-164-A201	LIST OF DRIVES, JB GROUPING AND I/O LIST	10	A4
39	PE-V0-483-164-A202	INSTRUMENT SCHEDULE	10	A4
40	PE-V0-483-164-A203	DATASHEET OF ANALYSERS	10	A4
41	PE-V0-483-164-A204	DATASHEET OF TRANSMITTERS	10	A4
42	PE-V0-483-164-A205	DATASHEET OF LOCAL INSTRUMENTS	10	A4
43	PE-V0-483-164-A206	DATASHEET OF SOLENOID VALVE	10	A4
44	PE-V0-483-164-A207	DATA SHEET AND GA FOR JUNCTION BOXES	10	A4
45	PE-V0-483-164-A208	CABLE SCHEDULE AND INTERCONNECTION DIAGRAM	12	A4
46	PE-V0-483-164-A209	INSTRUMENT INSTALLATION DRAWINGS/ HOOK UP DIAGRAM FOR INSTRUMENTS	12	A4
47	PE-V0-483-164-A210	LIST OF 230V AC UPS LOAD	12	A4
48	PE-V0-483-164-A211	POWER DISTRIBUTION SCHEME-230 VAC.	12	A4
49	PE-V0-483-164-A212	CONTROL LOGICS	12	A4
50	PE-V0-483-164-A213	GA OF AC & DC POWER DISTRIBUTION BOARD	10	A4
51	PE-V0-483-164-A214	ALARM AND ANNUNCIATION LIST	10	A4
		QAP		
52	PE-V0-483-164-A301	QAP FOR THICKNER MECHANISM	10	A4
53	PE-V0-483-164-A302	QAP FOR CENTRIFUGE	10	A4
54	PE-V0-483-164-A303	QAP FOR HORIZONTAL CENTRIFUGAL PUMP	10	A4
55	PE-V0-483-164-A304	QAP FOR SCREW PUMP (VERTICAL/HORIZONTAL)	10	A4

56	PE-V0-483-164-A305	QAP FOR METERING PUMP	10	A4
57	PE-V0-483-164-A306	QAP FOR BLOWER	10	A4
58	PE-V0-483-164-A307	QAP FOR ATMOSPHERIC TANK	10	A4
59	PE-V0-483-164-A308	QAP FOR BUTTERFLY VALVE	10	A4
60	PE-V0-483-164-A309	QAP FOR DIAPHRAGM VALVE	10	A4
61	PE-V0-483-164-A310	QAP FOR PRV	10	A4
62	PE-V0-483-164-A311	QAP FOR GATE VALVE	10	A4
63	PE-V0-483-164-A312	QAP FOR NRV	10	A4
64	PE-V0-483-164-A313	QAP FOR MS/ CS PIPES	10	A4
65	PE-V0-483-164-A314	QAP FOR SS PIPES	10	A4
66	PE-V0-483-164-A315	QAP FOR BALL VALVE	10	A4
67	PE-V0-483-164-A316	QAP/ ICL OF WWT (FOR BALANCE OF ITEMS)	10	A4
68	PE-V0-483-164-A317	QAP FOR CLARIFIER MECHANISM	10	A4
69	PE-V0-483-164-A318	QAP FOR AGITATOR	10	A4
MANDATORY SPARE				
70	PE-V0-483-164-A401	MANDATORY SPARES LIST FOR WWT	14	A4
ELECTRIC HOIST				
71	PE-V0-483-164-A500	MANUFACTURING QUALITY PLAN WITH SUB VENDOR LIST	8	A4
72	PE-V0-483-164-A501	GA DRAWING FOR ELECTRIC HOIST, DSL ARRANGEMENT AND PAINTING DETAILS	10	A4
73	PE-V0-483-164-A502	SCHEMATIC CIRCUIT DIAGRAM INCLUDING CABLE SCHEDULE AND PANEL DIAGRAM	10	A4
74	PE-V0-483-164-A503	MECHANISM SIZING CALCULATION	10	A4
75	PE-V0-483-164-A504	O&M MANUAL INCLUDING ERECTION PROCEDURE	16	A4
MANUAL HOIST (CHAIN PULLEY BLOCK)				
76	PE-V0-483-164-A600	MANUFACTURING QUALITY PLAN	8	A4

77	PE-V0-483-164-A601	GA DRAWING FOR CPB WITH DETAIL BOM WITH PAINTING DETAILS	10	A4
78	PE-V0-483-164-A602	O&M MANUAL INCLUDING ERECTION PROCEDURE	10	A4

'*' Basic engineering documents.

Notes:-

1. The above drawing list is tentative and shall be finalized with the successful bidder after placement of order. While some of the drawings indicated above may not be applicable, some additional drawings may also be required based on scope of work.
2. Drawings shall be prepared in Auto-Cad latest edition. Required no. of hard and soft copies (editable) of the drawings shall be furnished as per requirement specified elsewhere in the specification.
3. Only manual calculation with authentic supporting literature (e.g. extracts of hand Book/ standard/codes) shall be acceptable. All design calculations and drawings shall be in SI system only.
4. All the drawings and documents including general arrangement drawing, data sheet, calculation etc. to be furnished to the customer during detailed engineering stage shall include / indicate the following details for clarity w.r.t. Inspection, construction, erection and maintenance etc.: -

a) All drawings and documents shall indicate the list of all reference drawings including general arrangement.
b) All drawings shall include / show plan, elevation, side view, cross - section, skin section, blow - up view; all major self-manufactured and bought out items shall be labeled and included in BOQ / BOM in tabular form.
c) Painting schedule shall also be made as a part of general arrangement drawing of each equipment / items indicating at least 3 trade names.
d) All the drawings required to be furnished to customer during detailed engineering stage shall include technical parameters, details of paints and lubrication, hardness and BOQ / BOM in tabular form indicating all major components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.
e) Drawings/ documents to be submitted for purchasers review/ approval shall be under Revision A, B, C… etc. while drawings /documents to be submitted thereafter for customer's approval after purchaser's approval shall be under R-0, 1, 2, 3 ….etc.
f) Drawings and documents not covered above but required to check safety of machines/ system, shall be submitted during detailed engineering stage without any commercial implication.
g) All drawings shall include "B.O.M" and indicate quantity, material of construction, make along with IS/BS No., Technical parameters, dimensions, hardness, machining symbol and tolerance, requirement of radiography and hydraulic tests, painting details, elevation, side view, plan, skin section and blow-up view for clarity.
h) All drawings shall be prepared as per BHEL's title block and shall bear BHEL's drawing No.

i) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's/ Customer's/ Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.
j) Bidder to follow the following the drawing submission schedule:
k) 1st submission of drawings from date of LOI as per the submission schedule.

l) Every revised submission incorporating comments – within 7 days.
m) Bidder to submit revised drawings complete in all respects incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to bidder's account. For any clarification/ discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL for across the table discussions/ finalizations/ submissions of drawings.

ANNEXURE VI

REQUIREMENTS OF SPARES, TOOLS & TACKLES

REQUIREMENTS OF SPARES, TOOLS & TACKLES

1.0 Scope

This section covers the general requirements regarding the spares and tools & tackle for all the equipment and systems in Waste Water Treatment Plant.

2.0 Mandatory Spares

The Bidder shall supply in his scope mandatory spares as listed below in this Section.

3.0 Tools and Tackle

1. The Contractor shall supply with the equipment one complete set of all special tools and tackles and other instruments required for the erection, assembly, disassembly and proper maintenance of the plant and equipment and systems. These special tools will also include special material handling equipment, jigs and fixtures for maintenance and calibration / readjustment, checking and measurement aids etc.
2. These tools and tackles shall be separately packed and sent to site. The Contractor shall also ensure that these tools and tackles are new and not used by him during erection, commissioning and initial operation. For this period the Contractor should bring his own tools and tackles. All the tools and tackles shall be of reputed make acceptable to the Purchaser.

4.0 Guidelines for Mandatory Spares and Tools and Tackle

1. The bidder shall supply the mandatory spares as listed below.
2. In case the description / nomenclature of any of the items of spares/tools and tackles is differing from the description / nomenclature indicated in the list of mandatory spares, the bidder shall offer functionally equivalent part in lieu of the listed item.
3. In case if such items of spares/tools & tackles indicated as “not applicable”, are found applicable at a later date during execution of the project, such items of spares/tools & tackles are to be supplied within the ordered cost of the mandatory spares.
4. If any of the items of spares ordered is found to be not applicable during detailed engineering stage/execution stage, the bidder shall have to supply alternative items of spares/tools & tackles. The alternative items of spares/tools & tackles are to be mutually agreed between the PURCHASER and BIDDER.
5. In respect of quantity mentioned as ‘Set’ means the total quantity of all the components/items used in particular equipment unless otherwise specified.

Example-1
One set of spare part which is having four different items of which first item is having 2 similar parts, second one is having 3 similar parts and other two are having one part each, then one set means, combination of 2 similar parts of first item and 3 similar parts of second and one each of 3rd & 4th items.
Example-2
If the quantity of particular spare part is more than one, set means the total no. of similar parts.

6. Wherever % is indicated for the mandatory spares, the quantity shall be calculated for % of supply for total quantity unless otherwise specified
7. All relevant drawings to identify of spares/tools & tackles are to be furnished when called for by the PURCHASER

5.0 Start up and Commissioning Spares

Start up and commissioning spares are those spares which may be required during the start-up and commissioning of the equipment/system till the commercial operation of the Plant. The Contractor shall provide all such start up and commissioning spares and keep an adequate stock of the same to be brought by him to the site for the plant erection and commissioning. These must be available at site before the equipment are energized. The unused spares, if any, should be removed from there only after commercial operation of the plant. All start up spares which remain unused at the time shall remain the property of the Contractor.

6.0 General Requirements of Spares

1. The Contractor shall indicate the service expectancy period for the spares parts (mandatory) under normal operating conditions before replacement is necessary.
2. All spares supplied under this contract shall be strictly inter-changeable with the parts for which they are intended for replacements. The spares shall be treated and packed for long storage under the climatic conditions prevailing at the site e.g. small items shall be packed in sealed transparent plastic with desiccator packs as necessary.
3. All the spares shall be manufactured along with the main equipment components as a continuous operation as per same specification and quality plan.
4. The contractor will provide purchaser with cross-sectional drawings, catalogues, assembly drawings and other relevant documents so as to enable the purchaser to identify and finalise order for recommended spares.
5. Each spare part shall be clearly marked or labelled on the outside of the packing with its description. When more than one spare part is packed in a single case, a general description of the content shall be shown on the outside of such case and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purposes of identification.
6. All cases, containers or other packages are to be opened for such examination as may be considered necessary by the purchaser.

7. The Contractor will provide the purchaser with all the addresses and particulars of his sub-suppliers while placing the order on vendors for items/ components/ equipment covered under Contract and will further ensure with his vendors that the purchaser, if so desires, will have the right to place order for spares directly on them on mutually agreed terms based on offers of such vendors.

8. The Contractor shall warrant that all spares supplied will be new and in accordance with the Contract documents and will be free from defects in design, material and workmanship.

9. The Contractor shall guarantee the long term availability of spares to the purchaser for the full life of the equipment covered in the Contract. The Contractor shall guarantee that before going out of production of spare parts of the equipment covered under the Contract, he shall give the purchaser at least 2 years advance notice so that the latter may order his bulk requirement of spares, if he so desires. The same provision will also be applicable to Subcontractors. Further, in case of discontinuance of manufacture of any spares by the Contractor and/or his sub-contractors, Contractor will provide the purchaser, two years in advance, with full manufacturing drawings, material specifications and technical information including information on alternative equipment makes required by the purchaser for the purpose of manufacture/procurement of such items.

MANDATORY SPARES LIST

S.No.	EQUIPMENTS	QUANTITY
1.	**Secondary Clarifier feed pumps with motor & acc**	
1.1	Impeller	1 No.
1.2	Casing	1 No.
1.3	Shaft	1 No.
1.4	Shaft sleeves	1 Set
1.5	Impeller/ casing liner	1 No.
1.6	Seals	1 Set
1.7	Pump & motor bearing	2 Set
1.8	Gear box	1 No.
1.9	Pump- motor coupling	1 No.
2.	**Treated water transfer pumps with motor & acc.**	
2.1	Impeller	1 No.
2.2	Casing	1 No.
2.3	Shaft	1 No.
2.4	Shaft sleeves	1 Set
2.5	Impeller/ casing liner	1 No.
2.6	Seals	1 Set
2.7	Pump & motor bearing	2 Set
2.8	Gear box	1 No.
2.9	Pump- motor coupling	1 No.
Note:		
(A)	**If any item as listed above under mandatory spare list is not applicable, then bidder to supply its equivalent spares.**	
(B)	**If any item which is considered as not applicable by bidder and if the same is found to be applicable during detailed engineering, bidder to supply the same without any cost implication.**	

ANNEXURE-VII

FORMAT FOR OPERATION AND MAINTENANCE MANUAL

Bidder to submit operation and Maintenance manual with minimum information as listed in below check list during contract stage.

1.1 CHECK LIST FOR OPERATION & MAINTENANCE MANUAL

Project name:
Project number:
Package Name:
PO reference:
Document number :
Revision number:

Sl.no. & Sections	Description	Tick (√)if included in Manual			Remarks
		Yes	No	Not Applicable	
1.	Cover page				
1.1	Project Name				
1.2	Customer/consultant Name				
1.3	Name of Package				
1.4	Supplier details with phone, FAX ,email address , Emergency Contact number				
1.5	Name and sign of prepared by , checked by & approved by				
1.6	Revision history with approval Details				
2.0	Index				
2.1	showing the sections & related page nos All the pages should be numbered section wise				
3.0	Description of Plant/System				
3.1	Description /write up of operating principle of system equipment/ associated sub-systems & accessories/controls system , operating conditions, performance parameters under normal , start up and special cases				
3.2	Equipment list and basic parameter with Tag numbers				
3.3	Data sheets approved by Customer/for information and catalogues provided by original manufacturer				
3.4	Associated other packages and Interface /terminal points				
3.5	P&ID & Process Diagrams				
3.6	GA Layout drawings, As-built drawings , Actual photograph of items/system (Drawings of A2 & bigger sizes are to be attached in the last)				
3.7	Single line/wiring diagrams				
3.8	Control philosophy /control write-ups				

4.0	Commissioning Activities (if not covered in separate document i.e. erection manual, commissioning manual)				
4.1	Pre-Commissioning Checks				
4.2	handling of items at site				
4.3	Storage at site				
4.4	Unpacking & Installation procedure				
5.0	Operation Guidelines for plant personal/user/operator				
5. 1	Interlock & Protection logic along with the limiting values of protection settings for the equipment along with brief philosophy behind the logic, drawings etc. to be provided.				
5. 2	Start up, normal operation and shut down procedure for equipments along with the associated systems in step by step mode. Valve sequence chart, step list, interlocks etc. with Equipment isolating procedures to be mentioned.				
5. 3	Do's & Don't of the equipments.				
5. 4	Safety precautions to be taken during normal operation. Safety symbols, Emergency instructions on total power failure condition/lubrication failure/any other condition				
5. 5	Parameters to be monitored with normal values and limiting values				
5. 6	Trouble shooting with causes and remedial measures				
5. 7	Routine operational checks, recommended logs & records				
5. 8	Changeover schedule if more than one auxiliary for the same purpose is given				
5. 9	Painting requirement and schedule				
5. 10	Inspection, repair , Testing and calibration procedures				
6.0	Maintenance guidelines for plant personal				
6.1	List of Special Tools and Tackles required for Overhaul/Trouble shooting including special testing equipment required for calibration etc.				
6.2	Stepwise dismantling and re-assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained, clearances etc. to be mentioned. Tolerances for fitment of various components to be given.				
6.3	Preventive Maintenance & Overhauling schedules linked with running hours/calendar period along with checks to be given				
6.4	Long term maintenance schedules				

	especially for structural, foundations etc.				
6.5	Consumable list along with the estimated quantity required during commissioning, normal running and during maintenance like Preventive Maintenances and Overhaul. Storage/handling requirement of consumables/self-life.				
6.6	List of lubricants with their Indian equivalent, Lubrication Schedule, Quantity required for each equipment for complete replacement is to be given				
6.7	List of vendors & Sub-vendors with their latest addresses, service centers ,Telephone Nos., Fax Nos., Mobile Nos., e-mail IDs etc.				
6.8	List of mandatory and recommended spare parts list				
6.9	Tentative Lead time required for ordering of spares from the equipment supplier				
6.10	Guarantee and warranty clauses				
7.0	**Statutory and other specific requirements considerations.**				
8.0	**List of reference documents**				
9.0	**Binding as per requirement**				

ANNEXURE-VIII

PACKING PROCEDURE

DOMESTIC PACKING

COMMON GUIDELINES

1 GENERAL:

This standard lays down packing instructions for domestic packing of Components/ Assemblies/ Equipment to be despatched against Customer's contracts, for which there are no special instructions issued by the Engineering Departments. For Seaworthy Packing refer standard AA0490004 wherever applicable.

The Components/Assemblies need to be packed suitably to avoid physical damage & corrosion during transit & storage. For specific applications the concerned engineering department shall issue a product standard. Reference of this product standard, must appear in the Shipping list/Packing List.

2 SCOPE:

This procedure gives minimum guidelines to be complied with for domestic packing of Components /Assemblies/ Equipment. This domestic packing shall be suitable for different handling operations and for the adverse conditions during transportation and during indoor / outdoor storage of materials.

3 WOOD SPECIFICATION

Based on availability, the wood shall conform to specification AA51401 or AA51402.

4 TYPES OF PACKING:

The following 5 types of packing have been standardized for packing of General Components/ Assemblies.

1) '**OP**' - Open Type.
2) **'PP**' - Partially Packed.
3) '**CP**' – Crate/Box Packing - Components/Equipment requiring physical protection.
4) '**CQ**' - Case Packing – Machined components-Small & Medium Components/ Assemblies/ Equipment which require corrosion & physical protection.
5) '**CR**' - Case Packing – Electrical/Electronic Components/ Assemblies, which require special packing viz. Water Proof, Shock Proof etc…

5 DESCRIPTION OF TYPES OF PACKING:

The various types of packing, as standardized above, are described below.

5.1 'OP' - Open Type

In case, of components which are not affected by water & dust and do not require special protection, are generally not machined, shall be sent as open packages. However, these components may be sent in crates, wherever necessary.

5.2 'PP' - Partially Packed

Components which need special protection at selected portions only shall be despatched partially packed. Machined surfaces should not be allowed to come directly in contact with the wood. Such surfaces should be protected with 100GSM(Colourless) Multi Layered Cross Laminated Polyethylene

COPYRIGHT AND CONFIDENTIAL
The Information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.
It must not be used directly or indirectly in any way detrimental to the Interest of the company.

Film to Specification No. AA51420. All sharp corners and edges shall be protected by rubber mats to prevent damage to the polyethylene film

5.3 'CP' - Crate Packing

Assemblies/Components which need only physical protection from the point of view of handling shall be despatched duly packed in crates.

5.4 'CQ' - Case Packing - Machined Components/Assemblies/Equipment

Small and medium sized components/assemblies/equipment due to size/weight and to avoid handling and pilferage problems shall be packed in Case/Containers. Wherever required adequate quantity of silica gel to AA55619 or VCI Powder/Tablets, packed in thin muslin cloth cotton bags shall be suitably placed. Small machines/components of less weight shall be provided with suitable cushioning by Rubberised coir. The components inside the case shall be entirely covered with 100GSM(Colourless) Multi Layered Cross Laminated Polyethylene Film Specification No. AA51420, wherever required. This may be prescribed for electronic parts/critical machined components/surfaces.

For mechanical product like valves where motors are separately securely wrapped in polyethylene, the requirement of individual component wrapping shall be exempted.

5.5 'CR' - Case Packing - Electrical & Electronic Components/Assemblies

Delicate components likely to be damaged e.g. Gauges, Instruments etc. are to be wrapped in waxed paper or polyethylene air bubble film and packed in cartons. Adequate quantity of Silica gel to AA55619 packed in cotton bags of 100grams each are to be suitably placed in the cartons. The cartons shall be entirely covered with 100GSM(Colourless) Multi Layered Cross Laminated Polyethylene Film Specification No. AA51420 before being packed in the cases. VCI Powder/Tablets can be used as an alternative to Silica Gel to AA55619.

Empty space in the cartons shall be filled with rubberized coir to get proper cushioning effect. The cartons shall be manufactured from corrugated Fiber Board, meeting requirements of AA51414.

6 PREPARATION OF PACKING CASES

6.1 DIMENSIONS:

a) Thickness of planks for Front, rear, top and bottom sides and binding, jointing battens shall be 25/20mm +2/-3 mm as per applicable drawings of the respective units.

b) Width of all planks including the tongue shall be more than 125mm and after plaining it shall be minimum 100mm.

c) Minimum number of planks shall be used for a shook.

d) Horizontal, vertical, diagonal planks shall be given for binding (number of such planks depend on the dimension of panel.

e) Width of binding planks shall be minimum 100mm.

f) Distance between any 2 binding planks shall be less than 750mm.

g) diagonal planks shall be used in between vertical binding planks when distance between inner to inner of vertical planks is more than 750mm

h) Distance of the outer edges of these planks from the edge of case shall be less than 250mm.

i) Diagonal planks are not required for top planks and width side, if the width of pallet is less than 750mm.

6.2 JOINTING OF PLANKS

Single length planks shall be used for cubicles whose overall length is less than 2400mm. For cubicles of length more than 2400mm, jointing is permitted. The jointing shall be done with one single or maximum of 2 planks of wood same as other planks of width 250 mm (minimum) with two rows of nails on either side of the joint in zigzag manner. From the joint along height side, it shall be of lap joint with overlap of at least the width of plank.

6.3 TONGUE AND GROOVE JOINTS

Two consecutive planks shall be joined by tongue and groove joint. Depth of tongue shall be 12+1 mm, thickness of tongue shall be 8 +1 mm. The groove dimensions shall be such that the tongue fits tightly into the groove to make a good joint. This type of joint can be done based on the product requirement wherever required.

6.4 PERMISSIBLE DEFECTS

Wood shall be free from knots, bows, visible sign of infection and any kind of decay caused by insects, fungus, etc.

End splits: Longest end splits at each end shall be measured and lengths added together. The added length shall not exceed 60mm per meter run of shook's. Wood pins shall be used to prevent further development of split.

Surface cracks: Surface cracks with a maximum depth of 3mm are permissible. A continuous crack of any depth all along the length is not allowed.

6.5 OTHER MATERIALS

6.5.1 NAILS

The dia. of the nails shall be 3.15mm. The length of the nails shall be 65mm wherever two planks of 25mm thickness are joined and 75mm wherever a 25mm planks is joined to a 50mm plank.

6.5.2 BLUE NAILS

These are used for nailing bituminized Kraft paper/hessian cloth to the planks. The length of the nails shall be 16mm.

6.5.3 HOOP IRON STRIPS

These are used for strapping the boxes. The width of the strips shall be 19+1mm and thickness 0.6+0.01mm. The material shall be free from rust.If sufficient nailing is done for bigger boxes, strapping need not be done.

6.5.4 CLIPS

These shall be used for strapping the hoop iron strips on the boxes.

6.5.5 BRACKETS

These brackets are used for nailing to the corners of cubicle boxes. The brackets shall be of mild steel of thickness min 2mm and width 25+1mm. The brackets shall be of "L" shape, the length of each side being 100+2mm. Two holes shall be provided towards the end of each side for screwing /nailing.

6.5.6 FASTENERS

Bolts, double nuts, spring washers will have to be used for packing of some special items like transformers, reactors, breakers, etc., to hold the job to the bottom plank of the box. The bolts, nuts, washers will be provided by the vendor. Drilling of holes will have to be done using contractor's tools.

6.5.7 MULTI LAYERED CROSS LAMINATED POLYTHELENE FILM

100GSM (Colourless) Multi Layered Cross Laminated Polythelene Film Specification No: AA51420 are used to make covers to the jobs individually. The cross lamination gives qualities of extra toughness, together with flexibility and lightness coupled with good weather resistance to ultra violet rays.

6.5.8 RUBBERISED COIR:

The rubberized coir is used as cushioning material. For the packing of loose items, items are to be arrested by using rubberized coir. For the packing of cubicles rubberized coir of thickness 25mm and width 75mm shall be used.

6.5.9 FOAM RUBBER / 'U' FOAM:

This is used for covering the delicate items. This material is provided by the vendor.

6.5.10 MARKING PLATE:

This shall be of anodized aluminium sheet. Size of the marking plate shall be maintained minimum of size as per the details specified in the Figure 4.

6.5.11 PACKING SLIP HOLDER:

This shall be of galvanized iron tinned sheet /Aluminium sheet

6.5.12 SILICA GEL:

This shall be of indicating type to conform to IS: 3401/AA55619.Silical gel shall be used for such products only where moisture needs to be avoided.

6.5.13 COTTON BAGS:

These are used for holding silica gel. The bags shall have the following matter indicated on them:

BHEL-UNIT NAME	PLACE-PINCODE
SILICA GEL	INDICATING TYPE
BLUE :	ACTIVE
ROSE :	REDUCED ACTIVITY
WHITE :	NO ACTIVITY. TO BE REPLACED WITH FRESH SILICA GEL

6.5.14 COTTON/ PLASTIC TAPE:

This is used for tying small items. And also to prevent vibrations of moving parts within the cubicles.

6.5.15 MARKING INK:

The ink used normally is black in color. In some special cases other color also will have to be used. The ink shall be non-fading/indelible and non-washable by water.

6.5.16 POLYETHYLENE BAGS:

These are to be used for keeping the Packing slips. The bag shall be of size 70mm X 100mm (minimum).

6.5.17 Hessian cloth, twine thread, paint will have to be used in packing certain items.

6.5.18 Mechanical Latching clamps:

For CLW Railway panels and similar Panels self-locking clamps can also be used on need basis in conjunction with or apart from regular bolt and nut fixing arrangement. For reusable boxes, these clamps provide easy locking and unlocking arrangement. These clamps will be made available from BHEL in some cases.

6.5.19 STICKERS

The following stickers to be put by the vendor on cubicles/Boxes after packing.

1) Case No sticker: 2 nos. Size 25.Cm x 0.45Cm
2) BHEL Monogram sticker: 1 no. Size 1.75Cm x 2.3Cm
3) Address sticker: 2 nos. Size 3.8Cm x 3.0Cm
4) Direction sticker “Front” & “Back” - 4 nos. Size 2.0Cm x 0.75Cm
5) Chain Mark Sticker: 4 Nos. Size – 3.0Cm x 0.75Cm
6) "Fragile” sticker: 2 Nos. Size. 2.1Cm x 1.5Cm
7) "DO NOT STACK” sticker - 2 Nos. Size 3.0Cm x 2.2Cm

In place of stickers, writing all the details legibly with paint shall be allowed & respective units may take decision accordingly.

7 PACKING OF CUBICLES:

7.1 The packing is to be done as per clause 5 in all respects.

7.2 The cubicles are already fixed on wooden pallets. Hence the contractor need not arrange the bottom pallets normally.

7.3 The cubicles will be of different sizes both width wise and lengthwise. The cubicles may be made up of single suite, 2 Suite, 3 Suite, 4 Suite, etc., The width of the cubicles generally varies from 400 mm to 1650mm.The length of the cubicle, generally varies from 1500 mm to 4800 mm. The height is normally 2430 mm. In some cases, the height may be less/more.

7.4 MULTI LAYER CROSS LAMINATED POLY FILM

The inner surface of 4 sides of shook's shall be nailed with Multi-layer cross laminated poly film (as per 6.5.7) using blue nails (as per 6.5.2) wherever 2 pieces of Cross laminated poly film are used, the joint shall have an overlap of minimum 20mm.

The inner surface of top cover shall be nailed with Multi-layer cross laminated poly film (as per 6.5.7). This sheet shall project outside on 4 sides by at least 100mm and shall be nailed properly on sides. Joining of sheets should have overlap of minimum 20mm.

The cubicles shall be covered with Multi-layer cross laminated poly film (as per 6.5.7).

7.5 SILICA GEL:

Silica gel (as per 6.5.12) packed in cotton bags shall be kept at different places inside the cubicle as per BHEL-Unit directions. Each suit of cubicle shall be provided with 1 kg of Silica gel (for a 4 suit cubicle 4 kgs of Silica Gel to be used. The bag containing silica gel to be as per 6.5.13).

7.6 LOOSE PARTS:

Any loose parts in the cubicles shall be tied using cotton/ plastic tape. Wooden battens shall be provided wherever necessary.

7.7 WOODEN BATTENS:

In case of cubicle which are not rectangular in shape like control desks, sufficient number of wooden rafters/battens of proper size shall be provided to give strength to the package.

7.8 RUBBERISED COIR:

Gap between the cubicle and the case shall be filled with rubberized coir (as per 6.5.8) with distance between consecutive layers less than 500mm.

7.9 CLAMPING:

Packing shall be bound at edges by nailing M.S. Clamps / Brackets (as per 6.5.5). Each vertical edge shall have minimum 3 clamps. Top horizontal edges will have one clamp for every meter length of package. However, minimum 4 clamps shall be nailed at the top for any cubicle.

7.10 PACKING SLIP:

Packing slip kept in the polyethylene bag (As per 6.5.16) shall be placed in the box at appropriate place. In addition, one more packing slip covered in polyethylene cover and packing slip holder (as per 6.5.11) shall be nailed to front / rear of case.

7.11 MARKING PLATE:

One no. (As per 6.5.10) shall be nailed to the front side of the case.

7.12 CASE MOUNTING:

After complete packing, stencil marking of various details and marking of symbols shall be done as per BHEL instructions using indelible / non washable marking ink.

7.13 Different types (Typical) of Cubicles with sizes for Packing

1. Single suite cubicle - 900 x 950 x2500
2. Two suite cubicle - 1650 x 950 x 2500
3. Three suite cubicle - 2400 x 950 x2500
4. Four suite cubicle - 3150 x 950 x 2500
5. Regulation cub - 1300 x 1350 x 2500
6. Thy cub - 2870 x 1350 x 2500
7. VFD Cub - 3800 x 1550 x 2500

7.14 PACKING OF CUBICLES FOR EXPORT

Refer Corporate Standard AA0490009.

8 PACKING OF LOOSE ITEMS/SPARES

1) Shape of cases shall be square, rectangular with single gabled roof or with double gabled roof depending on the nature of the job to be packed. Construction shall be as per drawings enclosed. Only gable will be additional as required.
2) Wood shall conform to specification AA51401 or AA51402 with Tongue and Groove joint as per clause 6.3.
3) Width of planks shall be at least 100 mm. Width of binding planks (battens) shall be at least 75mm.
4) External surface of planks on front and rear shall be plane 100% (except bottom plank).
5) Inner surfaces of all 6 sides shall be lined with Multi Layered Cross Laminated Polythelene Film (as per clause 6.5.7) using blue nails.
6) Rubberized coir of minimum 25mm thickness and 100 mm width shall be nailed to inner surfaces of bottom and 4 sides of box.
7) Internal packing: Items that go into the box shall be packed using 100GSM, (Colourless) Multi Layered Cross Laminated Polyethylene Film Specification No: AA51420. Any space left between the job and the sides and the top of the box shall be filled with rubberized coir to get proper cushioning effect.
8) Certain items like transformers, reactors, breakers, etc., shall be bolted to the bottom of the box using bolts, nuts and washers.
9) Silica gel as per clause 6.5.12 held in cotton bags as per clause 6.5.13 shall be kept at proper places in the box.
10) Packing slip kept in polyethylene bag (clause 6.5.16) shall be placed in the box.
11) Marking plate as per clause 6.5.10 shall be nailed to side of the box.
12) Two numbers of hoop iron strips as per clause 6.5.3 shall be strapped tightly on the case using clips.
13) Stencil marking of various details and marking of various symbols shall be done as per BHEL instructions using indelible/non-washable marking ink.
14) Loose items to be kept inside the cubicle

- The components which are removed from cubicle for shipping purpose only, such as meters shall be kept inside the cubicle individually, kept in wooden box and tied firmly in bottom of Cubicle.

- Other items which are given loose in addition to cubicle shall be packed in separate boxes.

9 BOX SIZES

9.1 BOX SIZES

Table 1 – SPARES WOODEN BOX DETAILS

SNO	BOX TYPE	BOX SIZE (in mm)	BOX Wt (in KG)	Carrying Capacity
1	A	800 X 200 X 200	15	
2	B	1500 X 200 X 200	22	
3	C	2000 X 200 X 200	27	
4	D	1100 X 200 X 200	15	
5	E	200 X 200 X 200	5	
6	F	320 X 250 X 260	13	
7	G	320 X 250 X 430	16	
8	H	430 X 370 X 430	23	
9	I	1100 X 400 X 400	45	
10	J	1500 X 500 X 400	65	
11	K	2000 X 500 X 400	93	
12	L	2500 X 500 X 400	88	
13	M	900 X 600 X 600	100	
14	N	3000 X 400 X 400	60	
15	P	600 X 500 X 400	35	
16	Q	710 X 630 X 600	90	
17	R	850 X 630 X 670	102	
18	S	1000 X 770 X 670	140	
19	T	2500 X 850 X 800	180	
20	U	1500 X 700 X 700	120	
21	W	1200X900X600	120	
22	Y	450 X 200 X 200	10	

Table 2 – WOODEN BOX DETAILS

BOX TYPE	**BOX SIZE (in MM)**	**BOX Wt (in KG)**	**Carrying Capacity**
1	320X250X260	10	
2	320X250X430	15	
3	430X370X430	25	
4	670X670X470	65	
5	720X630X600	75	
6	1000X770X660	100	
7	1100X430X670	80	
8	1200X1200X900	80	
9	1300X770X1050	155	
10	2500X850X800	225	
11	2000X1500X1200	305	
12	1850X1050X1250	260	
13	2000X800X800	180	
14	2600X1500X1600	470	
15	250X250X600	20	
16	250X250X880	30	
17	300X300X700	25	
18	380X380X880	45	
19	510X510X1400	60	
20	570X570X1400	80	
21	575X575X1875	105	
22	3600X1100X1100	390	
23	900X500X800	110	
24	2000X950X740	225	
25	1600X1120X700	220	
26	2500X2000X1200	490	
27	2900X1900X1400	525	
28	3000X1000X900	370	
29	3200X2200X950	450	
30	2150X1100X750	325	
31	2000X2000X700	130	
32	700X1200X1325	130	

COPYRIGHT AND CONFIDENTIAL
The Information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.
It must not be used directly or indirectly in any way detrimental to the Interest of the company.

Table 3 – STEEL BOXES

SL NO	TYPE	DIMENSION IN MM			WEIGHT	CARRYING CAPACITY (KGS)
		LENGTH	BREADTH	HEIGHT		
1	I	2480	1680	1500	339	4500
2	II	1200	900	600	061	2000
3	IIB	1800	850	950	115	2500
4	III	900	600	600	029	1000
5	IV	600	450	500	019	750
6	V	400	350	300	011	500

TYPICAL PATTERN OF WOODEN BOX

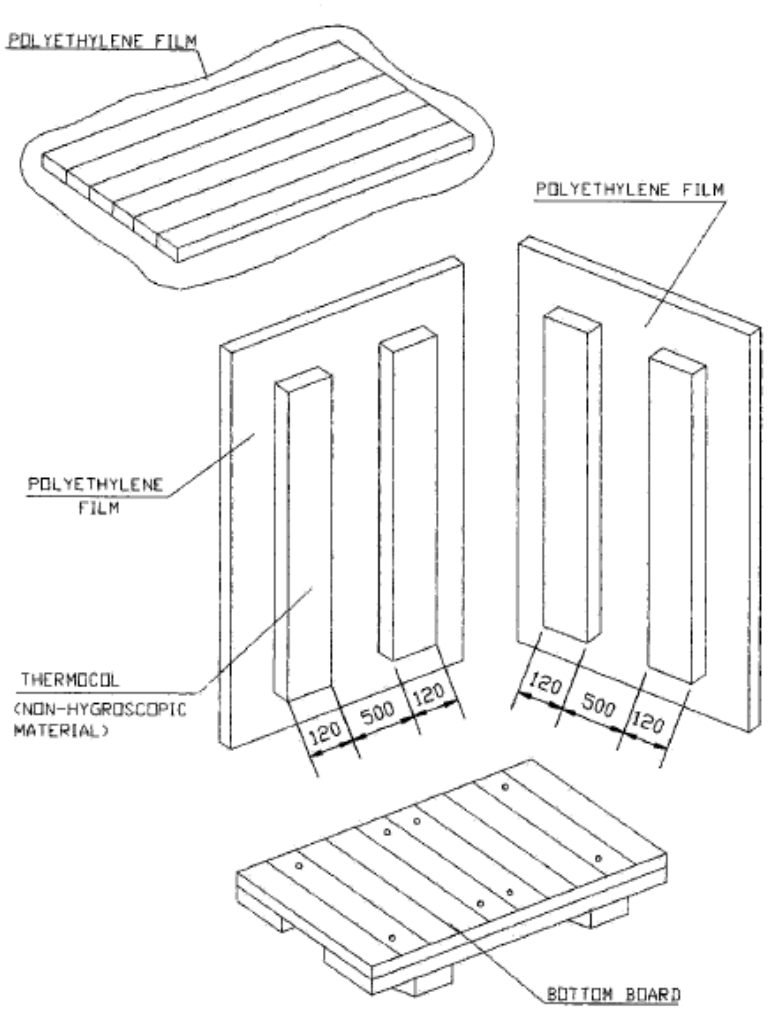


Figure 1

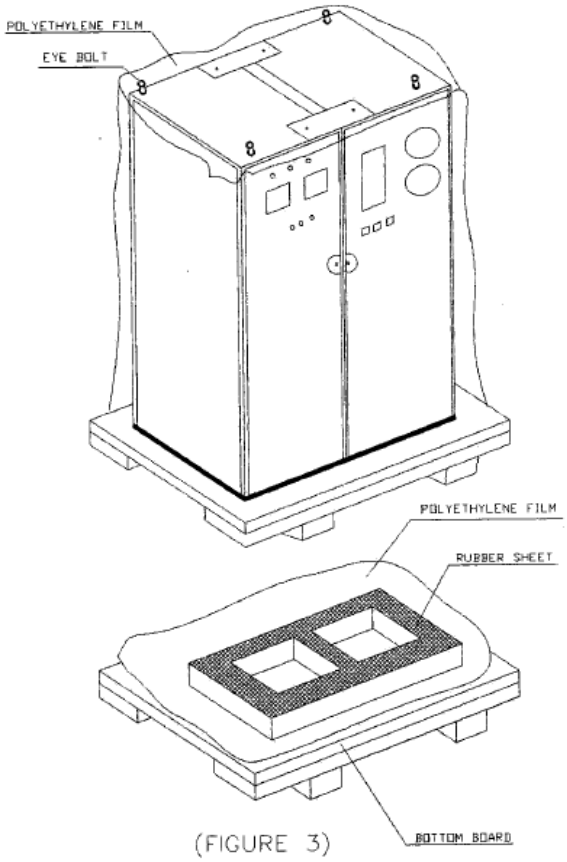


Figure 2

9.2 STEEL CONTAINERS:

Steel containers for packing can be used in case of repeated supplies of the same equipment. Empty steel containers are to be returned back from customer's end and to be reused for the next supplies. The containers are to be made of structural steel as per AA10108 with proper reinforcement with I, C and T Sections. Depends on the availability of resources & requirements units may be allowed to use standard cargo containers also instead of fabricated steel boxes.

a) Following precautions are to be taken during packing: -

b) Put the machine in the steel container properly,

c) Cover the machine with polythene.

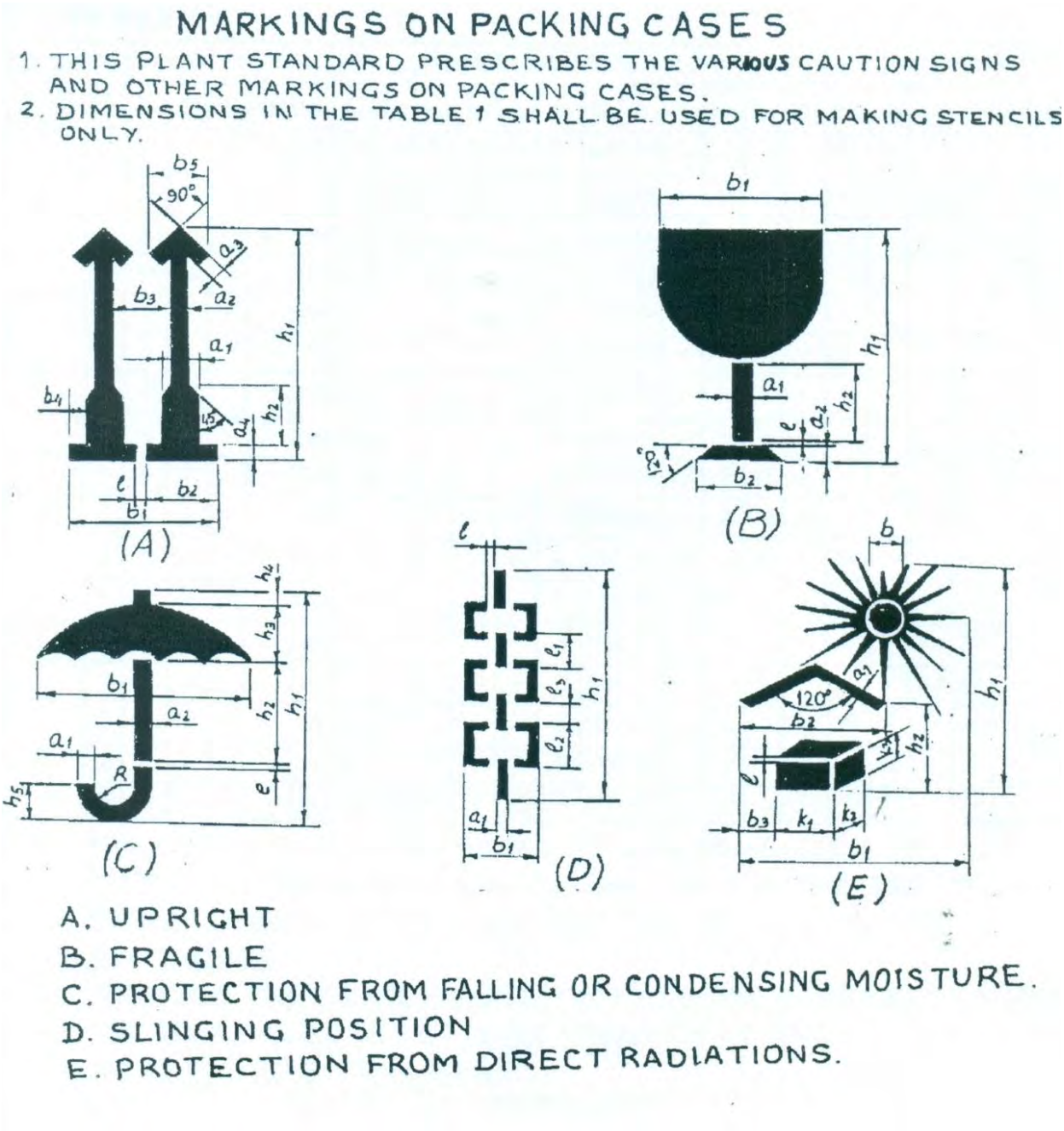
d) To arrest the movement in the steel container necessary wooden Blocks/Battons may be put.

e) Put cover on steel, container and Bolt Properly

9.3 SEALED PACKING:

Components sub-assemblies and assemblies sensitive to climatic conditions shall be packed seal tight. All the openings of the sensitive components, sub-assemblies and assemblies shall be blanketed to prevent the ingress of dust and moisture. The components sub-assemblies and assemblies are completely covered with 2 layers of polyethylene sheet. All sharp corners and edges are to be protected by rubber mats to prevent the polyethylene sheet from damage. Top surface of the case shall be free from dents to prevent rain water pockets.

10 MARKINGS/STENCILINGS



Center of Gravity

Figure 3

DESIGN-ATION		DIMENSION IN MM																						
		a1	a2	a3	a4	b1	b2	b3	b4	b5	b	l	h1	h2	h3	h4	h5	k1	k2	k3	l1	l2	l3	R
A	1	12	5	5	4	52	25	19	8	21		2	84	23										
	2	17	7	7	6	75	36	29	11	30		3	119	33										
	3	24	10	10	8	104	50	38	16	42		4	168	46										
	4	34	14	14	11	147	71	59	23	60		5	239	65										
B	1	5	5			50	33					2	84	25										
	2	7	7			71	47					3	119	36										
	3	10	10			100	66					4	168	50										
	4	14	14			142	94					5	239	71										
C	1	4	3			66						2	80	39	19	5	11							6
	2	6	4			85						3	114	55	27	7	16							9
	3	8	6			120						4	160	78	38	10	22							12
	4	11	9			170						5	227	110	54	14	31							17
D	1	6				30						4	148								30	30	10	
	2	9				42						5	209								42	42	14	
E	1	3				69	47	10			16	2	91	26				17	8	11				
	2	4				98	67	15			23	3	128	33				24	11	16				
	3	6				138	94	20			32	4	182	62				34	16	22				

Table 4

Black and Red Marking Ink to IS:1234 "Ink, Stencil, Oil Base, For Marking Porous Surfaces" or duplicating ink stencilling, oil base for marking porous surfaces.

All cases containing fragile items are to be stencilled with red marking and stencilling paint/ink

"HANDLE WITH CARE", "FRAGILE DO NOT TURN OVER".

Besides the caution signs the product information's shall be stencilled of letters with 13mm to 50mm height.

In case of consignment consists of more than one package, each package shall carry its package no as given in shipping list. All caution signs shall be stencilled in high quality full glossy out door finishing paint red in colour (AA56126). All other markings shall be carried out in black enamel(AA56126).

Caution signs & other markings shall be stencilled on both the end shooks & the side shooks.

Caution sign (for slinging) shall be stencilled only on side shooks at the appropriate place.

Note: Incase the size of package is small for using the stencils, then hand written letters/figures shall be allowed.

	BHEL – <unit> - <location> - <pin>				
CONSIGNEE					
MATERIAL					
CUSTOMER REF.			MO. NO.		
DESPATCH ADVICE NOTE NO			CASE NO		
DIMENSIONS(MM) L x B x H				NET WT –KGS	GROSS WT –KGS
SPECIAL INSTRUCTIONS	HANDLE WITH CARE - KEEP DRY DO NOT DROP - DO NOT TILT				

Figure 4 – TYPICAL MARKING PLATE (225 X 170)

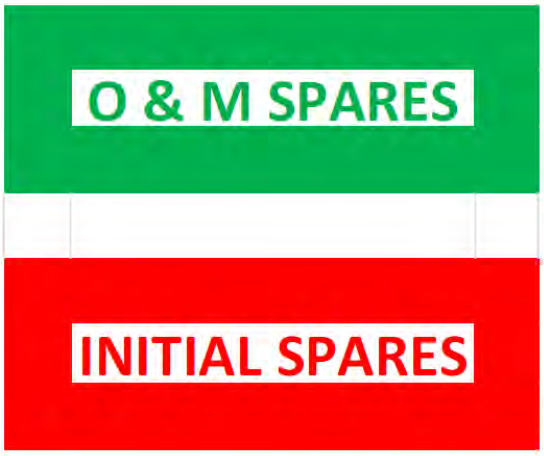


Figure 5

Easy spares [Initial and O&M] Traceability and Identification at units and as well as at sites:

11 RECYCLING OF INCOMING WOODEN PACKING CASES

OBJECTIVES

– To utilize useable wood of incoming packing cases, for manufacturing of new packing boxes.
– To recycle incoming wooden packing cases, as such, wherever possible.

1) All incoming wooden packing cases received from suppliers /customers will be opened carefully, with the intention of reusing them, by Shop.
2) After carefully taking out the contents, the empty wooden packing cases will be shifted by Shop to the specified locations i.e. bin / nearly spaces, already earmarked in stores.
3) Material shifting contractor engaged by store, will collect all such wooden packing cases and scrap wood from specified points, on a regular basis.
4) After collecting / loading the empty packing cases/ scrap wood, contractor will take the carrier first to Weighment Bridge for weighment, thereafter; he will go to Carpentry, where Carpentry representative will identify the packing cases which can be used by Carpentry for manufacturing of New Packing Boxes. All such identified packing boxes will be unloaded and handed over to Carpentry by contractor.
5) These packing boxes will be made re-useable after necessary rectification and additional work.
6) Contractor will again take the carrier for weighment and this second reading will also be recorded on the same “Weighment Slip”.
7) Weight of empty packing cases / scrap wood taken will be calculated on the basis of 1st and 2nd weighment readings recorded on the “Weighment Slip”. A copy of“Weighment Slip” (where both the weighment readings are recorded) will be given by the contractor to the carpentry representative. Based on this “Weighment Slip”, carpentry will maintain a register in which details of quantity received will be recorded.
8) All “Weighment Slips” will invariably be signed by carpentry representative (even when no boxes have been unloaded by carpentry). Store will accept the scrap wood only if “Weighment Slips” are signed by carpentry representative.
9) Balance empty packing cases / scrap wood will be handed over by contractor to Store, for storing in scrap yard.
10) A separate area in Scrap yard will be provided, for executing the work of denailing of wooden packing cases, under supervision of carpentry.
11) Carpentry contractor will identify packing cases / scrap wood for denailing, which will behanded over to him by Store, at Scrap yard, for denailing and further operation.
12) Quality and Carpentry will jointly inspect the wood generated by de-nailing process and will prepare “INSPECTION CUM RECEIPT REPORT OF USEABLE WOOD RECEIVED FROM TPS – STORE BY CARPENTRY”.
13) After acceptance of the wood by Quality and Carpentry, the same will be shifted to carpentry for receipt and its record will be maintained by carpentry.
14) This will be a Permanent Productivity Project executed by carpentry. “Productivity Savings “duly verified at the current Purchase Order rate of wood, will be sent every month to Resource Management Department, for highlighting it in their monthly progress report.

12 STANDARD METHOD OF PACKING

Table 5 - Standard Method of Packing

DESCRIPTION	CASE	CRATE	SKID	BUNDLE	BARE	DRUM	METAL DRUM	FIBRE DRUM
PRESSUE VESSELS								
TOWERS					O			
TANKS					O			
VESSELS					O			
GASKETS	O							
FASTENERS	O							
COVERS		O						
EXCHANGERS								

CORPORATE STANDARD

DESCRIPTION	CASE	CRATE	SKID	BUNDLE	BARE	DRUM	METAL DRUM	FIBRE DRUM
HEAT EXCHANGERS					O			
TUBE BUNDLE	O							
SHELL					O			
AIR FIN COOLERS					O			
COLOUMNS, MOTOR SUSPENSIONS, PLENUM CHAMBERS, SCREEN GUARDS, ETC					O			
BEARING BLOCKS	O							
FANS	O	O						
MOTORS	O							
GASKETS	O							
FASTENERS	O							
TEST FLANGES			O					
TEST RINGS			O					
COVERS			O					
CRYOGENIC VESSELS								
COLD CONVERTERS					O			
HORIZONTAL STORAGE TANKS					O			
TRANSPORTATION TANK					O			
COLD BOX					O			
DRYING UNIT					O			
DRYING BOTTLES					O			
MOISTURE SEPARATORS					O			
SILENCERS					O			
ONGC SKIDS					O			
VAPORISER		O						
SPECIAL PRODUCTS								
SI/VI PIPING		O						
CRO BIO CONTAINERS	O							
AIR BOTTLES	O							
TITANIUM BOTTLE	O							
WAR HEAD CONTAINER	O							
MISSILE CONTAINER	O							
FUEL CONTAINER	O							
AIR LOCK ASSEMBLY	O							
BOILER DRUMS					O			
BOILER ITEMS								
COILS			O					
PANELS					O			
HEADERS			O		O			
FEEDERS								
MACHINED ITEMS								
SHELL SEGMENTS					O			

DESCRIPTION	CASE	CRATE	SKID	BUNDLE	BARE	DRUM	METAL DRUM	FIBRE DRUM
SHELL SEGMENTS IN STACKS					O			
SPHERE PETALS								
COLOUMNS, BASE PLATES, TIERCOS, PIPES, NOZZLE E1, F1, INTERNAL PIPES, PADS ETC.					O			
ROLLERS	O							
VALVE TRAYS								
VALVE TRAY COMPONENTS	O							
LATTICE GIRDERS		O						
FASTENERS	O							
GASKETS	O							
SUB CONTRACTS								
FAB STRUCTURALS					O			
SUPPORTING STRUCTURALS					O			
STRUCTURE SUB ASSEMBLY					O			
FAB PIPES					O			
GRATINGS					O			
STAIR CASES					O			
HANDRAILS/ PLATFORMS					O			
BOUGHT OUT COMPONENTS								
IRON & STEEL (LIKE PLATES, BEAMS, ANGLES, CHANNELS ETC.)					O			
PIPE FITTINGS								
CS PIPES, TUBES					O			
SS PIPES, TUBES					O			
FIN TUBES	O							
ELBOWS		O			O			
FLANGES	O	O						
VALVES	O							
GAUGES	O							
DEMISTERS		O						
ABSCRBANTS (LIKE MOLECULAR SIEVES, ACTIVATED ALUMINA, MOBILE SORBID)						O		
PAINT TINS		O						
PAINT DRUMS						O		
IGNITORS	O							
SPRAY NOZZLES	O							
ELECTRICAL INSTRUMENTATION								
MOTORS, PUMPS, COMPRESSORS, TURBINES	O							
SWITCH BOARDS, DISTRIBUTION BOARDS, STARTERS, JUNCTION BOXES		O						
INDICATORS, VIBRATOR SWITCHES	O							

DESCRIPTION	CASE	CRATE	SKID	BUNDLE	BARE	DRUM	METAL DRUM	FIBRE DRUM
CABLE BUNDLES, CABLE DRUMS					O			
CABLE TRAYS, CABLE RACKS, EARTHING MATERIAL		O						
OPERATIONAL SPARES	O							

13 PROCEDURE FOR HANDLING OF COMPONENTS

The purpose of this procedure is to protect the quality of the components/equipment while handling in various stages of manufacturing packing & despatching.

13.1 Adequate care shall be taken in handling the material, and components to avoid damage during receipts, storage issue manufacture & despatch operations.

13.2 Appropriate material handling equipment like fork lifters, cranes etc. shall be used where needed.

13.3 Lifting by crane and transportation by trolley of critical items and large components like rotors castings etc. shall be done carefully.

13.4 For critical items, where specified, special handling fixtures shall be used for lifting.

13.5 Slings and shackles used for lifting the components/equipment shall be checked for fitness and suitability before use.

13.6 Slings used on machined surfaces shall be suitably padded. No slings shall be used on journal surfaces.

13.7 Precision machined components like blades, catches, rollers etc. shall be lifted using suitable wooden pallets.

13.8 HANDLING OF COMPONENTS ON RECEIPT/DESPATCH

Before loading/unloading a packing case from the carrier look for the following shipping instructions painted on the packing case.

a) The markings showing the upright position.

b) The markings showing the sling position

c) Markings showing the fragile contents.

d) Other required markings as per clause no.10

13.8.1 Appropriate cranes and slings should be used for different components/ cases. Slings should normally make an angle as minimum as possible (width wise) but in no case more than 15º.

13.8.2 Handling and lifting should be done without jerks or impacts.

13.8.3 Immediately after receipt of the goods, the packing should be examined all-round for any sign of damage. If necessary, lift the cover or a number of boards of the case so as to make the contents visible. In the event of sealed packing being used the plastic sheeting should not be damaged. It is imperative that the packing material is restored in original condition after the inspection.

13.8.4 On receipt of the equipment it should be checked with the shipping list and missing or damage if any should be reported immediately. It is important to arrange for immediate examination to determine the extent of the damage, the cause of the damage and where applicable the person or persons responsible for the damage. According to general practice when transporting by railway or by road vehicle the carrier concerned should be immediately called upon (within specified periods) for jointly establishing a statement of the damage. This is essential as a basis for a subsequent claim and possible damage report to the insurance company.

13.8.5 Protective coating applied on machined surfaces should not be disturbed. The plastic covering should be put back carefully so that it prevents ingress of dust and moisture. Some packing may have vapour phase inhibitor (VPI) paper enclosed inside the packing cases. This should be restored to its original place as far as possible.

13.8.6 Silica gel and such other chemicals kept in the box as desiccants and indicators should also be left in the box itself.

14 GENERAL GUIDELINES FOR ODC TRANSPORTATION/DESPATCH

Based on the Dimensions/Weight indicated in the Transportation Sketch, the type of Trailer is decided and indicated in the Tender Enquiry.

14.1 TRANSPORTATION:

1. LOW BED TRAILERS (LB 8):
   - Well Bed Length : 10000mm
   - Over Gooseneck : 13000mm
   - Width : 3000mm
   - Carrying Capacity : 40MT

2. LOW BED TRAILERS (LB 16):
   - Well Bed Length : 12000mm
   - Over Gooseneck : 16000mm
   - Width : 3000mm
   - Carrying Capacity : 75MT

3. TOW TYPE TRAILERS (WITH FRONT DOLLEY 16 TYRES): 12000MM length
   (for Exceptional equipment length: 30000mm and above)

   Bigger Dia equipment are loaded in the Well with overhanging.

   Smaller Dia equipment with excess length are loaded over Gooseneck with rear hanging.
   The Vehicle Dimensions are defined above are only guidelines for selection based on actual Dimensions/ Weight of the Consignment

14.2 PACKING:

For all ODCs, Wooden Saddles are cut to the diameter of equipment as per the Transportation Sketch.

Wooden Saddles	For Diameter up to 4000mm	For Diameter above 4000mm
Length:	1836/2743mm (6'0"/9'0")	3353mm (11'0")
Width:	300mm (1'0")	300mm (1'0")
Height:	Saddle + one/two wedges a top	Saddle + three/four wedges a top

Number of Saddles:	
Minimum	3 in case of Loading inside Well +1 when loaded on Gooseneck
Maximum:	4 in case of Loading inside Well +2 when loaded on Gooseneck

For Securing the equipment firmly on the Trailer, 19mm (3/4"), wire rope with 25mm (1") Heavy Duty Turn Buckles / BD Clamps are used as Lashing for the equipment.

14.3 NUMBER OF LASHINGS:

	CONSIGNMENT LOADED INSIDE WELL BED	CONSIGNMENT LOADED OVER GOOSENECK
a) up to 40MT	4 (2 Single Line lashing 2 Double Line Lashing)	5 (3 Single Line Lashing 2 Double Line Lashing)
b) 40MT to 60MT	5 (3 Single Line Lashing 2 Double Line Lashing)	5 (Single Line Lashing 3Double Line Lashing)
c) 60MT and above	5 (2 Single Line Lashing 3 Double Line Lashing)	6 (3 Single Line Lashing 3 Double Line Lashing)

15 GUIDELINES FOR HANDLING/LOADING/LASHING

15.1 HANDLING

Figure 6

Before unloading the jobs Completely painted and neatly stencilled will be checked.

Pipes with split type end cover will be checked

Figure 7

All Coil Tubes to be provided with End Caps.

Figure 8

Neatly stacked Coil Assemblies.

Figure 9

Columns to be lifted with Nylon belts. This protect painting, edges and attachments.

Figure 10

15.2 LOADING

All the components to be transported by putting inside the properly fabricated Crating

Figure 11

Small components may fall down while transporting without closed crating and there are chances of missing of small parts. Hence, it is always better to transport small components in closed containers/crating. Loose to be being shipped in a closed crating.

Figure 12

No component loaded over the crating.

Figure 13

Headers supported with wooden V blocks at 3 meters interval.

Figure 14

Spacers in between each coil assembly.

Figure 15

Goose pipe to be provided with rubber pad protects removal of painting and damage to the job.

Figure 16

15.3 LASHING

Use Nylon belts only for lashing of all components. It prevents removal off painting and cut in the materials.

Figure 17

Nylon Belts used for lashing the beams.

Figure 18

16 PRODUCT WISE SPECIAL INSTRUCTION

Additional instructions of packing not included in this standard shall be covered by individual product standard.

17 REFERRED STANDARDS (Latest publications including amendments):

1) AA51420	2) AA55619	3) AA51414	4) IS:3401	5) AA10108
6) AA56126	7) AA51402	8) AA51401	9) IS:1234	

VACUUM PACKING FOR ELECTRONIC COMPONENTS

1 GENERAL

This standard lays down the packing instructions for packing of components / Electronic module / Assemblies to be dispatched against Customer contracts.

2 SCOPE

This procedure covers method of packing electronic components using vacuum packing in a wooden packing boxes.

3 OBJECTIVE

To establish a rust proof safe packing procedure and where the components required to protect against temperature and humidity. In general minimum temperature +5 deg C and maximum temperature 45 deg C, and relative humidity between 10% to 40%.

4 PACKING BOX

Wooden Box shall be made as per BHEL Standard AA0490010 for Domestic/ AA0490009 for Export/ AA0490004 for Seaworthy packing. Size of the box as per the contract requirement which has to be checked by QC.

5 PACKING PROCEDURE

a) Cleaning parts shall be thoroughly cleaned just before VCI (Volatile Corrosion Inhibitor) Vacuum packing. Finger prints on cleaned items are to be avoided as the same are very corrosive.

b) VCI Rust preventive oil (Ferrous grade oil base) shall be applied to all the components to withstand any corrosion.

6 VCI VACUUM PACKING

a) Bubble wrapping the items VCI vacuum packing.

b) Appropriate vapour corrosive packets one pouch (1 gm. /pouch) of VCI Anticorrosive Powder and one pouch (10gm./ pouch) of VCI Desiccant per 1000 cub. meter packing space shall be placed inside the VCI vacuum packing.

c) All the components shall be separately packed using VCI laminated Aluminium foils from which air/moisture are removed by the air vacuum device and sealed thoroughly using heat sealing machine. At the time of the evacuation the vacuum inside the pack should be less than 0.5 ata.

d) One identification slip containing component information such as description of item, Material No. Customer PO, Item No. Quantity etc. shall be put inside the VCI vacuum packing.

e) Top cover of the wooden box shall be sealed only after final clearance from QC for confirmation of above.

f) All boxes should be covered by water proof tarpaulin over top and on all sides.

g) The packing boxes shall be covered with GI sheets (0.25 -0.4mm thick) on all the sides for Export / Seaworthy packing.

h) Vacuum packing room temperature and Relative Humidity should be maintained as mentioned below:

Min. +5 deg. C and Max. 45 deg. C, Relative humidity between 10% to 40%.

COPYRIGHT AND CONFIDENTIAL
The Information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.
It must not be used directly or indirectly in any way detrimental to the Interest of the company.

7 COMPONENTS REQUIRED

7.1 VCI laminated Aluminium foil

Volatile Corrosion Inhibitor (VCI) safe foil shall be with aluminium barrier laminated which is flexible, heat sealable, water vapour and anticorrosion resistant barrier laminate of polyester, Aluminium foil and VCI Polyethylene. It is used as a primary packaging material for packing metal components and sealed with the help of a heat sealer after vacuuming with vacuum machine maintaining the humidity level below 40 RH inside the package.

7.2 Composition construction of VCI laminated Aluminium foil

a) PET Film : 12 Microns
b) Bonding layer : 2 Microns
c) Aluminium Foil : 9 Microns
d) Bonding layer : 2 Microns
e) VCI Poly film : 100 Microns
f) Total thickness : 125 Microns + or – 5%

7.3 Properties of VC Laminated Aluminium foil

a) Basic Weight : 138 gsm +/- 8%
b) Sealing condition : 180 C/ 2 sec
c) Tensile strength
   MD: 20 kgf
   CD: 18 kgf
d) Tear Strength
   MD 4.8 kg
   CD:3.4 kg
e) Heat Seal Strength : 30.380 N/cm
f) WVTR Value : 0.05gms/m /24 hrs.
g) OTR Value : 0.1 cc/m/24 hrs

8 MARKING OF PACKING BOX

Mark the following information on the two adjacent sides of the each package

a) Material No.
b) Customer PO
c) Item No.
d) Quantity
e) Storage Requirement : Indoor
f) Content Description : Electronic Module
g) Net weight (in kg)
h) Dimension (L x W x H in centimetres)
i) Project Name
j) Consignee
k) Water proofing (Umbrella Stencilling)
l) Upside direction

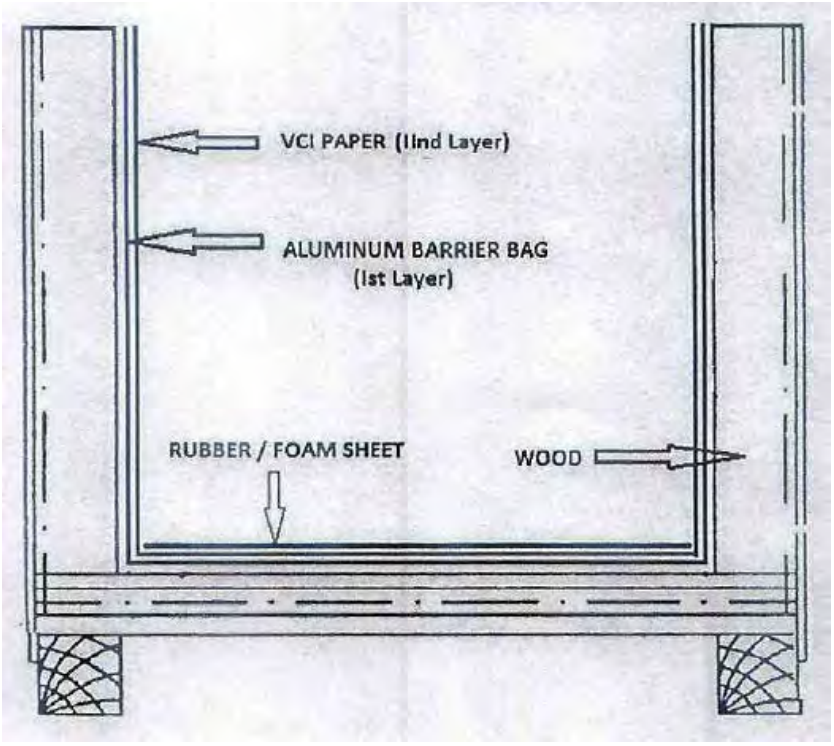

VCI PAPER (IInd Layer)
ALUMINUM BARRIER BAG
(Ist Layer)
RUBBER / FOAM SHEET
WOOD

Figure 1

VACUUM PACKING FOR ELECTRICAL COMPONENT

1 GENERAL

This standard lays down the packing instructions for packing of components / Electrical components Stator/ Rim punching, Wound Pole/ Field Coils and Stator coils / bars to be dispatched against Customer contracts.

2 SCOPE

This procedure covers method of packing component in a wooden packing boxes.

3 OBJECTIVE

To establish a rust proof safe packing procedure and where the components required to protect against temperature and humidity. In general minimum temperature +5 deg C and maximum temperature 45 deg C, and relative humidity between 10% to 40%.

4 PACKING BOX

Wooden Box shall be made as per BHEL Standard AA0490010 for Domestic/AA0490009 for Export/ AA0490004 for Seaworthy packing. Size of the box as per the contract requirement, which has to be checked by QC.

5 PACKING PROCEDURE

a) All items packed are to be marked by QC with “OK” stickers. Varnished stator punchings are to be brought down to room temperature before labelling them “OK” for packing. Do not pack hot/warm stator punchings that have is just received from the varnishing.

b) Packing of stator punchings, wound pole/ field coils and stator coils / bars should be done in a covered shed.

c) Packed materials are to be stacked in proper alignment and to be kept in wooden packing.

6 Additional Packing Methodology for Stator / Rim Punchings (Double stacking) only

In order to eliminate the use of studs avoid double stack packaging per box. Where double stacked packing boxes are unavoidable, the stator /rim punchings are to be securely tightened using GI studs, nuts and soft material washers (rubber/plastic). GI studs, nuts and soft material only to be used in case of double stacking of rim / stator punchings (with holes). Use soft rubber washers to seal the punctured opening at the bottom from where the studs pass in each layer of VCI (Volatile Corrosion Inhibitor) paper, polythene and tarpaulin sheet in case of rim /stator punchings (with holes).

a) GI studs with rubber washer to be placed initially inside the wooden packing box.

b) Over the wooden base, place water proof tarpaulin sheet.

c) Rubber washer shall be placed after the layer of tarpaulin sheet.

d) Then place a layer of porous plastic sheet with total thickness of at least 5mm (for cushioning and reduces the chances of damage to punchings).

e) Place the Aluminium Barrier laminated Bags over this porous sheet, place the rubber washer over it.

f) Place VCI papers on the Aluminium barrier bag and fix with rubber washer.

COPYRIGHT AND CONFIDENTIAL
The Information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED.
It must not be used directly or indirectly in any way detrimental to the Interest of the company.

g) PVC Pipes shall be inserted over the GI studs. These pipes are to be used to cover each stud, to protect its direct contact and hence rubbing with punchings.

h) Now place the stack of punchings over the VCI paper and securely tighten the punchings using nuts and soft material, washers.

i) Each layer should be secured in position. Wrap the punchings with VCI paper and properly sealed separately using an adhesive tape.

j) Silica Gel packets are to be placed over the VCI paper and uniformly distributed inside the boxes on the VCI paper to remove/prevent moisture.

k) Aluminium barrier laminated bag has secured in position and properly sealed by using heat sealing machine and air to be drained out by using vacuum pump. At the time of the evacuation the vacuum inside the pack should be less than 0.5ata.

Use two separate VCI papers for doubled stacked boxes independently covering each stack. Similarly two Aluminium barrier laminated bag are to be used to wrap the two stacks independently, as explained above.

7 Additional Packing Methodology for Wound Pole/ Field Coils and Stator Coils/Bars only

a) Over the wooden base, place the waterproof tarpaulin sheet.

b) Then place a layer of porous plastic sheet with total thickness of at least 5mm (for cushioning and reduces the chances of damage to Wound pole/field coils and stator coils/ bars.

c) Place the Aluminium barrier laminated bag over this porous sheet.

d) Place the VCI paper (Volatile Corrosion Inhibitor as per BHEL Standard AA51406) on the Aluminium barrier laminated bag along with rubber washer.

e) Bare copper portion of field coils and stator coils / bars to be covered by VCI paper pouch and fasten with VCI tape.

f) Now place the wound pole, stack of field coil and stator coil / bars over the VCI paper.

g) Each layer should be secured in position. Wrap wound pole / field coils and stator coils / bars with VCI paper and properly sealed separately using an adhesive tape.

h) Silica Gel packets are to be placed and uniformly distributed inside the boxes on the VCI paper to remove/prevent moisture.

i) Then Aluminium barrier laminated bag has secured in position and properly sealed by using heat sealing machine and air to be drained out by using vacuum pump. At the time of evacuation the vacuum inside the pack should be less than 0.5ata.

j) The VCI paper must contact the stator / rim punchings, wound pole / field coils and stator coils/bars. It has to ensure that the VCI paper, Aluminium barrier bag should not get damage / puncture during the packing process.

k) Top cover of the wooden box shall be sealed only after final clearance from QC for confirmation of above.

l) All boxes should be covered by water proof tarpaulin over top and on all sides.

m) The packing boxes shall be covered with GI sheets (0.25 -0.4mm thick) on all the sides for Export / Seaworthy packing.

n) Vacuum packing room temperature and Relative Humidity should be maintained as mentioned below:

Min. +5 deg. C and Max. 45 deg. C, Relative humidity between 10% to 40%.

8 COMPONENT REQUIRED

8.1 VCI laminated Aluminium foil

Volatile Corrosion Inhibitor (VCI) safe foil shall be with aluminium barrier laminated which is flexible, heat sealable, water vapour and anticorrosion resistant barrier laminate of polyester, Aluminium foil & VCI Polyethylene. It is used as a primary packaging material for packing metal components and sealed with the help of a heat sealer after vacuuming with vacuum machine maintaining the humidity level below 40 RH inside the package.

8.2 Composition construction of VCI laminated Aluminium foil

a) PET Film : 12 Microns
b) Bonding layer : 2 Microns
c) Aluminium Foil : 9 Microns
d) Bonding layer : 2 Microns
e) VCI Poly film : 100 Microns
f) Total thickness : 125 Microns + or – 5%

8.3 Properties of Aluminium Barrier laminated Bag

a) Basic Weight : Unit: g/sq. m 150 +/- 5
b) Tensile strength : Unit: N/sq. mm MD: 40 (min.)
Unit: N/sq. mm TD: 41 (min.)
c) Water Vapour Transmission : Unit: g/m^2 0.01 in 24 hrs. at 38 deg C & 90% RH(max)
d) Oxygen Transmission : Unit: cm^3/m^2 0.02 in 24 hrs. at 38 deg C & 90% RH (max)
e) Sealing Temp. : Unit : Degree C 180-220 deg C

9 MARKING ON PACKING BOX

Mark the following information on the two adjacent sides of the each package.

a) Box No.
b) Customer PO
c) Product Name.
d) Project Name
e) Quantity
f) Storage Requirement : Indoor
g) Net weight (in kg)
h) Dimension (L x W x H in centimetres)
i) Consignee
j) Water proofing (Umbrella Stencilling)
k) Upside direction
l) Sling position indicator

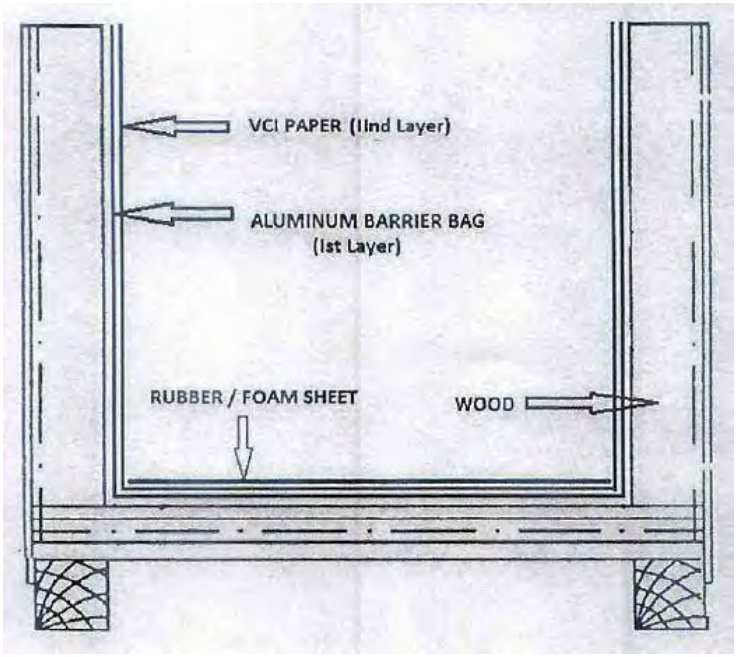


Figure 1

Figure 2

Figure 3

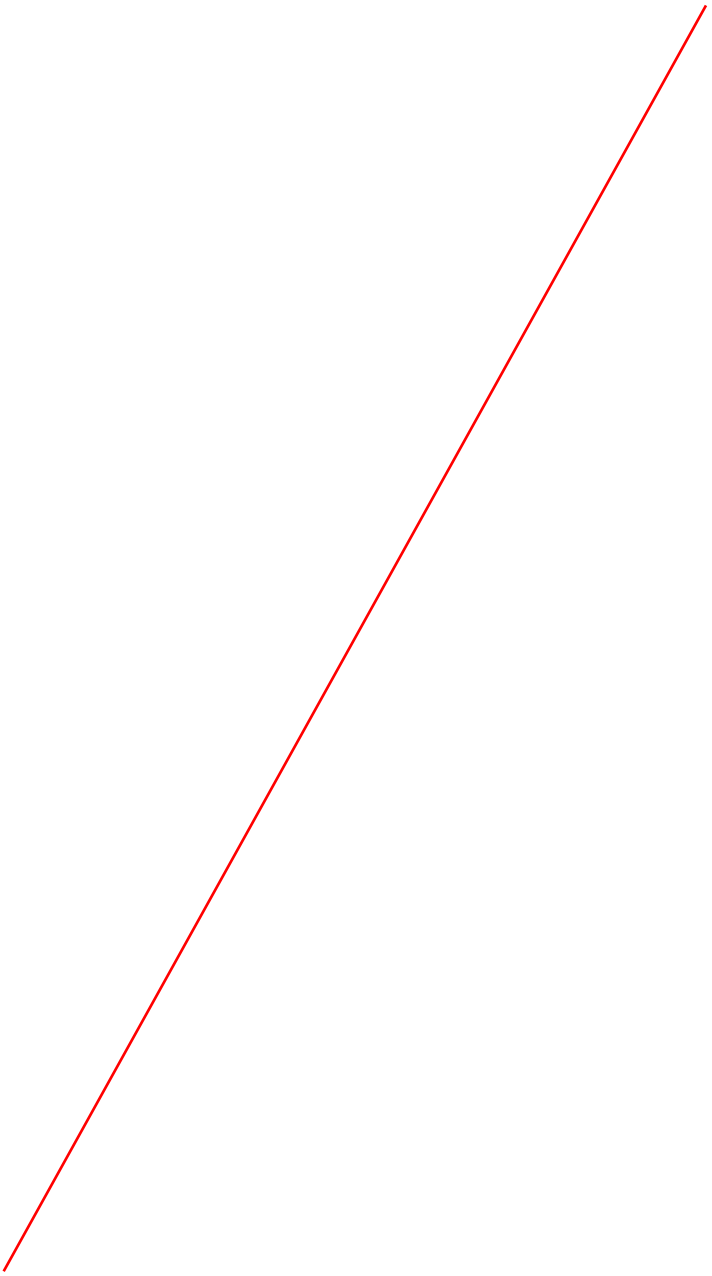
Figure 4

Figure 5

ANNEXURE-IX

PROTECTIVE COATING AND PAINTING

NON METALLIC PARTS OF PRIMARY SECONDARY CLARIFIERS & THICKENER SHALL BE PAINTED FOR SEA WORTHY APPLICATION.



CONTENTS

CLAUSE NO.	DESCRIPTION	PAGE NO.
1.00.00	INTENT OF SPECIFICATION	1
2.00.00	CODES & STANDARDS	1
3.00.00	GENERAL REQUIREMENTS	2
4.00.00	SURFACE PREPARATION	3
5.00.00	PAINT APPLICATION	7
6.00.00	INSPECTION	11
7.00.00	SPECIFICATION OF COATING SYSTEMS	15
8.00.00	TESTING REQUIREMENTS	23
9.00.00	INFORMATION / DATA REQUIRED	26
ANNEXURE-1	MARKET AVAILABLE COATING SYSTEMS AS PER SPECIFICATION	27

VOLUME : II-A

SECTION-V

PROTECTIVE COATING AND PAINTING

1.00.00 INTENT OF SPECIFICATION

1.01.00 This specification addresses the requirements of all labour, material, and appliances necessary with reference to preparations for lining / painting, application as well as finishing of all lining / painting for all mechanical and electrical equipment, piping and valves, structures etc. included under the scope of this Flue Gas Desulphurisation Plant package.

1.02.00 The bidder shall furnish and apply all lining, primers including wash primers if required, under-coats, finish coats and colour bands as described hereinafter or necessary to complete the work in all respects.

2.00.00 CODES & STANDARDS

2.01.00 The bidder shall follow relevant Indian and international standards wherever applicable in cleaning of surface, selection of lining material / paints and their application. The entire work shall conform to the following standards / specifications (latest revision or as specified).

a)	SSPC SP 10 / NACE 2 / SA 2½	:	Near white blast cleaning
B)	SSPC PA 2	:	Measurement of dry film coating thickness with magnetic gauges.
c)	ASTM D 45	:	Method for pull off strength using portable adhesion tester.
d)	NACE RP 0274 – 2004	:	High-voltage electrical inspection of pipeline coatings.
e)	NACE SP 0188 – 2006	:	Discontinuity (holiday) testing of new protective coatings on conductive substrates.
f)	NACE RP 0169 – 2002	:	Control of external corrosion of underground or submerged metallic piping systems.

g)	AWWA C 210 – 2007	:	Liquid-epoxy coating systems for the interior and exterior of steel water pipelines.
h)	IS 3589:2001 Annexure-b	:	Steel pipes for water and sewage specification.
i)	AWWA C 222-2000	:	Polyurethane coating for the interior and exterior of steel water pipe and fittings.
j)	IS 13213 : 2000	:	Polyurethane full gloss enamel (two pack)
k)	ISC HD 20 (11902)	:	Polyurethane coating for interior and exterior of steel pipe and fittings.
l)	ISC HD 20 (11055)	:	Solvent less liquid epoxy system by application of interior and exterior surface of steel pipeline.
m)	IS 10221	:	Coating and wrapping for buried piping

3.00.00 GENERAL REQUIREMENTS

3.01.00 The bidder shall submit a detailed written description in the form of a manual covering coating equipment, procedures, materials inspection test, and repair etc. to owner/consultant for approval.

3.02.00 The bidder shall also provide certificates from paint/primer manufacturer mentioning the batch numbers, date of manufacture and shelf life etc. of the materials to be used. In addition to that manufacturing quality plan (MQP) and field quality plan (FQP) shall also be submitted prior to commencement of supply of material and field application.

3.03.00 Paint/coating application work at site shall be done either by paint manufacturer or by their authorized applicator. The authorized applicator shall have proper training & certification from manufacturer. Applicator shall possess all the necessary specialized equipment and manpower experienced in similar job.

3.04.00 If necessary, the material may be heated and applied by airless spray / plural component spray system.

3.05.00 Manufacturer's specific recommendation, if any, shall be followed during application of lining / paints.

3.06.00 In areas where there is danger of spotting automobiles or other finally finished equipment or building by wind borne particles from paint spraying, a purchaser approved method shall be adopted.

3.07.00 The colour scheme of the entire FGD Plant equipment and auxiliaries area, covered under this specification shall be approved by the purchaser in advance before application.

3.08.00 All indoor and outdoor piping, insulated as well as uninsulated will have approved colour bands painted on the pipes at conspicuous places throughout the system, as approved by purchaser.

3.09.00 Inside surfaces of vessels / tanks shall be protected by anticorrosive paints or rubber lining as required / specified elsewhere in the specification. External surfaces of all vessels / tanks shall be protected by anti-corrosive painting.

3.10.00 For vessels / tanks requiring lining and anti-corrosive painting all inside surface shall be blast cleaned using non-siliceous abrasive after usual wire brushing.

3.11.00 Natural rubber lining shall be provided on the inside of vessels / tanks as required / specified elsewhere in the specification, in three layers resulting in a total thickness not less than 4.5 mm.

3.12.00 Surface hardness of rubber lining shall be 65 +/- 5 deg. A (shore).

3.13.00 After the lining is completed, the vessels / tanks shall not be subjected to any prolonged exposure to direct sunlight in course of its transportation, erection etc. They shall not be stored in direct sunlight. No further lining or burning shall be carried out on the vessel, after application of the lining.

3.14.00 All lining projecting outside of the vessel shall be protected adequately from mechanical damages during shipment, handling storage etc.

3.15.00 Suitable warnings, indicating the special care that must be taken with respect to these lined vessels shall be stenciled on their outside surface with the letters at least 12 mm high.

3.16.00 All insulated piping shall have aluminium sheet jacketing.

4.00.00 SURFACE PREPARATION

4.01.00 Most metallic articles that are usually given protective coatings are heavily contaminated and require, at least, some cleaning treatment before the coating is applied. The importance of surface preparation cannot be over emphasized as many investigations have shown convincingly that the performance and durability of any protective coatings are, to a large extent governed by the thoroughness of surface preparation. Often they concluded

that careful cleaning and preparation of the surface were more important than the quality of the protective coating.

4.02.00 Surface contamination in the form of rust, scale, oil grease and dirt is often obvious. Invisible contamination may also be present and represents, on the whole, a greater hazard. Examples of the latter are soldering fluxes, perspiration in the form of hand marks, chlorides from marine atmosphere and sulfite from industrial atmosphere.

4.03.00 The following table gives a surface preparation specification in the descending order of Effectiveness:

Sl. No.	Methods of cleaning	Specifications NACE/SSPC
1.	White metal blast	NACE # 1, SSPC SP 5-63
2.	Near –white metal blast	NACE # 2, SSPC SP 10-63
4.	Acid Pickling	SSPC SP 8-63
5.	Brush Blast	NACE # 4, SSPC SP 7-63
6.	Flame Clean and Power Sanding	SSPC SP 4-63
7.	Power Tool Cleaning	SSPC SP 3-63
8.	Chip and Hand Wire Brush	SSPC SP 2-63
9.	Solvent Wipe	SSPC SP 1-63

4.04.00 The following table gives the Specifications for sand / shot / grit blasting

Sl. No.	Methods of Cleaning	Specification
1.	NACE # 1	White sand blast
2.	NACE # 2	Near-white sand blast
3.	NACE # 3	Commercial blast
4.	Pickle, phosphate treated	
5.	NACE # 1	Grit
6.	NACE # 1	Shot
7.	NACE # 4	Brush blast
8.	No surface preparation	

4.05.00 Inspection of blasted steel surface

For the purpose of inspecting the blasted steel surface with sand abrasive, the respective “Visual standards” shall be utilized.

The standards used in industry to describe surface preparation are:

i. National association of Corrosion Engineers (NACE)
ii. Steel Structural Painting Council (SSPC)
iii. Swedish Pictorial Standards

White metal blast (SSPC 5-63, NACE No.1, and SA-3)

This is defined as removing all rust, scale, paint etc. to a clean white metal which has a uniform Grey white appearance. Streaks and stains of rust or

other contaminants are not allowed.

Near white metal (SSPC 10-63, NACE No.2, SA – 2.5)

This provides a surface of about 95% as clean as white metal. Light shades and streaks are not allowed.

Commercial blast (SSPC 6-63, NACE No.3, SA –2)

This type of blast is more difficult to describe. It essentially amounts to about 2/3 of a white metal blast, which allows for very slight residues of rust and paint in the form of staining.

Brush of blast (SSPC 7-63, NACE No.4 SA-1)

This preparation calls for removal of loose rust, paint, scales, etc. Tightly adherent paint, rust and scale is permitted to remain.

4.06.00 Pictorial Standards of different surface preparation to be adopted

During surface preparation operations, the surface condition obtained shall be compared with pictorial standards available for getting the specified condition. These pictorial standards are available in steel structural painting Manual (Vol. 1), “Good painting practice “, visual standards of surface cleaning sp 7,6,10 and 5 are described in page No.185 and 186 viz. Fig 9,11,12 and 13.Surface profile gauge and surface compactor could be used to check surface conditions according to NACE standard TM 01 70 of NACE.

4.07.00 PRESSURIZED WATER CLEANING METHODS

These standards provides requirements for the use of high and ultra-high pressure water jetting to achieve various degrees of surface cleanliness. This standard is limited in scope to the use of water only without the addition of solid particles in the stream. These standards define four levels of working pressure:

SSPC-SP WJ-1/NACE WJ-1:	Water-jet cleaning of metals. Clean to bare substrate.
SSPC-SP WJ-2/NACE WJ-2:	Water-jet cleaning of metals. Very thorough cleaning.
SSPC-SPWJ-3/NACEWJ-3:	Water-jet cleaning of metals. Thorough cleaning.
SSPC-SP WJ-4/NACE WJ-4:	Water-jet cleaning of metals. Light cleaning.

This cleaning standard defines 4 levels of cleanliness for visible contamination by water jetting and 3 levels for non-visible contamination, such as chlorides and other soluble salts. See the full standard for complete definitions on the level of cleanliness.

4.08.00 SPECIFICATIONS FOR COPPER SLAG BLASTING:

1. The surface shall be cleaned of all dust and heavier layers of rust by copper slag blasting the entire internal surface to photographic standard SIS: 055900- 1967.

2. The consumption rate of copper slag is 1.6 Kg/Sqm of the blasted area. This has to be ensured strictly.

3. All tools, equipment, base material, hand and power tools for cleaning, including scaffolding material, copper slag blasting equipment, air compressor, etc. shall be arranged by the contractor at site in sufficient quantity.

4. The compressor used shall be of size enough to produce displacement of 5.6 to 7.0 Cum/Min of air at a pressure of 7 Kg/sq.cm. Standard blasting equipment, hoppers, hoses nozzles and attachments shall be used to obtain best test results and to maintain safety standards. The rate of cleaning shall be about 15 sq.mt. per hour at a pressure of 7 kg/sq.cm.

5. The abrasive used shall be of the physical properties as mentioned below and shall be free from oil, loan and mud etc.

6. The blast cleaned surface shall be blasted with dry compressed air before applying primer. This should be done even if the surface appears very clean and white in colour. The white colour may be due to deposition of silicon and reflection of light on the surface.

7. Proper earthing and bonding arrangements shall be made to prevent any damage by sparks produced by static electricity. Bonding shall be done between tank and blast nozzles and hopper and air compressor also. The bonding conductor should not be less than 16 SWG single strand copper cable.

8. The time gap between blast cleaning and application of primer shall not be more than THREE hours. Blast cleaning work shall, commence from top to bottom.

9. The blast cleaning operation shall be carried out keeping the nozzle at an angle of 30 degree to the vertical in order to prevent rebounding abrasive from showing down the abrasives emerging from nozzle and from under cutting the material to be removed.

10. A blast cleaning, the percentage of bare metal obtained shall be between 95% to standards of SA 2 ½ of the Swedish standard referred above. (Pictora) surface preparation standards for painting steel surfaces).

11. Arrangements for inspection of various stages of the job shall be made available by the Contractor so that the entire sand blasted area is available for inspection. Any defective work noticed shall be immediately rectified and even reblasting shall be done if necessary.

5.00.00 PAINT APPLICATION

The coating is a unique product. It is only after application on the substrate a coating becomes valuable and useful. The manufacturer shall produce high performance liquid coatings, yet the product usefulness lies in the hands of the applicator. That is the reason why stress is given for proper and careful application as a key to the success of any coating. Protection by coating mainly depends upon three factors

a) The material
b) The surface preparation
c) The application

If any one of the three is weak, protection value is affected to that extent.

High performance coatings are especially sensitive to misapplication and may fail drastically. Therefore, it is imperative that the instruction for application be followed explicitly, particularly when applying sensitive and expensive high performance coating systems.

The purpose of coating application is to develop a continuous highly adherent film with an even thickness over the substrate. To achieve this, various factors have to be considered such as type of coatings and weather conditions, application methods etc. It is advisable to avoid painting below 10^0C and above 40^0C, if the relative humidity is above 80%, during the rainy weather and wind velocity is above 24km/hr or else freezing will occur before the paint dries.

5.01.00 Application methods

There are a number of methods by which coatings can be applied. The two principal methods are by brush and spray. The other methods are paint pad applications, electrostatic spray, electro-coating, dipping and fluidized bed technique. The latter methods are primarily for in-plant application.

The choice of application methods depends on a number of factors. The first is the type of coating. Most of the oil-based coatings can be easily applied by brush but it is the slowest process. Spray application is the fastest for large flat surfaces. The type of surface is also a factor. For small and intricate areas, brushing is probably the best method. If the surface is used and pitted, application of the first coat by brushing is probably the best method.

Brushing can be done in almost all areas, since the liquid coating is transferred from the brush to the surface. Spraying however, causes problem with toxic solvents as well as a possible fire hazard due to fume build up.

Spraying in small, enclosed areas are usually not suggested. Clean up is also a factor. Cleaning a brush is the least difficult procedure and cleanup of spray equipment is the most time consuming and most complicated procedure.

5.02.00 Storing and handling of paints

Coating materials (paint) as they are packed at the manufacturing plant are thoroughly dispersed, with the pigments fully suspended and of a uniform consistency in terms of both texture and colour. Unfortunately, very few coatings are applied within a short time after manufacture. They may be placed in inventory at the manufacturing plant or sent to a distribution point where they will be held for a period of time. Also, the coating material may be purchased several months before its actual use and again under different conditions. Thus, coatings generally must be remixed and properly re-dispersed prior to actual application.

A pigment, which is usually heavier than the vehicle, tends to settle and may even cake at the bottom of the container. Coatings vary to a wide degree in this particular characteristic. Some may stay suspended for many years; others settle out hard at the bottom of the container. This is a defect. Paints, which gelled in the container or in which the pigment liveried (i.e. become thick and rubbery) are not satisfactory for use and cannot be practically redispersed. The formulation has to contain proper antisettling additive to avoid this defect.

The purpose of remixing and re-dispersion is to make the coating completely homogeneous, so that upon application the pigment and vehicle can produce the film that was intended by the manufacturer. In certain cases, particularly in oil-type vehicles, there may be skin on the surface of the liquid. These should be removed before re-dispersion, since they will not get redispersed into the vehicle.

5.03.00 Mixing

The mixing process is not practically easy, even if the system has not settled hard. This is often neglected by applicators, particularly in coatings, which have settled rather solidly. There have been examples of coatings that were applied with at least half of the pigment remaining at the bottom of the container un-dispersed and later thrown away with the container. This procedure does not allow for the maximum performance of coating properties and normally leads to rapid coating failure.

Mechanical mixing

It is always better to use a mechanical mixer of some type, since mechanical mixing always produces a more uniform coating and does so much more rapidly than manual mixing. Manual mixing should only be done under unavoidable circumstances and only in containers with the maximum of a 20-liter capacity.

Even when the coating has settled rather hard, the propeller-type agitator can break it up and re-disperse it to a point, which is closely equivalent to its original form. Nevertheless, care should be taken in the mixing operation, particularly to ensure that the material at the bottom and lower sides of the container has been well separated from the container and re-dispersed. Some materials form soft sediment, which clings to both the sides of the container and the bottom, making it necessary to scrape these off before they can be properly dispersed. This is usually done by manual operation. The mixing should be done in such a manner that splashing is avoided.

The speed of a mechanical mixer should be as low as possible in order to obtain the re-dispersion of the pigment in the vehicle. The coating should have a slight vortex at the surface. A large vortex tends to mix air into the coating, which can cause pinholes and air bubbles during application.

Manual mixing

If the manual mixing is necessary, the liquid portion of the coating should be separated into a clean container. The lower, thicker part of the coating can then be more readily mixed into a heavy paste, including the material, which is clinging to the sides of the container. Once the heavier material is mixed into a smooth paste, the remainder of the liquid from the second container can be remixed into the original container with the heavy material, making sure that the two are thoroughly mixed into a uniform coating. One way to do this is to pour the material back and forth between the two containers. This is called boxing. The materials should be poured back and forth several times to assure complete uniform mixing.

5.04.00 Two component coatings

In the case of two component coatings, there are two materials that must be checked to determine whether or not they are properly dispersed prior to being mixed together. Two component coatings are extremely common at the present time. They include numerous kinds of epoxy coatings, coal tar epoxy coatings, polyurethane coatings, and inorganic zinc coatings. With two component coatings, it is essential that the two components be separately and thoroughly mixed. Two component materials are designed to react chemically, so that if they are not thoroughly mixed, the chemical reaction may not take place properly. Mechanical blending of the two components is recommended to obtain a thoroughly mixed product. The two component materials often are in different colours so that a satisfactory mixing can be readily identified. The fully mixed coating should have a uniform colour and consistency.

5.05.00 Mixing dry powder and liquid

The primary example of mixing dry powder and liquid components is in the use of inorganic zinc coatings. In-organic zinc coatings are made from liquid component and dry powdered zinc. The first step is to determine whether or not the liquid component is thoroughly mixed and dispersed to a completely

homogeneous liquid. This usually is not difficult since most liquid components are lightly pigmented.

Second, stir the total contents of the powder slowly into the total content of the liquid until it becomes a well dispersed, free flowing material. In the case of inorganic zinc coatings, the manufacturers supply the liquid and the powder in two different containers in the exact amount that should be mixed. It is essential that the total powder and total liquid be used in order to obtain the desired final coating. Mixing small portions of zinc and liquid is not recommended, since correct proportions are seldom measured under field conditions.

5.06.00 Straining

Most coatings are thoroughly strained prior to being placed in their container. When the container is opened, if the contents have not settled to a hard deposit in the bottom, straining in the field may not be necessary. On the other hand, if the pigment has settled hard, if the coating has a skin on the surface, or if the product is a material such as inorganic zinc, straining is recommended. Straining prior to spraying often eliminates considerable downtime due to gun clogging by small particles those blocks the orifice in the gun.

Straining can be done with a fine fly screen with a mesh size 150µm or through nylon stocking. Nylon stocking does not contain any lint and is a very fine mesh that most coating materials can readily pass through. Mosquito netting or similar materials also are used, although they often contain some lint, which can cause problems.

5.07.00 Compatibility of different paints

While applying multicoated system of paint it is always desirable to have a first-hand knowledge of compatibility of different coating systems with one another. A general view of such information is given in the following table. This is only a general view.

Primer	Oleo resinous	Alkyd	Silicone alkyd	Vinyl	Chlorinated rubber	Epoxy (2 pack)	Urethane
Oleoresins	C	C	C	NR	NR	NR	NR
Alkyd	C	C	C	NR	NR	NR	NR
Silicone alkyd	C	C	C	NR	NR	NR	NR
Phenol resin	C	C	C	NR	NR	NR	NR
Vinyl	C	C	NR	C	C	C	NR
Chlorinated rubber	C	C	C	C	C	NR	NR
Epoxy	NR	NR	NR	C	C	C	C
Coal tar epoxy	NR	NR	NR	NR	NR	C	NR

Zinc-rich epoxy	NR	NR	NR	NR	C	C	NR
Inorganic zinc	NR	NR	NR	C	C	C	NR
Urethane	NR	NR	NR	NR	NR	NR	C

NOTE: C-Normally

NOTE: C-Normally compatible; NR- Not recommended due to known or suspected problems. Certain combinations marked "NR" may be used provided a suitable tie coat is applied.

6.00.00 INSPECTION

Inspection techniques shall be applied at various stages i.e. from purchase of coating materials to paint application and evaluation of performance during service. Inspection procedures at various stages before and after the application of coating systems over the oil installations have been described below:

6.01.00 Paint composition

The type of paint system shall be selected depending upon the environmental conditions. Generally primer, undercoat and finish coats are used in protective coating system. The purchased paint materials are used in protective coating system. The purchased paint materials shall be tested for the following properties to ascertain whether the supplied paint conforms to the specifications.

i. Type of film formers present
ii. Type of pigments present
iii. Thickness per coat
iv. Volume solids
v. Pigment volume concentration
vi. Area coverage per liter of the paint
vii. Specific gravity
viii. Drying time and
ix. Main pigment content in total pigmentation

It is the duty of the inspection engineer to get the paint system tested for the above factors. The painting operation shall be started only after the values obtained coincide with the required specification of the paint system.

It is essential to see that the surface is not wet during the application of the paint. Moreover paints should not be applied when the humidity of the environment is above 80%. The atmospheric temperature should not be below 10^{o}C during the painting operation.

6.02.00 Procedure for testing paint samples

The following laboratory test procedures shall be adopted for the characterization of the film-formers, pigments and studying the properties of the paint.

a) Type of film-formers present

The film former shall be separated out of the paint by means of centrifuging. It is then to be analyzed using infrared spectroscopy for identifying the functional group. i.e. the type of film formers.

b) Type of pigments present

After separating the pigment from the paint and proper drying, it shall be subjected x-ray diffraction for identifying the pigment.

c) Thickness per coat

Magnetic thickness gauges are used to measure the thickness of the paint film applied over the iron-substrate. The thickness is measured in micrometer (µm). Some of the thickness gauges operating under magnetic principle are elecometer, posi test and micro test. Thickness gauges operating on eddy current principle are used to measure coating thickness over metals other than steel/magnetic substrates.

d) Volume solids

Paint is a mixture of three major components such as pigment, binder and thinner.

The pigment and film-former will remain in the paint film after the evaporation of the solvent. The pigment and film former together are called as solids. The volume of these together in the liquid paint is called as volume solids. This is determined as follows:

A known volume of the paint is taken. Let it be V1. Distilling the solvent and collecting it in a measuring cylinder determine the volume of the solvent present of the paint. Let it be V2. By subtracting V2 from V1, we can determine the volume solids.

e) Pigment volume concentration (PVC)

Pigment volume concentration is defined as

$$PVC = \frac{\text{Volume of pigment}}{\text{Volume of pigment + Volume of binder}} \times 100$$

By separating out the pigment and binder form the paint and knowing their specific gravity, we can calculate PVC.

f) Area coverage per liter of the paint

This is determined by taking a known volume of the paint and applying it over a surface. The area covered by the known volume of the paint is determined. From this value, area covered by one liter of the paint is calculated.

g) Specific gravity

For determining specific gravity, a cup of known volume is taken. The difference in weight of the cup filled with paint and the empty cup gives the weight of paint of known volume. From this, we can calculate specific gravity.

h) Drying time

i) Touch Dry

In this case, if the coated surface is touched with finger, no finger mark should be found on the coating.

ii) Hard Dry
It is the condition of coating drying very hard. Unless the coating itself is damaged with force, no pressure could mar the coating in this condition. This condition is attained usually after seven days.

i) Flow properties (viscosity) of the paint (Ford cup method)

Ford cup is the mostly used instrument for studying the flow properties of the paint. Ford cups having different orifice sizes are available in the market. The varying orifice sizes are meant for measuring the flow time of different viscosities. Generally, the most viscous liquids require bigger orifice. The results are reported simply as seconds per cup. Number

6.03.00 Spot testing procedures

The following spot tests will be useful to identify the binders (film-formers) qualitatively before application at the site.

a) EPOXY RESIN

i) Filter paper test

This test can be carried out even with paint itself. 0.5 gms of paint part (binder part) / binder is taken in a 100 ml beaker and treated with 1ml concentrated sulfuric acid. The beaker is slightly heated at 60^{o}C for a few minutes. It is again mixed with 5ml of conc.H_2SO_4 until the colour intensity is similar to that of very dilute potassium-di-chromate solution. A drop of the solution is taken in a glass rod and is spread over a filter paper. If Bis-phenol-A-type of epoxy resin is present, a purple colour develops in 1 minute, the colour eventually turns blue.

ii) Formaldehyde Test

Few drops of the sample is dissolved in 1 to 2 ml of concentrated sulphuric acid if necessary by heating to 40°C to 50°C. One to two drops of formaldehyde solution is added in to it. An orange colour, which on dilution with water turns violet to blue indicates the presence of epoxy resins.

b) Chlorinated rubber resin

Few milligrams of the sample is allowed to stand in pyridine at room temperature for few minutes. Few drops of methanolic potassium hydroxide solution is added in to it. If chlorinated rubber resin is present in the solution, a yellow precipitate is formed which gradually darkness to a yellow-brown colour.

c) Isocyanate hardener

The aliphatic nature of isocyanate is confirmed by the following spot test. A small sample of isocyanate hardener is heated in a test tube util white fumes are evolved and these fumes are absorbed on a filter paper. One drop of a solution of 4-nitrobenzene-di-azofluoroborate in methanol (1%) on the filter paper should give any coloration, confirms the presence of aliphatic isocyanate. If any coloration is seen on the filter paper, this will confirm the presence of aromatic isocyanate

The infrared spectra of the aliphatic isocyanate will show peaks at 1370 cm-1 and 2250-2350 cm-1.

Physical, Chemical and Instrumental methods of paint analysis with their relevant standards are given in the following tables.

i) Physical Tests

Paint property	IS Standard	ASTM
Preparation of panels	IS 101 PART1 – SEC3	D 609
Preparation of Tin panels	IS 101 PART1 – SEC3	D 609
Viscosity (KU)	IS 101 PART1 – SEC5	D 562
Weight per Gallon	IS 101 PART1 – SEC 7	D 1475
Fineness of Grind	IS 101 PART3 – SEC 5	D 1210
Water content	IS 101 PART2 –SEC 1	D 95
Coarse particles and skins		D 185
Drying times Set to touch Dry for recoating Dry hard	IS 101 PART3 – SEC 1 & 2	D 1640
Pigment content	IS 101 PART8 – SEC 2	D 2371
Vehicle content		D 2371
Non – volatile content	IS 101 PART2 – SEC2 & PART8 – SEC –2	D 2369
Adhesion	IS 101 PART5 – SEC2	D 3359
Brushing properties	IS 101 PART1 – SEC4	

Exposure tests of paints on metals		D 1014
Salt spray resistance	IS 101 PART6 – SEC1	B 117
Accelerated weathering	IS 101 PART6 – SEC5	D 822
Leafing		D 480
Flexibility	IS 101 PART5 –SEC	D 522

ii) Chemical Tests

PAINT PROPERTY	TEST METHOD (ASTM)
Chemical resistance	D 1308
Liquid dryers	D 564
Aluminum	D 480
Aluminum silicate	D 718
Calcium carbonate	D 34
Extenders in colors	D 126
Iron oxide	D 768, D 50
Leaded zinc oxide	D 34
Red lead	D 49
Water soluble salts	D 2448, D 2455
Zinc oxide	D 34
Zinc powder	D 521
Zinc sulfide	D 34

iii) Instrumental Tests

Paint property	Test method (ASTM)	Instrument
Dry Opacity	A 2805	Reflectometer
Gloss	D 523	Gloss meter
Color	D 2244	Colorimeter
Vehicle Identification	D 3168 D 3271	Infrared spectrophotometer Gas chromatograph
Solvent solids Identification	D 3271	Gas chromatograph
Vehicle solids Identification	D 2621	Infrared spectrophotometer

7.00.00 SPECIFICATION OF COATING SYSTEM

7.01.00 Protective coating for steel structures

Most commonly used coating system for atmospheric zone of blast cleaned steel structures are given below:

7.01.01 System-1

Coating system used for atmospheric open exposure zone is one coat of inorganic zinc-rich primer, one coat of epoxy-Glass flake filled intermediate coating and one coat of aliphatic polyurethane provides better performance in more aggressive services. The coating system for closed atmosphere is also the same system with the replacement of aliphatic urethane with aromatic polyurethane top coat. The surface preparation of this Zinc rich primer requires sand blasted surface or grid blasted surface to the Swedish Specification of Sa 2.5. The coating systems are to be applied by spray method. The specification of the system is as given below:

i. Specification of Inorganic zinc rich primer

Colour	Green Grey
Gloss Level	Matt
Volume Solids	63%
Typical Thickness (DFT)	70-80 microns
Theoretical Coverage	8.40 m²/litre
Method of Application	Airless Spray, Air Spray
Drying Time	One Hour
Volatile Organic Compound	216 g/ Litre
Mix Ratio	Liquid Binder Base part(A) 3: Powder Zinc component part (B)1
Working Pot Life	2-2.5 hours
Shelf Life	1 year

ii. Specification for glass flake filled epoxy coating

Colour	As desired
Finish	Semi-Glossy
Type	Two packs
Application	By brush or spray
Dry film thickness/coat	100– 110 µm
Volume solids	Approx. 90 ± 2 %
Area coverage (theoretical)	8 to 9 sq.m/ litre
Surface dry	4 hrs.
Hard dry	24 hrs.
Over coating	24 hrs.
Recoatability	24 hours.
Full cure	1 week.
Shelf life	12 months

iii. Specification for Aliphatic Polyurethane top coat for open zone

Colour	Required colour
Gloss Level	Glossy
Volume Solids	63±2%
Typical Thickness (DFT)	50-60 microns
Theoretical Coverage	8 - 9 m²/litre
Method of Application	Airless Spray, Air Spray
Guiding data for airless spray:	
Nozzle tip (inch/1000)	15-21

Pressure at nozzle (minimum)	150 bar/2100 psi
Drying Time	One Hour
Volatile Organic Compound	340 g/ Litre
Mix Ratio	Acrylic Polyol Base part 5: Aliphatic Isocyanate Hardener part 1
Working Pot Life	3 hours
Shelf Life	2 years

iv. Specification for Aromatic Polyurethane top coat for closed zone

Colour	Required colour
Gloss Level	Glossy
Volume Solids	63±2%
Typical Thickness (DFT)	50-60 microns
Theoretical Coverage	8-9 m²/litre
Method of Application	Airless Spray, Air Spray

Guiding data for airless spray:

Nozzle tip (inch/1000):	15-21
Pressure at nozzle (minimum):	150 bar/2100 psi
Drying Time	One Hour
Volatile Organic Compound	340 g/ Litre
Mix Ratio	Acrylic Polyol Base part 5: Aliphatic Isocyanate Hardener part 1
Working Pot Life	3 hours
Shelf Life	2 years

7.01.01 System-2

The surface preparation is not possible through blast cleaning, then the surface is cleaned with wire brushing or power tool cleaning and coated with two coats of non aluminium epoxy mastic followed by an aliphatic polyurethane coating is recommended.

i. Specification for non aluminium Epoxy mastic paint (High build)

Colour	As desired
Finish	Semi-Glossy
Type	Two pack
Application	By brush or Airless spray
Dry film thickness/coat	100-110 microns
Volume solids	Approx. 80 ±2 %
Area coverage (theoretical)	6 to10 sq.m/litre
Surface dry	4 hrs.
Hard dry	12 hrs.
Recoatability	24 hours.
Full cure	7 days.
Shelf life	months (or as recommended by manufacturer

ii. Specification for Aliphatic Polyurethane top coat for open zone

Colour	Required colour
Gloss Level	Glossy
Volume Solids	63±2%
Typical Thickness (DFT)	50-60 microns
Theoretical Coverage	8-9 m²/litre
Method of Application	Airless Spray, Air Spray

Guiding data for airless spray

Nozzle tip (inch/1000):	15-21
Pressure at nozzle (minimum):	150 bar/2100 psi
Drying Time	One Hour
Volatile Organic Compound	340 g/ Litre
Mix Ratio	Acrylic Polyol Base part 5: Aliphatic Isocyanate Hardener part 1
Working Pot Life	3 hours
Shelf Life	2 years

7.02.00 Protective coating system for Pipelines without Cathodic Protection

There are a number of factors to be considered for the selection of an external pipeline coating including physical and chemical stability of the coating in the pipeline environment, adhesion, and resistance to impact. The pipeline should be cleaned and prepare the surface for painting as follows:

The pipeline surface shall be cleaned. The main objective of surface preparation is to ensure that all contamination (rust, mill scale, etc.) is removed to reduce the possibility of initiating corrosion so that a surface profile is created that allows satisfactory adhesion of the paint to be applied. The surface of the pipe is cleaned with a wire brush or power tool cleaning to get the surface of Sa 2/St 3. Thus prepared surface to be cleaned with lint free cloth, which also includes cleaning & dewatering (in case of valve chamber) and drying the surface. After preparing the surface of the pipe for painting, the primer coat, undercoat and finish coat shall be applied. The coating system recommended for the pipeline is high build epoxy mastic coating as primer followed by an epoxy glass flake filled coating with the top coat of aliphatic polyurethane. The specifications of the systems are given below:

i. Specification for Epoxy mastic paint (High build)

Colour	As desired
Finish	Semi-Glossy
Type	Two pack
Application	By brush or Airless spray
Dry film thickness/coat	100-110 microns
Volume solids	Approx. 80 ±2 %
Area coverage (theoretical)	6 to10 sq.m/litre
Surface dry	4 hrs.
Hard dry	12 hrs.
Recoatability	24 hours.

Full cure	7 days.
Shelf life	12 months (or as recommended by manufacturer

ii. Specification for glass flake filled epoxy coating

Colour	As desired
Finish	Semi-Glossy
Type	Two packs
Application	By brush or spray
Dry film thickness/coat	100– 110 µm
Volume solids	Approx. 90 ± 2 %
Area coverage (theoretical)	8 to 9 sq.m/ litre
Surface dry	4 hrs.
Hard dry	24 hrs.
Over coating	24 hrs.
Recoatability	24 hours.
Full cure	1 week.
Shelf life	12 months

iii. Specification for Aliphatic Polyurethane top coat for open zone

Colour	Required colour
Gloss Level	Glossy
Volume Solids	63±2%
Typical Thickness (DFT)	50-60 microns
Theoretical Coverage	8-9 m²/litre
Method of Application	Airless Spray, Air Spray

Guiding data for airless spray:

Nozzle tip (inch/1000):	15-21
Pressure at nozzle (minimum):	150 bar/2100 psi
Drying Time	One Hour
Volatile Organic Compound	340 g/ Litre
Mix Ratio	Acrylic Polyol Base part 5: Aliphatic Isocyanate Hardener part-1
Working Pot Life	3 hours
Shelf Life	2 years

7.03.00 Protective coating for all other surfaces

The surface shall be cleaned with wire brushing or by power tools (St3). These structures will be protected by three layer system of Epoxy zinc rich primer followed by Glass Flake filled epoxy and aliphatic polyurethane finish coat. The specifications of the coating system are given below:

i. Specification for Epoxy Zinc rich primer

Colour	Grey
Finish	Matt
Type	Two pack
Application	By brush or spray

Pigment (Main)	Zinc dust (30-40% by wt. of the total pigments.)
Type of epoxy	Condensation product of bisphenol-A and Epoxide equivalent Epichlorohydrin with terminal Epoxide groups 450-500
Curing agent	Polyamide (amine value 210-230)
Dry film thickness/coat	50-60 µm
Volume solids	55±2% (volume)
Area coverage (theoretical)	11 to 14 sq.m/litre
Surface dry	2-3 hrs.
Hard dry	24 hrs.
Re-coatability	24 hours.
Full cure	5 days.
Shelf life	6 months under sealed conditions

ii. Specification for Epoxy glass flake paint

Colour	As desired
Finish	Semi-Glossy
Type	Two packs
Application	By brush or spray
Dry film thickness/coat	100–110 µm
Volume solids	Approx. 90 ± 2 %
Area coverage (theoretical)	8 to 9 sq.m/ litre
Surface dry	4 hrs.
Hard dry	24 hrs.
Over coating	24 hrs.
Re-coatability	24 hours.
Full cure	1 week.
Shelf life	12 months

iii. Specification for aliphatic Polyurethane top coat

Colour	Required colour
Gloss Level	Glossy
Volume Solids	63±2%
Typical Thickness (DFT)	50-60 microns
Theoretical Coverage	8-9 m²/litre
Method of Application	Airless Spray, Air Spray

Guiding data for airless spray:

Nozzle tip (inch/1000):	15-21
Pressure at nozzle (minimum):	150 bar/2100 psi
Drying Time	One Hour
Volatile Organic Compound	340 g/ Litre
Mix Ratio	Acrylic Polyol Base part 5: Aliphatic Isocyanate Hardener part-1
Working Pot Life	3 hours
Shelf Life	2 years

7.04.00 Summary of Specification of Coating System

The summary of the coating system shall be as mentioned below:

Area	Surface preparation	Recommended coating scheme
Directly exposed to Sunlight- Steel structures	Copper shot blasting to Sa2.5	Scheme I
	Power tool cleaning to St3	Scheme II
Indoor –Steel Structures	Copper shot blasting to Sa2.5	Scheme III
	Power tool cleaning to St3	Scheme IV
Pipelines (over ground)	Power tool cleaning to St3	Scheme V
All other surfaces	Wire brushing / Power tool cleaning to St3	Scheme VI

7.04.01 Scheme-I: For blast cleaned structures and exposed to sunlight

For new steel structures/Existing steel structures	Exposed to sun light Outdoor)	
Surface preparation	Copper slag blasting to Sa2.5	
Primer	Zinc ethyl silicate	50 – 60µm
Undercoat	Epoxy Glass flake (high build)	100 – 110 µm
Top Coat	Aliphatic polyurethane (TiO_2) rutile	50 – 60µm
Total dry film thickness (DFT)		200 –230µm

7.04.02 Scheme-II: For under prepared structures and exposed to sunlight

For new steel structures/Existing steel structures	Exposed to sun light (Outdoor)	
Surface preparation	Power tool cleaning St-3/Paint strippers	
Primer	Epoxy mastic(non aluminium)	100 – 110µm
Undercoat	Epoxy mastic(non aluminium)	100 – 110 µm
Top Coat	Aliphatic polyurethane (TiO_2) rutile	50 – 60µm
Total dry film thickness (DFT)		250 –280µm

7.04.03 Scheme- III: For blast cleaned structures and not exposed to sunlight

For new steel structures/Existing steel structures	Not exposed to sunlight (Indoor)	
Surface preparation	Blast Cleaning to Sa2.5	
Primer	Zinc Ethyl Silicate	50 – 60µm
Undercoat	Epoxy Glass flake (high build)	100 – 110 µm
Top Coat	Aromatic polyurethane TiO_2 (rutile)	50 – 60µm
Total dry film thickness (DFT)		200 –230µm

7.04.04 Scheme-IV: For under prepared structures and not exposed to sunlight

Surface preparation	Mechanical chipping / Power tool cleaning St-3/Wire brushing St-2	
Primer	Self-priming epoxy mastic	100 – 150µm
Under coat	Self-priming epoxy mastic	100-110 µm
Top Coat	Aromatic polyurethane TiO_2 (rutile)	50 – 60µm
Total dry film thickness (DFT)		250 –320µm

7.04.05 Scheme- V: For pipelines (above ground)

Surface preparation	Mechanical chipping / Power tool cleaning St-3/Wire brushing St-2	
Primer	Self-priming epoxy	100 – 150µm
Under coat	Epoxy Glass flake (high build)	100-110 µm
Top Coat	Aliphatic polyurethane TiO_2 (rutile)	50 – 60µm
Total dry film thickness (DFT)		250 –320µm

7.04.06 Scheme-VI: Coating specifications for all other surfaces

Surface preparation	Power tool cleaning St-3/ Paint strippers	
Primer	Epoxy Zinc rich	50 – 60µm
Under coat	Epoxy glass flake	100-110µm
Top Coat	Aliphatic polyurethane TiO_2 (rutile)	50 – 60µm
Total dry film thickness (DFT)		200–230µm

8.00.00 TESTING REQUIREMENTS

8.01.00 Measurement of dry film thickness

Measurement of dry film thickness of coating: coating thickness shall be in the range of ±20% and as per SSPC PA 2.

8.01.01 Apparatus / instrument

The instrument used for dry film thickness may be type 1 pull of gauges or type 2 electronic gauges.

8.01.02 Procedures

a) Number of measurements

For 100 square feet (9.29 square meters), five (5) spots per test area (each spot is 3.8 cm) in diameter. Three gauge readings per spot (average becomes the spot measurement).

b) If the structure is less than 300 square feet, each 100 square feet should be measured.

c) If the structure is between 300 and 1000 sq ft, select 3 random 100 square feet test areas and measure.

d) For structure exceeding 1000 square feet, select 3 random 100 square feet testing areas for the first 1000 sq ft and select 1 random 100 square feet testing area for each additional 1000 square feet

e) Coating thickness tolerance: individual reading taken to get a representative measurement for the spot are unrestricted (usually low or high readings are discarded). Spot measurements (the average of 3 gauge readings) must be within 80% of the minimum thickness and 120% of the maximum thickness.

Area measurement must be within specified range.

8.02.00 Electrical inspection (holiday) test

8.02.01 All the coated / lined pipes shall be tested with an approved high voltage holiday detector preferably equipped with an audio visual signaling device to indicate any faults, holes, breaks or conductive particles in the protective coating.

8.02.02 The applied output voltage of holiday detector shall have a spark discharge of thickness equal to at least twice the thickness of the coating to assure adequate inspection voltage and compensate for any variation in coating thickness. The electrode shall be passed over the coated surface at approximately half the spark discharge distance from the coated surface only one time at the rate of approximately 10 to 20m/min. The edge effect shall be ignored. Excessive voltage shall be avoided as it tends to induce holiday in the coated surface thereby giving erroneous readings.

8.02.03 While selecting test voltages, consideration should be given to the tolerance on coating thickness and voltage should be selected on the basis of maximum coating thickness likely to be encountered during testing of a particular pipe.

The testing voltage shall be calculated by using following formula. (as per NACE 0274 : 2004)

Testing voltage $v=7900\sqrt{t}\pm10\%$ where t=the average coating thickness, mm.

8.02.04 Any audio visual sound or spark leads to indicate pinhole, break or conductive particle.

8.03.00 Adhesion pull off test

After holiday the coated surface is subjected to adhesion pull off test as per ASTM D 4541.

8.03.01 Apparatus / instrument: adhesion tester consists of three basic components:

A hand wheel, a black column containing a dragging indicator pin and scale in the middle and a base containing three legs and a pulling “jaw” at the bottom and also dollies.

8.03.02 Prepare the test surface

Once test area is selected, test area shall be free of grease, oil, dirt, water. The area should be flat surfaces and large enough to accommodate the specified number of replicate test.

8.03.03 Prepare dolly (test pull stub)

The dolly is a round, two sided aluminium fixture. Both sides of the dolly looks same, however, one side sloped on top surface while flat on bottom surface. As the surface of the dolly is polished aluminium, roughen the same using a coarse sand paper.

8.03.04 Select an adhesive

Use araldite, a 100% solid epoxy adhesive. This adhesive requires at least 24 hours at room temperature to cure.

8.03.05 Attach the dolly to the surface

a) Using a wooden stick, apply an even layer of adhesive to the entire contact surface area of the dolly.

b) Carefully remove the excessive adhesive by using a cotton swab. Allow the adhesive to fully cure before performing the adhesion test.

c) Attach the dolly to the coated surface and gently push downward to

displace any excessive adhesive.

d) Push the dolly inward against the surface, and then apply tape across the head of the dolly.

8.03.06 Adhesion test procedure

a) Attach the adhesion tester to the dolly by rotating the hand wheel counter clockwise to lower the jaw of the device.

b) Slide the jaw completely under the head of the dolly. Position the three legs of the instruments so that they are sitting flat on the coated surface.

c) Slide the dragging indicator pin on the black column to zero by pushing it downward.

d) Firmly hold the base of the instrument in one hand and rotate the hand wheel clockwise to raise the jaw of the device that is attached to the head of the dolly. The dragging indicator pin will move upward on the black column as the force is increased and will hold the reading. Apply the tension using a moderate speed. Continue to increase the tension on the head of the dolly until (a) the minimum psi/mpa/kg/cm² required by project specification is exceeded and the test is discontinued, (b) the maximum psi/mpa/kg/cm² of adhesion tester has been achieved and dolly is still attached, (c) the force applied by the adhesion tester causes the dolly to dislodge.

e) Read the scale and record the adhesion value.

8.04.00 Coating repair

Defective coating shall be repaired in accordance with the following subsections.

8.04.01 Surface preparation

Accessible areas of pipe requiring coating repairs shall be cleaned to remove debris and damaged coating using surface grinders or other means. The adjacent coating shall be feathered by sanding, grinding or other method. Accumulated debris shall be removed by blowing with contaminant free air or wiping with clean rags.

8.04.02 Areas not accessible for coating repair such as interior surfaces of small diameter pipe shall be reprocessed and recoated.

8.04.03 Coating application

The coating system shall be applied to the prepared areas in accordance with procedure.

8.04.04 Repair inspection:

Repaired portion shall be electrically inspected using a holiday detector.

8.05.00 Welded field joints

8.05.01 Preparation

The weld joints shall be cleaned so as to be free from mud, oil, grease, welding flux, weld spatter and other foreign contaminants. The cleaned metal surfaces of the weld joint shall then be blasted or abraded using rotary abrading pads. The adjacent liquid epoxy / pu coating shall be feathered by abrading the coating surface for a distance of 25 mm.

8.05.02 Electrical inspection

After curing the coating system applied to the welding joints shall be holiday tested. Any holidays indicated by the detector shall be marked with chalk to identify the area of repair.

9.00.00 INFORMATION / DATA REQUIRED

The bidder shall submit complete list of paints and primers proposed, giving detail information, such as, chemical composition, drying time etc. And also unit rates for application of each type of paint along with supply shall be furnished.

ANNEXURE-I
MARKET AVAILABLE COATING SYSTEMS AS PER SPECIFICATION

Sl.No.	Specification	ASIAN PAINTS	BOMBAY PAINTS GRAUER & WEIL Paints	BERGER PAINTS	GRAND POLYCOTS	International Protective Coatings	KRISHNA CONCHEM
1.	Zinc Ethyl Silicate Primer	Apcosil 605 ZS	Zinc–o-sil 75	Zinc Anode 304	GP Prime 402	InterZinc 22	-
2.	Epoxy Zinc rich Primer	Apcodur CP 686			GP Prime 205	Inter Zinc 42	
3.	Self Priming Epoxy Mastic Paints	Rust-O-Cap	Penthdur Mastic 5527	Berger protecto Mastic	GP Prime guard 235	Interplus 256	-
4.	Epoxy Glass Flake Paint	Apcodur EP glass Flake	Pentadur Glass Flake 3580	Epilux Super Build ST Glass Flake Coating	GP SUPERGUARD GLASS-FLAKE	Interzone 505	Karaikote 100 S
5.	Aliphatic Polyurethane Paint	Apcothane CP 674	Pentathane 4512 (M)	Polyurethane Coating	GP Bond 141	Interthane990	-
6..	Aromatic Polyurethane Paint	---	--	--	GP COAT 131	---	

7.	Moisture Compatible anti Corrosion system			Epilux Durebild WSE Coating			Karaikote-6545
8.	Epoxy red oxide primer	AP CODUR Epoxy polyamide primer					
9.	Epoxy MIO Under coat	AP CODUR Epoxy MIO Under coat					
10.	Epoxy TiO2 Under coat	AP CODUR Epoxy 420HS					

ANNEXURE-X

SITE STORAGE AND PRESERVATION

CONTENT

1 SCOPE OF THE DOCUMENT

2 PURPOSE OF STORAGE & PRESERVATION

3 MEASURES TO BE TAKEN FOR STORAGE AND PRESERVATION

a) GENERAL STORAGE REQUIREMENTS

b) GENERAL PRESERVATION REQUIREMENTS

c) GENERAL INSPECTION REQUIREMENTS

4 TYPE OF STORAGE FOR VARIOUS EQUIPMENT

5. CONCLUSION

6. STACKING ARRANGEMENT FOR PLATES AND STRUCTURAL STEEL

1. SCOPE OF THE DOCUMENT

This guideline is prepared in intent to provide proper site storage and preservation of the Mechanical, Electrical and C & I items / equipment supplied under various bought out packages/items. This storage procedure shall be followed at different power plant sites by concerned agency for storage and preservation from the date of equipment received at site until the same are erected and handed over to the customer.

2. PURPOSE OF STORAGE & PRESERVATION

Many of the items may be required to be kept in stores for long period. It shall therefore be essential that proper methods of storage and preservation be applied so that items do not deteriorate, loose some of their properties and become unusable due to atmospheric conditions and biological elements.

3. MEASURES TO BE TAKEN FOR STORAGE, HANDLING & PRESERVATION

a) GENERAL STORAGE REQUIREMENTS

1. To the extent feasible, materials should be stored near the point of erection. The storage areas should have adequate unloading and handling facilities with adequate passage space for movement of material handling equipment such as cranes, fork lift trucks, etc. The storage of materials shall be properly planned to minimise time loss during retrieval of items required for erection.
2. The outdoor storage areas as well as semi-closed stores shall be provided with adequate drainage facilities to prevent water logging. Adequacy of these facilities shall be checked prior to monsoon.
3. The storage sheds shall be built in conformity with fire safety requirements. The stores shall be provided with adequate lights and fire extinguishers. 'No smoking' signs shall be placed at strategic locations. Safety precautions shall be strictly enforced.
4. Adequate lighting facility shall be provided in storage areas and storage sheds and security personnel positioned to ensure enforcement of security measures to prevent theft and loss of materials.
5. Adequate number of competent stores personnel and security staff shall be deployed to efficiently store and maintain the equipment / material.
7. The equipment shall be stored in an orderly manner, preserving their identification slips, tags and instruction booklets, etc., required during erection. The storage of materials shall be equipment-wise. Loose parts shall be stored in sheds on racks,

preserving the identification marks and tags in good condition. The group codes shall be displayed on the racks

6. At no time shall any materials be stored directly on ground. All materials shall be stored minimum 200 mm above the ground preferably on wooden sleepers

b) GENERAL PRESERVATION REQUIREMENTS

1. All special measures to prevent corrosion shall be taken like keeping material in dry condition, avoiding the equipment coming in contact with corrosive fluid like water, acid etc.
2. Materials which carry protective coating shall not be wrapped in paper, cloth, etc., as these are liable to absorb and retain moisture. The material shall be inspected and in case of signs of wear or damages to protective coating, that portion shall be cleaned with approved solution and coated with an approved protective paint. Complete record of all such observations and protective measures taken shall be maintained.
3. Generally equipment supplied at site are properly greased or rust protective oil is applied on machined/ fabricated components. However periodic inspection shall be carried out to ensure that protection offered is intact.
4. While handling the equipment, no dragging on the ground is permitted. Avoid using wire rope for lifting coated components. Use polyester slings (if possible) otherwise protective material (e.g. clothes, wood block etc.) should be used while handling the components with rope / slings
5. For Equipment supplied with finished paint, touch paint shall be done in case any surface paint gets peeled off during handling. Otherwise such surfaces shall necessarily be wrapped with polythene to avoid any corrosion. Further for equipment wherein finish coat is to be applied at site, site to ensure that equipment is received with primer coat applied.
6. It shall be ensured by periodic inspection that plastic inserts are intact in tapped holes, wherever applicable.
7. Pipes shall be blown with air periodically and it shall be ensured that there is no obstruction.
8. Silica gel or approved equivalent moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment, wherever necessary.
9. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion/jamming due to prolonged storage.

10. All the electrical equipment such as motors, generators, etc. shall be tested for insulation resistance at least once in three months and a record of such measured insulation values shall be maintained.

11. Following preservatives/preservation methods can be used depending upon type of equipment

    a. Rust preventive fluid (RPF)

    b. Rust protective paints

    c. Tarpaulin covers, in case of outdoor storage

    d. De-oxy aluminate for weld-ments

c) GENERAL INSPECTION REQUIREMENTS

1. Period inspection of materials with specific reference to –

   - Ingress of moisture and corrosion damages.
   - Damage to protective coating.
   - Open ends in pipes, vessels and equipment -
     - In case any open ends are noticed, same shall be capped.

2. Any damages to equipment / materials.

   - In case of any damages, these shall be promptly notified and in all cases, the repairs / rectification shall be carried out.
   - Any items found damaged or not suitable as per project requirements shall be removed from site. If required to store temporarily, they shall be clearly marked and stored separately to prevent any inadvertent use.

4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

The types of storage are broadly classified under the following heads:

i **Closed storage with dry and dust free atmosphere**. (C)

The closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated asbestos sheets / galvanised iron sheets for roofing. Brick walls / asbestos sheets can be used to cover all the sides. The floor of the shed can be finished with plain cement concrete suitably glazed. The shed shall be provided with proper ventilation and illumination.

ii **Semi-closed storage**. (S)

The semi closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated / asbestos sheets for roofing. The floor shall be brick paved. If required a small portion of sides can be covered to protect components from rainwater splashing onto the components.

iii Open storage (O)

The open yard shall be levelled, well consolidated to achieve raised ground with the provision of feeder roads for crane approach along with access roads running all sides. One part of the open yard shall be stone pitched, levelled and consolidated with raised ground suitable for storing / stacking heavier and critical components with due space to handle them by cranes etc . Adequate number of sleepers, concrete block etc. to be provided to make raised platforms to stack critical materials.

A separate yard to be identified as "scrap yard" slightly away from main open yard to store wooden/steel scraps, which are to be disposed off. This is required to avoid mix up with regular components as well as to avoid fire hazard.

Some of the components, which are having both machined & un-machined surfaces and are bulky, shall be stored in open storage area on a raised ground and suitably covered with water proof / fire retardant tarpaulin.

The equipment listed below shall be stored and inspected as per requirement mentioned in the table below.

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
Raw material /mechanical items like pipes, plates, structure sections etc.)				
1.	Steel pipes (lined/unlined)	S	Damage , paint, corrosion, rubber lining peeling	Provide end cap
2.	MS Plates	S	Damage, paint, corrosion	
3.	SS Plates	S	Damage	
4.	Non-metallic pipes	S	Damage, cracks	Provide end cap
5.	Stainless steel pipes	S	Damage ,	Provide end cap
6.	MS sections, beams	S	Damage, paint, corrosion	
7.	Cable trays	S	Damage, condition of preservations	
8.	Insulation sheets	S	Damage	
9.	Insulation	C	Damage, packing	
10.	Hangers Rods	S	Damage, paint, packing	
11.	Tubes	S	Damage, paint , packing	Provide end cap
12.	Hume pipes	O	Damage	
13.	Castings	O	Damage, paint, corrosion	
Fabricated mechanical items (pressure vessels, tanks etc.)				
14.	Pressure vessels (unlined)	O	Damage, paint, corrosion,	Covered nozzles
15.	Atmospheric storage tanks (unlined)	O	Damage, paint, corrosion	Covered nozzles

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
16.	Pressure vessels (lined)	S	Damage, paint, corrosion, rubber lining	
17.	Atmospheric storage tanks(lined)	S	Damage, paint, corrosion, rubber lining	
18.	Support structures	O	Damage , paint, corrosion	
19.	Flanges	C	Damage , paint, corrosion	
20.	Fabricated pipes	S	Damage , paint, corrosion	Provide end cap
21.	Vessels internals	C	Damage , paint, corrosion ,packing	
22.	Grills	S	Damage , paint, corrosion	
23.	Angles	S	Damage , paint, corrosion	
24.	Bridge mechanism/clarifier mechanism	O	Damage , paint, corrosion	
25.	Cranes, rails	S	Damage , paint, corrosion	
26.	Stair cases	O	Damage , paint, corrosion	
27.	Ladders/handrails	O	Damage , paint, corrosion	
28.	Fabricated ducts	S	Damage , paint, corrosion	
29.	Isolation Gates	O	Damage , paint, corrosion	
30.	Fabricated boxes/panels	S	Damage , paint, corrosion	
Mechanical components like valves, fittings, cables glands, spares etc.)				
31.	Valves	S	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
32.	Fittings	S	Damage , packing	Provide end cap
33.	Cable glands	C	Damage , packing	
34.	Tools & tackles	C	Damage , packing	
35.	Nut , bolts, washers,	C	Damage , packing	
36.	Gasket & Packings	C	Damage , packing	
37.	Copper tubes	C	Damage , packing, corrosion	Provide end cap
38.	SS tubing	C	Damage , packing	Provide end cap
Rotating assemblies (pumps, blowers, stirrers, fans, compressors etc.)				
39.	Pumps	S	Damage , packing, corrosion	Shaft rotation
40.	Blowers/Compressors	S	Damage , packing, corrosion	Shaft rotation
41.	Agitators/stirrers/radial launders	C	Damage , packing, corrosion	Shaft rotation
42.	Rollers for chlorine tonner mounting	C	Damage , packing, corrosion	
43.	Centrifuge	S	Damage , packing,	
44.	Gear box	C	Damage , packing, corrosion	
45.	Bearings	C	Damage , packing, corrosion	
46.	Fans	S	Damage , packing, corrosion	
47.	Dosing skids	S	Damage , packing, corrosion	
48.	Pump assemblies	S	Damage , packing, corrosion	
49.	Air washers(INTERNALS)	S	Damage , packing	
50.	Air conditioners (split)	C	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
51.	Elevators(CONTAINERIZED)	O	Damage , packing, corrosion	
52.	Chillers/VA machines	S	Damage , packing	
53.	Air handling Unit/Package unit	S	Damage , packing	
54.	Chlorinators & Evaporators	C	Damage , packing	
55.	Ejectors	C	Damage , packing	
56.	Electrolyser	C	Damage , packing	
Miscellaneous items like chain pulley blocks, hoists etc.				
57.	Chain pulley blocks	S	Damage, Packing	
58.	Electric hoists	S	Damage, Packing	
59.	Fire extinguishers	C	Damage, expiry date	
60.	Fork Lift Truck	S	Damage, Packing	
61.	Hydraulic Mobile Crane	O	Damage, Packing	
62.	Mobile Pick Up & Carry Crane	O	Damage, Packing	
63.	Motor boats	O	Damage, Packing	
64.	Safety showers	S	Damage, Packing	
65.	Diffusers/dampers	S	Damage, Packing	
Chemicals and consumables (acid, alkali, paints, oils, reagents and special chemicals)				
66.	Hydro Chloric Acid (HCl)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical
67.	Sulphuric acid (H_2SO_4)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
68.	Sodium hydroxide (NaOH)	Store in canes/ storage tank in dyke area	Date of production/ leakage/ fumes/ breather	hazardous chemical ,breather to be checked for air ingress
69.	Sodium hypo chlorite	To be stored under shed	Date of production/ leakage/ fumes	hazardous chemical ,self-life normally 15-30 days after which strength of chemical decays
70.	Ammonia	S	Date of production/ leakage/ fumes	Store in closed storage tanks, hazardous chemical
71.	CW treatment chemicals	S	Date of production , Self-life	Store in closed canes
72.	RO/UF cleaning chemicals	S	Date of production , Self-life	Store in closed canes
73.	Lime	C	Damage to packing , seepage	Prevent moisture, rain
74.	Alum bricks	C	Damage to packing	Prevent moisture, rain
75.	Poly electrolyte	S		Store in closed storage tanks
76.	Laboratory chemicals(powder)	C	Damage, Packing self-life	
77.	Laboratory chemicals(liquid)	C	Damage, Packing self-life	
78.	Lubrication oils	C	Leakage	
79.	Paints	S	Leakage ,air tightness	
80.	Sand	O	Damage of packing	No hooks
81.	Salt (NaCl)	C	Damage of packing, water ingress	Prevent moisture, rain
82.	Anthracite	S	Damage of packing	
83.	Activated carbon	S	Damage of packing	

Sl. No.	**Description of the equipment**	**Type of Storage**	**Check for**	**Remarks**
84.	Thermal insulation	S	Damage of packing	
85.	Cement	C	Damage of packing	Prevent moisture, rain
86.	Gravels	O	Damage of packing	
87.	ION exchange resins	C	Damage , packing	Refer manufacturer guidelines
88.	RO membranes	C	Damage , packing	Refer manufacturer guidelines
89.	UF membranes	C	Damage , packing	Refer manufacturer guidelines
90.	Cleaning chemicals	C	Damage , packing	Refer manufacturer guidelines
91.	Chemicals for analysers/calibration	C	Damage , packing	Refer manufacturer guidelines
Electrical and C & I items (motors, cables etc.)				
92.	Motors	C	Damage , packing	
93.	Cable drums	O	Damage	
94.	Control Panel /control desk, UPS ,JB	S	Damage, Packing	
95.	Instruments(gauges/analysers)	C	Damage	
Special items		As per Manufacturer's item, like Hydrogen cylinders, Ozonator, Analyser, Chlorine dioxide generators etc.		

5. CONCLUSION

Concerned storage agency at site should make sure that loss in equipment performance and wear & tear are minimised through proper storage and preservation. The above are broad guidelines and cover major equipment / materials. However specific storage practices shall be followed as per manufacturer recommendation. All the necessary measures even in addition to the ones mentioned above, if found necessary, should be taken to achieve the objective.

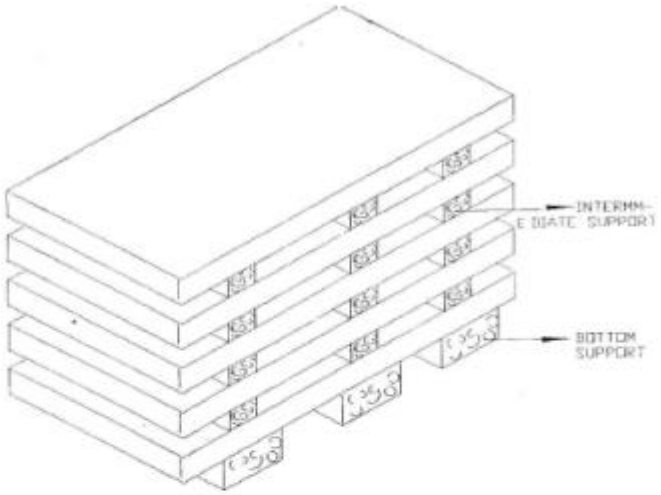


Figure – 1 – PLATE STACKING ARRANGEMENT

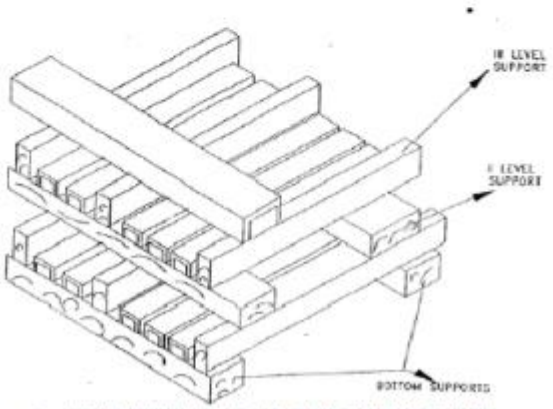


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT

ANNEXURE-XI

GENERAL TECHNICAL REQUIREMENTS & ENGINEERING SERVICES

BIDDER TO REFER RELEVALNT PORTION APPLICABLE WITH RESPECT TO FGD WASTE WATER TREATMENT.

VOLUME : II-A

SECTION - IV

GENERAL TECHNICAL REQUIREMENTS

CONTENTS

CLAUSE NO.	DESCRIPTION	PAGE NO.
1.00.00	CODES AND STANDARDS	1
2.00.00	DESIGN CRITERIA	2
3.00.00	REDUNDANCY	3
4.00.00	NAME PLATES / RATING PLATES / LABELS	3
5.00.00	SAFETY AND SECURITY	5
6.00.00	GUARDS	5
7.00.00	LOCATION AND LAYOUT REQUIREMENTS	6
8.00.00	OPERATION AND MAINTENANCE CONSIDERATIONS	8
9.00.00	MATERIALS	9
10.00.00	LUBRICATION	10
11.00.00	LUBRICANTS, SERVO FLUIDS AND CHEMICALS	10
12.00.00	PLANT LIFE AND MODE OF OPERATION	11
13.00.00	PACKAGING & MARKING	11
14.00.00	PROTECTION	12
15.00.00	PAINTING	13
16.00.00	COLOUR CO-ORDINATION AND FINISH	13
17.00.00	ENVIRONMENT PROTECTION AND NOISE LEVEL REQUIREMENT	13
18.00.00	INSPECTION AND TESTING	15
19.00.00	TRAINING OF OWNER'S PERSONNEL	16
	ATTACHMENTS	
ANNEXURE-I	LIST OF STANDARDS FOR REFERENCE	19
ANNEXURE-II	CRITERIA FOR LAYOUT	21

VOLUME : II-A

SECTION - IV

GENERAL TECHNICAL REQUIREMENTS

1.00.00 CODES AND STANDARDS

1.01.00 Except where otherwise specified, the design of FGD Plant package shall comply with the appropriate Indian Standard or an agreed internationally accepted Standard Specification as listed in the Annexure-I to this Section and mentioned in detailed specifications, each incorporating the latest revisions at the time of tendering. Where no internationally accepted standard is applicable, the Bidder shall give all particulars and details as necessary; to enable the Owner to identify all of the FGD Plant package in the same detail as would be possible had there been a Standard Specification.

1.02.00 The Bidder shall submit along with his bid the list of main codes and standards proposed to be used for the design, construction and testing of the plant. Where the Bidder proposes alternative codes or standards in place of those mentioned in this technical specification, he shall include in his tender one copy (in English) of each Standard Specification to which materials offered shall comply. In such case, the adopted alternative standard shall be equivalent or superior to the standards mentioned in the specification.

1.03.00 Wherever specified or required to the FGD Plant package shall conform to all applicable statutory regulations such as Indian Boiler Regulations, Indian Electricity Rules, Indian Explosives Act, Factories Act etc. Wherever required, approval for the FGD Plant package supplied under the specification from statutory authorities shall be the responsibility of the Bidder.

1.04.00 In the event of any conflict between the codes and standards referred above, and the requirements of this specification, the requirements, which are more stringent, shall govern. And if they are equally stringent, the Bidder shall follow the hierarchy as follows:

i) Local regulations
ii) Local codes and standards
iii) This Technical Specifications
iv) Industry codes and standards

1.05.00 In case of any change of code, standards and regulations between the date of purchase order and the date the Bidder proceeds with manufacturing the Owner shall have the option to incorporate the changed requirements. It shall be the responsibility of the Bidder to bring such changes to the notice of the Owner and advise Owner of the resulting effect.

1.06.00 Combining or mixing of codes and standards of different institutions with respect to individual engineered components/equipments shall not be permitted without the written approval of the Owner.

2.00.00 DESIGN CRITERIA

2.01.00 Capability

The Flue Gas Desulphurisation (FGD) System shall be designed to comply with the design and guarantee point conditions mentioned below and should achieve Sulphur Dioxide (SO_2) level of not exceeding 150 mg/Nm^3 and 150 mg/Nm^3 respectively at 6% excess oxygen level at the stack outlet under all plant operating conditions. The SO_2 removal efficiency shall not be less than 95 % under all operating condition. These shall be modified to more conservative values if Contractor experience warrants the same. However, no credit shall be given to the Contractor for this during evaluation of the bids. Utilization of these values in no way relieves the Contractor of his responsibility to meet all the guarantee requirements.

a) Design Point : BMCR load with worst Coal, 45 deg.C and 60% RH ambient condition

b) Guarantee Point : TMCR load with worst Coal, 27deg.C and 60% RH ambient condition

2.02.00 Equipment Sizing Margins

The following equipment sizing design margins shall be used, as a minimum, based on normal operation of the plant (2x500MW at TMCR) with Coal having highest Sulphur content unless other margins are specified in this Design Specifications.

Equipment/ System	Mass Flow Margin	Pressure Margin
Absorber (gas and slurry)	10%	NA
Limestone Grinding system	10%	NA
Gypsum Dewatering System	10%	NA
Hydro-cyclone	10%	NA
Pumps	10% min.	15% (friction losses)
Blowers/Compressors/ Vacuum pumps	10% min.	10%
Conveyors	10% min.	NA
Crushers	20% min.	NA
Flue Gas Booster Fans	20%	44%

2.03.00 Off-normal operation

2.03.01 The FGD system shall also be capable of operating with partial bypass of flue gas.

2.03.02 The flue gas temperature at inlet to FGD shall be about 175^0C. However, in case of APH failure the flue gas temperature may rise to about 375^0Cfor a short duration and the FGD system shall be designed to suitably withstand such operation without any damage to the system.

2.03.03 The FGD plant shall be capable of following the load imposed by the boiler, including rate of load changes, minimum load and the anticipated daily and annual load schedules. Furthermore, the FGD plant shall be capable to be put in operation, while the boiler is in operation at any load, without any disturbance in the operation of the Units.

3.00.00 REDUNDANCY

3.01.00 Redundancy of design shall be such that the performance of primary and auxiliary equipment shall be sufficient to meet the availability requirements of the plant.

3.02.00 Each equipment whose failure could result in damages to another equipment, or reduce the availability of the plant shall be backed up by a stand-by equipment.

3.03.00 Each equipment whose unavailability due to a failure could result in damages to another equipment or create a health & safety risk for the personnel shall be backed up by a stand-by equipment, one of them being fed by an emergency source in case of external black out.

3.04.00 Design of availability of the FGD Plant equipment & auxiliaries will be such that a failure with consequential shutdown of one Absorber & auxiliaries will in no circumstances be at the origin of a shutdown of the other Absorber & auxiliaries.

3.05.00 Redundancy criteria applicable for specific systems have been addressed in respective sections of the specification (Volume IIB to II-I) and tender drawings (Volume IIJ).

4.00.00 NAME PLATES/ RATING PLATES/ LABELS

4.01.00 Instruction plates, nameplates (rating plates) or labels shall be permanently attached to each main and auxiliary item of FGD Plant equipment & auxiliaries, including instruments, in a conspicuous position. These plates shall be of stainless steel and shall be engraved with the identifying name, type, identification number and manufacturer's serial number, together with the loading conditions under which the item of plant has been designed to operate.

4.02.00 Items such as valves, etc. which are subject to hand operation, shall be provided with nameplates so constructed as to remain clearly legible throughout the life of the plant giving due consideration to the difficult climatic conditions to be encountered. Nameplates shall be securely mounted where they will not be obscured in service by insulation, cladding, actuators or other equipment. Bidder shall pay specific attention to the nameplates/labels during painting, so that these are not painted over. Direction of flow is also to be engraved. All actuated valves shall be provided with labels, which shall include the valve and actuator reference number.

4.03.00 All nameplates and labels shall be in English language. All measurements shall be in S.I. units.

4.04.00 All segregated phases of conductors or bus ducts, indoor or outdoor, shall be provided with coloured phase plates to clearly identify the phase of the system.

4.05.00 Nameplates shall be 3 mm thick laminated white, black, white traffolyte for electrical and control panels and stamped stainless steel with lettering of a minimum height 5 mm for other equipment of FGD Plant Equipment & auxiliaries. Warning labels and emergency equipments shall have red lettering in place of black. Danger labels shall have red lettering on a white background. Labels shall be of sufficient size to carry a full description of the FGD Plant item and its complete KKS identifier. The size and location of nameplates shall be subject to Approval of the Owner. Lettering in all cases shall be machine-made and made to be legible after prolonged time in the range of ambient conditions prevailing at the Site.

4.06.00 Universal designation system utilizing six level breakdown KKS numbering system shall be followed for equipment identification. Each piece of equipment, motor, pump, valve, instrument, switchgear cabinet, junction box, control panel, panel board and associated apparatus shall be provided with tag plates indicating tag number and description. All major equipment (including the absorber, hydrocyclone, ball mills, belt filters, auxiliary transformers, booster fans, large pumps and blowers and motors) shall be provided with the data plates, indicating the name of the vendor, type, serial number, year of fabrication, main characteristics, and all further information necessary for a complete identification of the equipment.

4.07.00 All piping shall be painted and/or marked in accordance with the fluid contained according to a power plant color code to be proposed by Bidder and approved by Owner.

4.08.00 Tags shall be fitted by stainless steel self-tapping screws, stainless steel banding such that they are not readily lost or broken during routine operations and maintenance.

4.09.00 Surfaces of labels for cubicles and control equipment shall have a matte or satin finish to avoid dazzle. Colors shall be permanent and free from fading. Danger labels shall have red lettering on a white background. Labels shall be

provided on front and rear access doors of all cubicles. Labels shall also be provided inside cubicles to assist the identification of apparatus and terminals.

4.10.00 All lifting beams, cranes, rails, jibs, hoists, slings, straps and other lifting equipment shall be properly tested and permanently marked with their lifting capacity.

5.00.00 SAFETY AND SECURITY

5.01.00 The design shall incorporate every reasonable precaution and provision for the safety of all personnel and for the safety and security of all persons and property. The design shall comply with all appropriate statutory regulations relating to safety. All structures and equipment shall be designed and constructed to withstand every foreseeable static and dynamic loading condition, including loading under earthquake conditions, with an adequate margin of safety.

5.02.00 Ready and safe access with clear head room shall be provided to all parts of the FGD Plant Equipment & auxiliaries for operation, inspection, cleaning and maintenance. All platforms shall be fenced and all stairways shall be provided with handrails.

5.03.00 Escape routes and clear ways shall be provided to allow speedy evacuation of the personals in the event of fire or explosion, and the plant layout shall allow for ease of access to all parts of the Works by rescue and fire fighting teams. The FGD Plant Equipment & auxiliaries layout shall be designed to localise and minimise the effects of any fire or explosion. The recommendations of NFPA, OSHA, etc. as necessary shall be followed in all respects.

5.04.00 The use of corrosive, explosive, toxic or otherwise hazardous materials shall be kept to a minimum during construction and the design of the plant shall minimise the requirement for such materials during operation and maintenance. Where such materials must be used, all necessary precautions shall be taken in the design, manufacture and layout of equipment to minimise the resulting hazard, and all equipment necessary for the protection and first-aid treatment of personnel in the event of accidents shall be provided. Particular attention is drawn to avoid the use of prohibited materials in any form as mentioned elsewhere in this specification.

6.00.00 GUARDS

6.01.00 Effective guards and fences must be provided to prevent injury to operators through accident or malpractice.

6.02.00 Mesh guards which allow visual inspection of equipment with the guard in place are generally preferable. The guards shall be constructed of mesh attached to a rigid framework of mild steel rod, tube, or angle and the whole galvanised to prevent loss of strength by rusting or corrosion. The guards shall be designed to facilitate removal and replacement during maintenance.

6.03.00 All drive belts, couplings, gears, sharp metallic edges and chains must be safely guarded. Any lubricating nipple requiring attention during normal running must be positioned where they can be reached without moving the guards.

6.04.00 Guards for couplings and rotating shafts shall be in accordance with latest revisions of BS PD 5304-2005/ BS EN 953-1998 or similar approved standard. All rotating shafts and parts of shafts must be covered.

6.05.00 Suitable fencing shall be provided to enclose all openings or doorways used for the hoisting and lowering of machinery etc. This fencing must be securely fixed but quickly detachable when required. A secure hand hold must be provided on each side of the opening or doorway.

7.00.00 LOCATION AND LAYOUT REQUIREMENTS

The majority of FGD Plant Equipment & auxiliaries (excluding Absorber and DG sets) shall all be of indoor installation. A broad list of buildings housing such equipment is given elsewhere in this specification. Layout should facilitate access for operation-maintenance and inspection of any one or more equipment/components at a time without disturbing the operation or installation of rest of the FGD Plant Equipment & auxiliaries. Further, Bidder should comply with the criteria given under the various equipment and system specifications as well as those stipulated in Annexure-II attached to this section.

Enclosed General Layout drawings show the location of major facilities. The Bidder shall try to retain these locations as far as practicable. The layout of equipment within the FGD area as shown in the tender drawings is indicative. The Bidder may, subject to Owner's approval alter the same to suit the space requirement of the equipment offered.

Bidder may give alternate layout of their own with different orientation and relocation but all the equipments and facilities as in tender drawing/specification should be covered and the overall BTG area layout as shown in tender drawing is to be maintained.

While preparing the detailed layout and deciding upon the transportation and construction/ erection strategy and functional requirements, the following aspects shall be ensured:

a) Face of the buildings and facilities shall be located in such a way so as to have an offset of minimum 20 m with respect to center line of double lane road and 15 meter with respect to center line of single lane road.

b) The spacing between various buildings and facilities shall be suitably decided so as to avoid interference between the foundations.

c) The area for construction/erection facilities like lay-down, pre-assembly, offices and stores will be accommodated within the areas available in General Layout Plan.

d) All statutory requirements including safe distances between various facilities as per applicable rules/acts/laws including local by-laws will be complied with.

e) Minimum clearances/ dimensions

i)	Around the equipment	:	1200mm
ii)	Width of all staircases	:	1200mm (Minimum)
iii)	Clear Head room within Plant Buildings for pipes, ducts, Structures & cable trays etc.	:	2.5m (Minimum)
iv)	Clear head room in outdoor Power Block area for cable trays & piping	:	8m (BOS)
v)	Clear head room in other outdoor Areas for cable trays & piping	:	3m (BOS)
vi)	Clear head room for conveyors	:	8m (BOS)

f) All piping shall be routed at a clear height of 2500mm (min.) from the nearest access level to clear man movement.

g) A walkway of 600mm (minimum width) with pipe hand rails & toe guards shall be provided all along length of the trestle for maintenance of cables & pipes. Ladders for approach to these platforms shall be provided near roads, passage ways and turning points.

h) Head room for man movement shall be minimum 2.5m at ground floor in boiler area and 2.1m over all platforms.

i) Height of trestles at approach roads to various buildings/facilities shall be 8M. In case building are located in off-site area and are adjacent to each other, then as a good engineering practice, the height of trestle shall be maintained all over as 8.0M.

j) Each equipment room shall be provided with alternate exits in case of fire/accidents as per requirements of factory act and TAC.

k) All cranes shall be provided with approach rung ladders at least at two places. Where ever cranes can't be maintained in situ on the carriage, facility to draw them to maintenance platforms as well as provision of suitable platforms with access facility shall be provided.

l) Each building shall have an identified vacant space for equipment unloading and maintenance and preferably a separate bay altogether in buildings housing heavy equipment. Provision for handling equipment by monorail hoist and/or overhead crane shall be made as

specified.

m) The plinth level with respect to the existing grade level shall be as indicated elsewhere in this specification.

n) The minimum clear height available between two consecutive floor slabs shall not be less than five (5) meters. Adequate provision for natural ventilation and illumination shall be made as per good engineering practices.

o) There shall be at least two (2) nos. main access doors, one on either side of each building, of which one shall be minimum 3 meters wide with rolling shutters for equipment entry. For multistoried buildings, at least two (2) nos. regular staircases diagonally opposite to each other shall be provided connecting all the floors and roof. These minimum requirements shall be augmented as required depending on the floor area, statutory requirements and TAC recommendations.

p) All buildings shall have provision for toilet and associated effluent discharge system together with facility for drinking water. The criteria for ventilation, fire protection and illumination of building spaces specified elsewhere in this specification shall be complied with.

q) Top cover over underground pipes/cables shall be minimum one (1) meter.

r) Cubicle for operating personnel shall be located at safe place near the equipment.

s) Cable racks / pipe racks shall have hand railings in walkways on both sides at appropriate heights.

t) All the buildings and facilities will be approachable by the fire tenders.

u) Utility pipes except fire water pipes will be routed over ground on trestles. No trenches for pipes will be envisaged as far as possible. In the Power block area, Fire water pipes will be routed in RCC trenches.

v) Wherever steam pipes or pipes conveying hazardous fluids are running over the trestle, fire water pipes shall not be routed on the same trestle.

8.00.00 OPERATION & MAINTENANCE CONSIDERATIONS

8.01.00 Space for ease of operation and maintenance including equipment removal, tube bundle/cartridge/rotor pulling etc. shall be provided. All valves, gates, dampers and other devices shall be located and oriented in such a way that

they are accessible from operating floor levels. Where this cannot be adhered to, platforms and walkways with hand railing and access ladders/structural steel staircase shall be provided as per layout availability to facilitate operation and maintenance.

8.02.00 Lifting devices i.e. hoists, chain pulleys, etc. shall be provided for handling of any equipment and/or part having weight in excess of 250 Kg during erection and maintenance activities**.** Suitable monorail beams, hooks etc. for this purpose shall be provided in the buildings. The monorail shall be extended to outside the buildings by minimum 2m. The monorail beam shall extend through suitable opening in the building fitted with an approved double flap steel door [with chain or better opening and closing mechanism], removable handrails, platforms etc to enable removal of equipment to ground level or vice-versa.

Lifting tackles, slings, etc. to be connected to hook of the hoist/crane shall also be provided by the Bidder for lifting the various equipment and accessories covered under this specification.

8.03.00 All similar parts of the equipment shall be made to gauge and shall be interchangeable with and shall be made of same material and workmanship as the corresponding parts of the equipment. Wherever feasible common components shall be employed in different pieces of equipment in order to optimize the spares inventory and utilization.

8.04.00 Suitable machinery-hatch, removable steel gratings / covers / hand-railing etc. shall be provided in Buildings, etc. as found necessary during detailed engineering.

9.00.00 MATERIALS

9.01.00 In selecting materials of construction of equipment, the Bidder shall pay particular attention to the atmospheric conditions existing at the Site and the nature of material/fluid handled. Wherever deviations are taken in respect of materials specified, the reasons shall be spelt out clearly in the proposal.

All materials shall be new and shall be of the quality most suited to the proposed application.

9.02.00 As far as possible, materials shall be in accordance with Indian or international standard specifications and shall be used in accordance with Indian or international codes of practice. Where such standards or codes of practice are not available sufficient information shall be provided to allow the Owner/ Consultant to assess the suitability of the material for the particular application.

Materials used for various components shall be those which have already proven operating experience in similar type of applications.

9.03.00 All parts which could deteriorate or corrode under the influence of the

atmospheric, meteorological or soil conditions at the Site, or under the influence of the working conditions shall be suitably and effectively protected so that such deterioration or corrosion is a minimum over the life of the plant.

9.04.00 Prohibited Materials

The use of the following materials is prohibited:

a) High alumina cement in structural elements

b) Wood wool slabs in permanent framework to concrete

c) Calcium chloride in mixtures for use in concrete works

d) Naturally occurring aggregate for use in reinforced concrete that does not comply with the applicable codes and standards

e) Cast iron for any oil service

f) Carcinogenic material and suspected carcinogenic materials by World Health Organization.

g) Asbestos or any other fibrous form of hydrated magnesium silicate

h) Any other material generally known to be deleterious if used or incorporated in such project like the facility.

10.00.00 LUBRICATION

10.01.00 Suitable efficient lubrication system shall be provided where necessary to ensure smooth operation free from undue wear.

10.02.00 Gear boxes and oil baths shall be provided with filling and drain plugs, both of adequate size. An approved means of oil indication including level switches and temperature indication shall be provided.

10.03.00 All high speed gears shall be oil bath lubricated. Low speed gears shall be lubricated by means of soft grease. Removable and accessible drip pans shall be provided to collect lubricant which may drop from operating parts.

10.04.00 All lubrication points shall be conveniently situated for maintenance purposes. It must be possible to carry out lubrication from a gangway or landing and without the removal of guarding or having to insert the hand into it. Where accessibility to a bearing for oiling purposes would be difficult a method of remote lubrication shall be fitted.

10.05.00 The Bidder shall supply grease gun equipment suitable to service each type of nipple fitted

11.00.00 LUBRICANTS, SERVO FLUIDS AND CHEMICALS

11.01.00 The Bidder shall provide a detailed and comprehensive specification for all lubricating oils, greases, control fluids and essential chemicals required for the entire plant. A sufficient supply of these shall be provided by the Bidder for initial commissioning, first fill and one year's topping.

11.02.00 The Bidder shall supply a detailed schedule giving the lubricant testing, cleaning and replacement procedures. All equipment and facilities necessary for the testing, cleaning and changing of lubricants, control fluids and chemicals shall be provided. The Bidder shall endeavour to reduce the varities and grades of required lubricants and control fluids to a minimum, match them to those already in use in the generating station in order to simplify procurement and minimise storage requirements. All lubricants and control fluids shall be of internationally recognised standards and shall be easily obtainable from a large number of Indian suppliers. Bidder shall also indicate the equivalent Indian Standard for the above for easy procurement in future.

11.03.00 No lubricant or control fluid shall have toxic or other harmful effects on personnel or on the environment. Safety data sheets for all lubricants, oils, chemicals etc .specifying composition, application, chemical properties and preventive or accidental care that must be taken before and after use shall be papered by the Bidder and submitted to Owner for approval

12.00.00 PLANT LIFE AND MODE OF OPERATION

The complete FGD Plant Equipment & auxiliaries including all the equipment and systems individually and collectively shall be designed for continuous operation for an economic service life of thirty (30) years under the prevailing site conditions and for the type of duty intended.

The critical components of the FGD Plant, the life of which is limited by time and temperature dependent mechanisms such as corrosion, thermal stress, creep and low cycle fatigue, etc. are to be designed considering expected duty conditions and cyclic load variations.

The allowable stresses shall be reduced so that life expectancy to minimum 2,00,000 hours of operation can be achieved.

The plant would be designed for base load operation as well as cyclic load variation. The load variation is expected to be as per schedule depending on power demand. The FGD Plant Equipment & auxiliaries shall be suitable for shutdown on every weekend, if required. Moreover, the FGD Plant Equipment & auxiliaries should be capable to operate frequently down to 40% load.

13.00.00 PACKAGING & MARKING

All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. While packing all the materials, the limitations

from the point of view of availability of railway wagon sizes in India should be taken account of. The details of various wagons normally available with Indian Railways for transportation of heavy equipment shall be considered by the Bidder. The Bidder shall be responsible for all loss or damage during transportation, handling and storage due to improper packing.

As per the information available, the dimensions of over-dimensioned (OD) consignment for transportation of the equipment by rail (if any equipment to be handled through rail transportation) are as below:

a) Width of the Package (from centre-line of rails - 1.6 metres on both sides) : 3.2 Meters

b) Height of the package from rail top : 4.47 Metres

The above indicates the dimensions which can be normally transported on the wagons without infringement of the "moving gauge". However, Bidder shall conduct his own route survey and transportation logistics for transportation of the equipments to project site by road/rail/sea and indicate the same in his proposal. In case of sea transportation, Bidder to consider unloading of equipment at Tuticorin port. Transportation to project site from the nearest railway station or sea port shall be considered by road only.

The identification marking indicating the name and address of the consignee shall be clearly marked in indelible ink on two opposite sides and top of each of the packages. In addition the Bidder shall include in the marking gross and net weight, outer dimension and cubic measurement. Each package shall be accompanied by a packing note (in weather proof paper) quoting specifically the name of the Bidder, the number and date of contract and names of the office placing the contract, nomenclature of contents and Bill of Material.

14.00.00 PROTECTION

Equipment having antifriction or sleeve bearings shall be protected by weather-tight enclosures. Coated surfaces shall be protected against impact, abrasion, discoloration and other damages. Surfaces that are damaged shall be repainted.

Electrical equipment, controls and insulations shall be protected against moisture and water damages. All external gasket surfaces and flange faces, couplings, rotating equipment shafts, bearings and like items shall be thoroughly cleaned and coated with rust preventive compound as specified above and protected with suitable wood, metal or other suitable covering to ensure their full protection. All exposed threaded parts shall be greased and protected with metallic or other suitable protectors.

All piping, tubing and conduit connections on equipment and other equipment openings shall be closed with rough usage covers or plugs. Male threaded openings shall be closed with rough usage covers or plugs. Female threaded

openings shall be closed with forged steel plugs. The closures shall be taped to seal the interior of the equipment. Open ends of piping, tubing and conduit shall be sealed and taped.

Returnable containers and special shipping devices shall be returned by the manufacturer's field representative at the Bidder's expense.

15.00.00 PAINTING

15.01.00 Please also refer to Section V of Volume-IIA, for details of painting.

15.02.00 For detail painting on building & structural steel elements refer Section-IIG/1 & IIG/2 of this specification.

16.00.00 COLOUR CO-ORDINATION & FINISH

16.01.00 Exterior surfaces throughout the FGD Plant area shall be finished in colours and textures which will blend harmoniously together and with the surrounding landscape.

16.02.00 Interior surfaces throughout the FGD area shall be finished in colours and textures which will blend harmoniously together and which will be conducive to; the comfort, well-being and high productivity of the operators. Operating equipment and services provided shall be colour coded for ease of identification.

16.03.00 All finishes shall be durable and as far as possible maintenance free. Finishes shall be easily cleaned.

16.04.00 Final colours and finishes shall be to the Approval of the Owner.

17.00.00 ENVIRONMENT PROTECTION AND NOISE LEVEL REQUIREMENT

17.01.00 Environment Protection

17.01.01 The FGD Plant Equipment & auxiliaries area shall be designed for installation and operation in harmony with the surrounding environment and all measures of pollution control shall be ensured by the Bidder to ensure zero discharge from liquid effluents and other effluents within the limits specified in Environment (Protection) Rules 1986 as amended till date.

In case 'The Ministry of Environment, Forest and Climate Change (MOEFCC)' stipulate any other conditions not specified hereunder while clearing the project, the same shall be complied by the Bidder.

17.01.02 Any specific requirement of State Pollution Authorities over and above the above stipulation shall also be complied with by the bidder.

17.02.00 Noise Level Requirement

The plant will be designed, constructed and provided with suitable acoustic measures to ensure the noise level criteria as per the following stipulations.

a) Maximum noise level shall not exceed 85 dB (A) when measured at 1 meter away from the noise emission source, at a height of 1.5 meters above finished floor level.

b) Maximum noise level from its source within the premises shall not exceed 70 dB (A) as per Environment (Protection) Rules 1986, Schedule-III, `Ambient Air Quality Standards' in respect of noise.

c) Maximum noise level shall not exceed 105 dB(A) for safety valves and associated vent pipes and 90 dB(A) for regulating drain valves. For operating control valves, the noise level shall be within the limit of 85 dBA. For all valves & orifices, the measurement shall be made one (1) metre down stream of the devices and one (1) metre from the surface of the pipe for any combination of pressure drop and flow.

d) Any statutory changes in stipulations regarding noise limitation that may occur in future according to State Pollution Control Board or Central pollution Control Board or The Ministry of Environment, Forest and Climate Change regulation during tenure of the contract, the Bidder shall comply with the requirement.

17.03.00 Environmental design specifications

17.03.01 Construction materials and system contents prohibited

a) No equipment or construction materials brought onto or incorporated into the Facility shall contain asbestos at any content level. Only suitable substitutes for asbestos are permitted to be used.

b) Chemicals that are not accompanied by a material safety data sheet shall not be permitted to be used in any Work Area or incorporated into the Work.

c) No ozone depleting substances (as defined by the 1987 Montreal Protocol) at any level are allowed to be used in systems provided by Bidder. Only suitable substitutes are permitted.

17.03.02 Ambient noise mitigation

The Facility noise levels shall not exceed the more stringent of Applicable Law or the Noise Compliance Guarantee.

The Bidder shall abate ambient noise to public receptors in accordance with the more stringent of Applicable Law or the Noise Compliance Guarantee. Mitigation measures that shall be considered during project design include, but are not limited to, the following:

a) Selecting equipment with lower sound power levels;

b) Installing silencers for fans, blowers, compressors;

c) Installing suitable mufflers on engine exhausts and compressor components;

d) Installing acoustic enclosures for equipment causing radiating noise;

e) Applying sound insulation to improve the acoustic performance of buildings;

18.00.00 INSPECTION AND TESTING

18.01.00 Inspection and Tests during Manufacture

18.01.01 The method and techniques to be used by the Bidder for the control of quality during manufacture of all FGD Plant Equipment & auxiliaries shall be as stipulated elsewhere in the specification.

18.01.02 The Owner's general requirements with respect to quality control and the required shop tests are set out elsewhere in this specification.

18.01.03 Before any item of FGD Plant Equipment & auxiliaries leaves its place of manufacture. the Owner shall be given the option of witnessing inspections and tests for compliance with the specification and related standards.

18.01.04 Advance notice shall be given to the Owner as agreed in the Contract, prior to the stage of manufacture being reached, and the piece of plant must be held at this stage until the Owner has inspected the piece, or has advised in writing that inspection is waived. If having consulted the Owner and given reasonable notice in writing of the date on which the piece of plant will be available for inspection, the Owner does not attend the Bidder may proceed with manufacture having forwarded to the Owner duly certified copies of his own inspection and test results.

18.01.05 Under no circumstances any repair or welding of castings be carried out without the consent of the Owner. Proof of the effectiveness of each repair by radiographic and/or other non-destructive testing technique, shall be provided to the Owner.

18.01.06 All the individual and assembled rotating parts shall be statically and dynamically balanced in the works.

Where accurate alignment is necessary for component parts of machinery normally assembled on site, the Bidder shall allow for trial assembly prior to despatch from place of manufacture.

18.01.07 All materials used for the manufacture of equipment covered under this

specification shall be of tested quality. Relevant test certificates shall be made available to the Owner. The certificates shall include tests for mechanical properties and chemical analysis of representative material.

18.01.08 All pressure parts shall be subjected to hydraulic testing as per the requirements of IBR. Other parts shall be tested for one and half times the maximum operating pressure, for a period not less than thirty (30) minutes.

18.01.09 All necessary non-destructive examinations shall be performed to meet the code requirements of ASME or IBR as applicable.

18.01.10 All welding procedures adopted for performing welding work shall be qualified in accordance with the requirements of Section-IX of ASME code or IBR as applicable. All welded joints for pressure parts shall be tested by liquid penetrant examination according to the method outlined in ASME Boiler and Pressure Vessel code. Radiography, magnetic particle examination and ultrasonic testing shall be employed wherever necessary/ recommended by the applicable code. At least 10% of all major butt welding joints shall be radiographed. Statutory payments in respect of IBR approvals including inspection shall be made by Bidder. Bidder's scope and responsibility shall also include preparation and submission of all necessary documents in the specific formats and manner stipulated by the statutory bodies, coordination and follow up for above approvals.

18.02.00 Inspection and Testing at Site

18.02.01 The full requirements for testing the system shall be agreed between the Owner and the Bidder prior to Award of Contract. The completely erected System shall be tested under the supervision of the Technical Advisor of the Bidder on site under normal operating conditions. The Bidder shall also ensure the correct performance of the System under abnormal conditions, i.e. the correct working of the various emergency and safety devices, interlocks, etc.

18.02.02 The Bidder shall provide complete details of his standard procedure for testing the quality of erection and the performance of erected FGD Plant Equipment & auxiliaries. These tests shall include site pressure test on all erected pipe work to demonstrate the quality of the pipe work and the adequacy of joints made at site.

18.03.00 For details of specific tests required on individual equipment refer to respective Technical volumes of this specification.

19.00.00 TRAINING OF OWNER'S PERSONNEL

The Bidder shall extend all possible assistance and co-operation to the Owner regarding the transfer of technology and developing expertise in the area of operation and maintenance of the FGD Plant Equipment & auxiliaries.

The details of the training programme will be discussed and finalised with the successful Bidder.

19.01.00 Training at Bidder's Premises

19.01.01 The Bidder shall conduct training of engineers and plant operators of the Owner on engineering, operation and maintenance of the Plant at the Bidder's or Associates or Sub-Bidder's premises where adequate training facilities are available during the design and manufacturing stage.

19.01.02 The training may also be arranged by the Bidder in any Plant where the equipment manufactured by the Bidder or his Associates is under installation, operation or testing to enable the trainees to become familiar with the equipment being furnished by the Bidder. All expenses inherently related to the training shall be borne by the Bidder and shall include but not be limited to travel expenses (international and inland fares), lodging and per diem charges as well as medical insurance, instructors fee, programme and miscellaneous cost to be incurred during the training.

19.01.03 The training programme shall be adequate for the trainees to acquire the necessary expertise and competence in the operation and maintenance of the FGD Plant Equipment & auxiliaries. The Bidder shall be responsible for the development of the Training Module and Programme Schedule which shall be submitted to the Owner for approval.

19.01.04 The components of the training modules shall include but not be limited to the training procedures/methodology, instructional materials such as audio visual materials, CDs and slides and manuals for each trainee. Three (3) sets of the materials included in the training modules shall be handed over to the Owner upon completion of the training. An evaluation shall be jointly undertaken by the Bidder and the Purchaser's representative on the adequacy, appropriateness and relevance of the training and the programme effectiveness after the training. The training material shall be in English language only.

19.01.05 The content of the training programme shall include but not be limited to:

1. Limestone based Flue Gas Desulphurisation Plant for Coal fired thermal plant principles in management and practice for operators, technicians and maintenance personnel.
2. Plant operation and systems training for operators including simulator training as applicable.
3. Maintenance training programme covering electrical, mechanical and instrumentation and control.

19.01.06 The timing of the training should be such that the participants will be conversant with sufficient know-how to participate in the pre-commissioning and commissioning tests of the FGD Plant Equipment & auxiliaries. Said training programme shall be submitted to the Owner for approval.

The Bidder shall provide qualified English speaking instructors and training coordinator(s) during the tenure of the training programme.

19.02.00 Operation and Maintenance Training at Site

19.02.01 The Bidder shall provide a comprehensive training programme related to design application, plant management, operation and maintenance, including trouble shooting, of the Bidder's supplied system and equipment at the Site starting from Start of Commissioning and thereafter up to the Final Acceptance of the first FGD Unit.

19.02.02 The following instructors shall be at the Site continuously during the training:

a) One (1) for Flue Gas Desulphurisation Plant
b) One (1) for Limestone Handling system (part time)
b) One (1) for Electrical Works
c) One (1) for Instrumentation and Control

19.03.00 The total man-months for training of engineers shall be maximum thirty (30), having following indicative break-up:

Discipline	**No. of Man-months**
Operation	12
Mechanical Maintenance	4
Electrical Maintenance	4
Control & Instrumentation	6
Maintenance Planning	4
	30

However, the details of the training programme will be discussed and finalised with the successful Bidder.

19.03.01 On-the-Job Training

19.03.02 During the period of pre-commissioning, commissioning and trial operation, the Owner shall provide operation and maintenance personnel to assist the Bidder in the operation and maintenance of his supply and work under the direction of the Bidder for the purpose of on-the-job training.

19.03.03 The Owner shall have the right to send to the Site his employees later intended to operate and maintain the equipment supplied under this Contract. The Bidder shall, without additional cost, use his site staff to instruct these employees on the operation and maintenance of the equipment. All instructions shall be in the English language.

ANNEXURE-I

LIST OF STANDARDS FOR REFERENCE

a) International Organisation for Standardisation (ISO).

b) International Electro-technical Commission (IEC).

c) American Society of Mechanical Engineers (ASME).

d) American National Standards Institute (ANSI).

e) American Society for Testing and Materials (ASTM).

f) American Institute of Steel Construction (AISC).

g) American Welding Society (AWS).

h) Architecture Institute of Japan (AIJ).

i) National Fire Protection Association (NFPA).

j) National Electrical Manufacturer's Association (NEMA).

k) Japanese Electro-technical Committee (JEC).

l) Institute of Electrical and Electronics Engineers (IEEE).

m) Federal Occupational Safety and Health Regulations (OSHA).

n) Instrument Society of America (ISA).

o) National Electric Code (NEC).

p) Heat Exchanger Institute (HEI).

q) Tubular Exchanger Manufacturer's Association (TEMA).

r) Hydraulic Institute (HIS).

s) International Electro-Technical Commission Publications.

t) Performance Test Codes (PTC).

u) Applicable German Standards (DIN).

v) Applicable British Standards (BS).

w) Applicable Japanese Standards (JIS).

ANNEXURE-I

x) Electric Power Research Institute (EPRI).

y) Standards of Manufacturer's Standardization Society (MSS).

z) Bureau of Indian Standards Institution (BIS).

aa) Indian Electricity Rules.

bb) Indian Boiler Regulations (IBR).

cc) Indian Explosives Act.

dd) Indian Factories Act.

ee) Tariff Advisory Committee (TAC) rules.

ff) Pollution Control regulations of Ministry of Environment, Forest and Climate Change, Govt. of India .

gg) Central Board of Irrigation and Power (CBIP) Publications.

hh) National Building Code (NBC).

ii) Indian Road Congress (IRC).

ANNEXURE-II

CRITERIA FOR LAYOUT

PLOT PLAN LAYOUT REQUIREMENTS

The guidelines will be applied in general, unless otherwise stated in other technical Volumes. In addition to these guidelines, Bidder shall refer the attached Area Plans, drawing no. 17A14-DWG-M-0002A, 0002B and 0002C for tentative arrangement of the various facilities under this package.

	ITEM	SPECIFICATION REQUIREMENT
A.	Site conditions to be considered	
1.	Prevalent wind direction(s) during dry seasons (for deciding the location of limestone stock pile and unloading areas, minimising the pollution effect due to dust)	West to East. Also see wind-rose in plot plan.
2.	Location of:	
	a) Plant drainage outfall point(s).	Towards North East
	b) Railway entries & exits.	Not Applicable
B.	Layout Requirements	
1.	Maximum permissible slope in	
a)	Rail track	Not applicable
b)	Road	1 in 30
c)	Sides of unpaved embankment	1 in 2
2.	Required road width	
a)	Main Plant access road	10.0 Metres with 1.5 m wide shoulders on either side.
b)	Primary roads without access for 500 T crane	7.5 Metres with 1.5 m wide shoulders on either side
c)	Access ways	4.0 Metres with 1.2m shoulders on either side.

ANNEXURE-II

d)	Road to the absorber area :	Yes.
3.	Required minimum horizontal distance between the nearest points of	
a)	Plant boundary and the boundary of residential area	(Local municipality/factory rule)
b)	Electrical transformer and any other	As per the Tariff Advisory building/facilityCommittee Rules.
c)	Fire water supply installation and any building/facility subject to fire risk.	As per the Tariff Advisory Committee Rules.
d)	Inflammable liquid (fuel oil, etc.) storage & handling installation and their fencing and other buildings/facilities.	Rules of the Indian Explosive (Indian Expolsives Act) and Indian Petroleum Code.
4.	Required minimum vertical clearance	
a)	Under pipes/cable racks at road crossings	8.0 Metres.
b)	Soil coverage over underground pipes for CW/ACW piping	1.0 Metre (minimum) 1.5M
c)	Outdoor Pipe/Cable trench (if required)	150 mm above FGL
d)	Minimum height of equipment (switchgear, cabinet etc.) above floor for HT cable entry	500 mm
e)	Minimum height of equipment (switchgear, cabinet etc.) above floor for LT cable entry	300 mm
5.	Railway Wagon clearance	Not applicable
6.	Minimum Clearance between any road edge and building/structure/ any fixed installation.	3 Metres.

ITEM **SPECIFICATION REQUIREMENT**

ANNEXURE-II

7.	Required level, above the local developed grade level, of	
a)	top of all roads	150 mm.
b)	all outdoor paved areas	150 mm.
c)	Temporary storage areas, workshops, offices, residence etc. required at the time of erection work.	Yes.

ANNEXURE-II

BUILDING/ EQUIPMENT LAYOUT REQUIREMENTS

1.0 BROAD GUIDELINES FOR LAYOUT PLAN

General layout plan indicating the available spaces for the exiting project is as shown in the tender drawing placed in Volume-J of the tender specification. It shall form the basis for further elaboration by the Bidder for the plant facilities, which are in his scope.

While preparing the detailed layout, planning the facilities in the Bidder's scope and deciding upon the transportation and construction/ erection strategy and functional requirements, the Bidder shall ensure the following aspects in addition to those mentioned earlier in this section:

i) The entire construction activity shall take into account the commissioning of the units.

ii) The finished floor level at ground level of the TG building shall be designated at EL. 0.0M and shall be 500mm above the finished ground level (FGL) of that area.

The finished floor level for various areas / facilities shall be as follows:-

FFL of Main Plant Building	-El.(±) 0.00M
Top of paving for Transformer Yard	-El. (-) 0.10M
Top of paving for Boiler/ ESP/ FGD/ Chimney area	-El. (-) 0.20M
FFL of buildings	-500 mm above FGL of respective area

iii) Hazardous chemical storage complex shall be designed in accordance with statutory agencies guideline

iv) DG Set Exhaust Pipes (Height & Orientation) shall be designed as per Environmental Regulations.

1.1 Common Control Room

Common Control room shall be provided by the Bidder common for both units.

Common Control Rooms / Control Equipment Rooms for each unit/ RIO rooms for each unit shall be provided with air-conditioning by the Bidder.

ANNEXURE-II

2.0 PLANT LAYOUT REQUIREMENT

2.1 The location of main plant block is indicated in the Plot plan drawing enclosed in Volume-J of the tender specification, however Bidder has to develop layout keeping the location/orientation of the existing main power block same as indicated in bid document. Bidder shall develop his own layout for the equipment offered and the same to be clearly brought out in the bid under the scope of Bidder. However, while developing the layout the Bidder must give due considerations for the following requirements:

i. The FGD control, control equipment's room and the Electrical room shall be common for both units and be located near the Absorber tower.

ii. The Electrical and control room shall be single-level and shall essentially house but not be limited to the followings:

1. Electrical Panels
2. Control panels, operator's consoles etc. for all modules. The control room shall not have any internal column inside the room. Large span roof beams for control room to be adopted and designed.
3. Computer room with engineering work stations & associated workstations.
4. A small conference room.
5. FGD Plant In charge room.
6. UPS & batteries.
7. Cabling and all other facilities associated with the above system.

2.2 The Control Room and control equipment rooms, computer room with programmer station, UPS room, shall be provided with Air conditioning. Washroom/Toilet facilities for ladies & gents separately shall be provided. Further, no vertical bracings, pipes, cable shafts etc. shall be routed through control room or control equipment room area. Design of control room interior including lighting, roof, flooring and decoration will also be provided by the Bidder

2.3 The following clearances to be maintained for C&I DCS/ DDCMIS/ PLC cabinets:

i)	Clearance from back	1200mm
ii)	Clearance from front wall	1200mm
iii)	Clearance from side	1000mm

The above clearances are minimum requirement and may increase with increase in door swing of the cabinets.

2.4 Layout of facilities and equipment shall allow removal of transformers without disturbing equipment, piping, cabling, ducts routed in the area.

ANNEXURE-II

Adequate space and provision for handling/removal of booster fans, pumps, motors, heaters, heat-exchanger, compressors, Switchgear Panels, Transformers during maintenance shall be provided.

2.5 The Limestone slurry preparation building, Gypsum dewatering building, Gypsum storage building shall be of multi-storied type designed to utilize gravity flow wherever possible.

2.6 Equipment requiring monitoring during regular operation shall be approachable from the ground floor through staircase. Staircase with minimum width of 1200 mm shall be provided for approach to elevated structures at 5m height from the nearest platform. Below this height a vertical ladder with minimum clear width of 600 mm may also be acceptable.

2.7 Platform with a minimum clear width of 1000 mm shall be provided all around the lowest absorber spray levels and mist eliminators. Similar platforms shall be provided at subsequent elevations if they are more than 3000 mm apart from each other. An adequately sized manhole with platform (min. 2 sq. m) shall be provided above each spray level. Ladders/staircase shall be provided for the access to the platform.

2.8 The absorber slurry recirculation pumps, gypsum bleed pumps and limestone feed pumps shall be mounted on the ground level. Suitable approach and platforms shall be provided for all the valves required during regular operation.

2.9 A 1500 mm space shall be provided around all pumps, except absorber recirculation pumps, where a 2000 mm space shall be provided.

2.10 Platform with a minimum width of 1500 mm shall be provided all around the pulverizers and feeders. Approach along with suitable platforms shall be provided for ball loading hoppers.

2.11 A 1000 mm wide platform with suitable approach shall be provided around each hydro-cyclone.

2.12 A 2000 mm wide floor/platform shall be provided all around each belt filter.

2.13 Independent floor drains with separate down comers shall be provided where fire protection system are provided.

2.14 All heavy equipment located in the buildings shall be accessible by the EOT cranes or hoists for their handling during erection and maintenance. Wherever special handling procedures are to be followed, the same shall be described in and attached with the bid.

ANNEXURE-II

2.15 Monorail for Magnetic Separators (ILMS & SEM) shall extend outside the building by minimum 2.0m. Tramp iron chute (up to ground level) shall be provided at floor on which above magnetic separators are installed.

2.16 The safety guard for the Take-up Carriage / Counterweight box of the Gravity Take-up unit shall be provided with a removable panel for entry of operating personnel for greasing / maintenance of pulleys etc.

2.17 Each Floor cleaning chute of Limestone Handling Plant buildings shall terminate at about 1.2 m above ground level. Floor cleaning chute (debris chute) shall be connected to tramp metal chute wherever feasible.

2.18 A suitable rail track and associated facilities like, mooring posts etc., shall be provided to facilitate the movement of transformers to the access road/ maintenance area.

2.19 Adequate distance shall be maintained between the transformers. As basic guidelines following norms will be adhered to:

i) Auxiliary transformers shall be separated from the adjacent building/structures and from each other by a minimum distance as defined below or by a fire wall of two hours of fire resisting of height at least 600 mm above bushing / pressure relief vent whichever is higher.

Oil capacity of individual transformer separating distance (in liters)	Clear (in Meters)
5,000 to 10,000	8.0
Above 10,000 to 20,000	10.0
Above 20,000 to 30,000	12.5
Over 30,000 or more	15.0

ii) In case of auxiliary transformers having an aggregate oil capacity in excess of 2300 liters or more but individual oil capacity of less than 5000 liters, the separating distance between transformers and surrounding building shall be at least 6M unless they are separated by fire separating walls or are protected by high velocity spray system.

iii) Waste water & oily waste from 220KV / 11 KV Transformer and auxiliary transformer yard areas shall be collected in common oil pits. These common oil pits shall be connected to ETP. Two nos. (1W+1S) vertical screw pumps shall be installed in each common oil pit. These pumps shall transfer oily waste to common oily pit located in ETP area for further treatment through suitable piping system.

iv) HVWS protection shall be provided as per CEA guidelines if the oil capacity more than 2000 liters or capacity of transformer 10MVA or more.

ANNEXURE-II

3.0 Layout requirements for Electrical MCC/switchgear rooms

For finalizing room size, following points shall be considered: -

i) Minimum clearance between HV/MV switchgear and LV switchgear shall be maintained as 2500mm.
ii) Minimum clearance between any obstruction like column, wall and vertical raceway, etc. and rear of LV switchboard shall be maintained as 1000mm respectively.
iii) Minimum clearance between two LV switchgear facing each other shall be maintained as 2000mm.
iv) Minimum rear to rear clearance of LV switchgear shall be maintained as 1000mm respectively.
v) Minimum rear to front clearance for PCC to PCC shall be maintained as 2000mm.
vi) Clearance between the bottom of ventilation duct and top of electrical panel shall be as per statutory requirement
vii) Minimum clearance between two non-drawout panels facing each other shall be maintained as 1500mm.
viii) Minimum clearance between wall and end of switchgear shall be maintained as 1000mm.
ix) Minimum clearance between the sides of two switchgears shall be 1000mm.
x) Minimum clearance between LV switchgear to dry type transformer shall be kept as 2000mm.
xi) Access to rooms, doors, etc. to be provided in various floors shall consider movement of the panels during erection and later during maintenance.
xii) Switchgear room/MCC room and cable vault shall be pressurized above the atmospheric pressure to prevent ingress of dust.
xiii) Control room, switchgear room shall be provided with separate entry and exit door. Rating of fire proof door to be provided in cable vault shall be 2 hours.
xiv) Walkways shall be provided for accessing the cable laid on cable trays in all pipe racks & cable racks.
xv) Cable vault floors shall have all openings properly ridged to prevent water drainage into the room below. In addition proper facilities shall be provided at cable vault floor to drain the water in case of operation of sprinkler system.
xvi) Air-conditioned rooms shall be provided with double door.
xvii) During design stage adequate space shall be provided for expansion of board on either side to accommodate addition of panel to take care of unforeseen factors.
xviii) All busducts shall enter the 415V PMCC from top.
xix) Minimum clearance between two HV / MV switchgear facing each other shall be maintained as 3500mm.

ANNEXURE-II

xx) Bottom to roof beam in HT/ LT switchgear room from finished floor level shall be 4.5m when the room has busducts and shall be 4.0m without busduct.

xxi) Cable spreader floors shall have all openings properly ridged to prevent water drainage into the room below. In addition proper facilities shall be provided at cable spreader floor to drain the water in case of operation of sprinkler system.

xxii) Wherever cables are taken out through wall openings, such openings shall be properly sealed with fire sealing compound.

xxiii) Fire isolation wall shall be provided wherever necessary as per fire safety norms. Opening in the fire separation wall shall be properly sealed with fire sealing compound after laying of cables.

xxiv) Major routes in BOP area (BOP Package area) shall be on overhead cable trays either supported from available structures, building structure. Only in specific areas as shall be approved by purchaser/consultant where number of cables are too small compared to the route length and in transformer yard, cable shall be routed in cable trenches.

xxv) The minimum clear height (excluding roof beam) shall be 3.0m.

xxvi) Bottom of roof beam shall be min. 3m

xxvii) In cable vaults clear height in walkway or cross over below the cable trays shall be 2.1m

4.0 EQUIPMENT LAYOUT REQUIREMENT

4.1 Local Pits/trenches in buildings are to be avoided. However pits/sumps which are unavoidable shall be provided with required dewatering arrangements by means of permanently fixed drainage pumps, further treatment of effluent for reuse purposes and piping up to the ETP for FGD Pump. Bidder shall provide required sump pumps/drainage pumps/submersible pumps, effluent treatment equipment/ system & Piping etc.

4.2 Pump shall be permanently fixed in the pits/sumps. If the pit depth is shallow, vertical top mounted sump pumps shall be provided and in deep pits self-priming drainage pumps (horizontal type) at floor level or alternatively submersible type pumps may be provided.

4.3 Each pit/sump shall be provided with two numbers (2x100% Capacity) of respective type pumps so that the entire pit is evacuated within 15-20 minutes and the operation of the pumps shall be interlocked through level measurement devices to be installed in the pit/sump so that the pumps shall start automatically and empty the pit.

4.4 The general design and construction features of Vertical sump pumps and Submersible pumps are furnished elsewhere.

4.5 In addition to the above, suitable drainage arrangement of different floors of plant buildings shall be provided. These drains shall be led to sumps in ground floor as per approved layout. Bidder shall also provide sump pumps of 2x100%

capacity in each sump pit and the sump drainage water shall be led to the ETP for FGD plant. Bidder shall also provide piping's, fittings etc. for taking this drain/oily waste water to ETP.

4.6 Bidder to furnish the detailed erection strategy along with the bid for major equipment's located in FGD area.

4.7 Bidder's shall prepare the detailed layout of FGD plant in the available space in the existing main power block area indicating the location of all major equipment. The layout shall be furnished along with the bids submitted by the Bidder.

4.8 Valves in the Bidder's scope shall be located in accessible positions

4.9 Provision of monorails with chain pulley blocks/HOT cranes along with hoist, as required shall be kept.

4.10 Approach for removal of equipment for maintenance shall be provided.

4.11 A/C and ventilation ducts, Bus ducts, and Critical Piping routes to be identified at conceptual stage.

4.12 No cable trenches, under-ground cable vaults and pipe trenches are acceptable unless otherwise approved by the Purchaser.

4.13 All the pipes and cables within the Plant boundary shall be routed above ground.

4.14 All other safety requirements as per the factories act, shall be observed while developing the layout.

4.15 Battery rooms should be properly ventilated to release the gases produced. An easily accessible wash basin should be provided in the battery room.

4.16 Pipelines shall be routed in such a way to avoid interference with other pipes and their hangers and supports, structure, equipment, electrical conduits, cable trays, ventilation ducts etc. The pipe routing shall also take into account the availability of structural members for providing suitable supports and hangers. Hot and cold premises of the system shall be suitably isolated/ segregated from each other. Also the electrical premises shall be fully segregated from system piping.

4.17 Piping layout shall have adequate flexibility to absorb all thermal expansion without causing undue stress in the pipelines.

4.18 All piping shall be grouped where practicable and shall be routed to present a neat appearance.

4.19 The piping shall be arranged to provide clearance for removal of equipment

ANNEXURE-II

requiring maintenance and for easy access to valves and other piping accessories required for operation and maintenance. Availability of access to valves and specialties shall be properly indicated on the layout drawing.

VOLUME : II-A

SECTION - VI

ENGINEERING SERVICES

CONTENTS

CLAUSE NO.	DESCRIPTION	PAGE NO.
1.00.00	GENERAL	1
2.00.00	DESIGN COORDINATION MEETING	1
3.00.00	CO-OPERATION WITH OTHER SUCCESSFUL BIDDERS AND CONSULTANTS	1
4.00.00	GUIDELINES FOR OWNER'S ENGINEERING SERVICES	2
5.00.00	INSTRUCTION MANUALS	4
6.00.00	PLANT HANDBOOK FOR FGD PLANT EQUIPMENT & AUXILIARIES	5
7.00.00	TENDER STAGE DOCUMENT SUBMISSION	5
8.00.00	CONTRACT STAGE DOCUMENT SUBMISSION AND APPROVAL PROCEDURE	6
ANNEXURE-1	FINALISATION OF SUBVENDOR	9

VOLUME : II-A

SECTION-VI

ENGINEERING SERVICES

1.00.00 GENERAL

1.01.00 As part of the overall project management activity, the Successful Bidder shall be responsible for proper Owner's Engineering and co-ordination of activities during various phases of execution of the contract. The Successful Bidder shall identify a person, designated as Project Manager, with whom the Owner, the Consulting Owner's Engineer or the Review Consultant shall interact on matters related to Owner's Engineering as well as execution of the contract. The Project Manager shall be the single-point contact person on behalf of the Successful Bidder and shall be responsible for all Owner's Engineering co-ordination. The Owner /Consultant /Review Consultant shall interact with the Project Manager only on all matters of co-ordination between the Owner and the Successful Bidder or on matters involving the Successful Bidder, his manufacturing units and sub-vendors. For the purpose of expediting the Owner or his representative may sometimes interact with the manufacturing units or sub-vendors of the Successful Bidders. However such interaction will not, under any circumstance, dilute the responsibility of the Successful Bidder to provide a fully Owner's Engineered and coordinated package under this contract.

1.02.00 On finalization of the contract, a procedure for exchange of Owner's Engineering information will be mutually agreed and finalized between the Owner and the Successful Bidder.

2.00.00 DESIGN COORDINATION MEETING

The Successful Bidder and his sub-vendors will be called upon to attend design co-ordination meetings with the Owner's Engineer, other Successful Bidders and the Consultants of the Owner during the period of execution of contract. The Successful Bidder including his sub-vendors shall attend such meetings at their own cost at Owner's office in Neyveli or Consultant's office in Kolkata/ or at mutually agreed venue as and when required and fully cooperate with such persons and agencies involved during those discussions.

3.00.00 CO-OPERATION WITH OTHER BIDDERS AND CONSULTING OWNER'S ENGINEERS

The Successful Bidder shall agree to cooperate with the Owner's other Bidders and Consulting Owner's Engineers and freely exchange with them such technical information as is necessary to obtain the most efficient and economical design and to avoid unnecessary duplication of efforts. The Owner's Engineer shall be provided with copies of all correspondences addressed by the Successful Bidder to other Sub- Vendors and Consulting

Owner's Engineers in respect of such exchange of technical information.

4.00.00 GUIDELINES FOR OWNER'S ENGINEERING SERVICES

4.01.00 Prior to commencement of the Owner's Engineering work as part of design submissions, all aspects of design viz., criteria for selection and sizing of all equipment and systems, design margins etc. including that for structural steel and civil work shall be outlined and these shall form the basis for the detailed Owner's Engineering work.

4.02.00 Owner's Engineering work shall be performed on modern and proven concepts and internationally accepted good Owner's Engineering practices but fully compatible with the Indian environments. Owner shall have the right to review and approve the Owner's Engineering work by themselves and/or through consultant and ask for any clarifications and changes/modifications to the work performed by Successful Bidder.

4.03.00 At any stage during the performance of assignment, the Successful Bidder may be required to make certain changes/modification/improvements in design/ drawing/other documents, which in the opinion of the Owner could result in better improved design, layout, operability, plant availability, maintainability, reliability or economy of the FGD Plant Equipment & auxiliaries and its systems/sub-systems in view of revised and more accurate information/data available at a later date(s) or feedback(s) received during execution/operation of similar units. Such changes/ modifications/improvements required could be identified by Owner and/or consultant and mutually discussed. Owner requires the Bidder to incorporate such action in the subject assignment appropriately without any additional cost liability and time implication to the Owner and same shall be within the responsibilities and Scope of the Successful Bidder.

4.04.00 During the course of review of detailed Owner's Engineering stages, it may be essential in the opinion of Owner to obtain certain classified data for review purposes only. In case Owner so desires, the Bidder shall submit such data to Owner.

4.05.00 During the course of review of detailed Owner's Engineering, it may be essential in Owner's opinion to obtain data and information on similar equipment and plants Owner's Engineered by the Bidder. In case Owner so desires the Bidder shall submit such data and information to the Owner.

4.06.00 It is not the intent to give details of every single task covered in the total Owner's Engineering work to be carried out by Successful Bidder, however, all Owner's Engineering work required for the satisfactory completion of the FGD Plant Equipment & auxiliaries as specified shall be carried out by the Successful Bidder. Broadly, the following are the minimum requirements in respect of scope of major items of work:

4.06.01 Preparation, updating and finalisation of scheme drawings, control and interlock diagrams, detailed and fully dimensioned layout drawings (FGD Plant area layout and equipment layout detailed plan, elevation and cross-sectional drawings at different elevations/ floor levels) covering all mechanical, electrical,

C&I, civil and structural items, equipment, systems and facilities.

Drawings and Schedules prepared by the Successful Bidder from time to time, as detailed designs are developed, shall be submitted for Owner's/ Consultant's approval before the work is taken up. Revisions, corrections, additions to drawings and schedules shall not be considered to change the scope of work.

4.06.02 Preparation of detailed technical specifications including data sheets, tender drawings and bill of material for all bought out items, as also finalisation of corresponding sub-Vendors.

4.06.03 Review of sub-Vendor's data, drawings, design calculations, schedules, bill of materials, instruction manuals etc. for all equipment, before forwarding them to Owner/Consultant for approval.

4.06.04 Preparation of civil construction drawings for all equipment showing foundation details and full details regarding equipment loads, floor openings, details of embedments, etc. required for preparation of civil construction drawings and also as referred at relevant sections of Scope & Exclusions. These documents shall be preceded by appropriate design calculations, static and dynamic analysis as necessary.

4.06.05 Preparation and finalisation of process piping and instrumentation diagrams and schematics, complete in all respects for all systems/packages of the FGD Plant package.

4.06.06 Preparation of consolidated schedules and bills of materials, including line numbers, tag numbers, source of supply, service conditions, specifications, materials, types and connections details, quantities for items of the FGD Plant package including dampers, steam traps, strainers, instrumentations, ducting.

4.06.07 Sizing of all piping and equipment as per the stipulated design criteria; carrying out of flexibility analysis/dynamic analysis as necessary; hangers & support Owner’s Engineering.

4.06.08 Final revision of all documents including preparation and compilation of Instruction Manuals for installation, commissioning, operation and maintenance for all equipment and systems. Refer clause 5.00.00 for the specific requirement in this regard.

4.06.09 Certification and submission of final as-built drawings for all areas.

4.06.10 Preparation and compilation of all drawings, schedules and instructions which may be required at site, whether separately mentioned or not.

4.06.11 All erection and assembly drawings which may be required at site.

5.00.00 INSTRUCTION MANUALS

5.01.00 The Bidder shall provide all necessary instruction manuals for the Owner’s

review, comment, and final acceptance as required in the contract. The instruction manual shall contain full details required for erection, commissioning, operation and maintenance of each equipment. The instruction manual shall be submitted in the form of one (1) soft copy in CD and 15 hard copies.

5.02.00 **Erection Manuals**

5.02.01 The erection manuals shall be submitted at least three (3) months prior to commencement of erection activities of particular equipment/system. The manuals shall contain the following as a minimum:

a) Erection strategy.

b) Sequence of erection.

c) List of tools, tackles, heavy equipments like cranes, dozers etc required for erection.

d) Bill of Materials.

e) Safety precautions to be followed during erection.

f) Erection instructions.

g) Critical checks and permissible deviation/tolerances.

h) Check-list for pre-commissioning activities

i) Check-list for commissioning of the system.

j) Procedure for initial checking, testing and acceptance norms.

5.03.00 **Operation & Maintenance Manuals**

5.03.01 The operating and maintenance instructions together with drawings of the equipment, as completed, shall be in sufficient detail to enable the Owner to operate, maintain, dismantle, reassemble, and adjust all parts of the equipment. They shall outline a step-by-step procedure for all operations likely to be carried out during the life of the FGD Plant Equipment & auxiliaries. Each manual shall include a complete set of drawings together with performance/ rating curves of the equipment and test certificates wherever applicable.

5.03.02 If after commissioning and initial operation of the FGD Plant Equipment & auxiliaries, the manuals require any modification/ additions in the view of the Owner or Bidder, the same shall be incorporated and the updated final manuals shall be submitted to the Owner.

5.03.03 The manuals shall include the following:

a) List of spare parts along with their drawing and catalogue and Pro-

forma for ordering spares.

b) Location and identification guide for bearings of various equipments and lubrication schedule including charts showing lubrication checking, testing and replacement procedure.

c) Wherever applicable, fault location charts shall be included to facilitate fault detection.

d) Detailed specification for all consumables (including lubricating oils, greases, chemicals etc.) required for each equipment.

6.00.00 PLANT HANDBOOK FOR FGD PLANT EQUIPMENT & AUXILIARIES

The Bidder shall provide the plant handbook for FGD Plant Equipment & auxiliaries to the Owner as per provision of the contract.

The Plant Handbook shall contain the following as a minimum:

a) Design and performance data

b) Process & instrumentation diagrams

c) Single line diagrams

d) Sequence & Protection interlock schemes

e) Alarm and trip values

f) Performance curves

g) General layout plan and layout of TG building and auxiliary buildings

h) Important Do's and Don'ts.

7.00.00 TENDER STAGE DOCUMENT SUBMISSION

7.01.00 The Bidder shall submit along with his bid all documents/drawings as specified in specification and respective sections of the Technical Specifications in Vol-II and Vol-III. The documents shall include but not be limited to the following:

a) All Bid proposal sheets duly filled up.

b) Detailed experience list and financial resources of the Prime Bidder his collaborators/associates in this bid as well as the sub-vendors proposed.

c) Scheme drawings indicating scope of supply and service as offered by the Bidder indicating clearly exclusions, if any.

d) List of terminal points of the package offered together with quality and

quantity of various input (i.e. steam, water, air, electricity etc.) as required from the Owner at such interfaces.

e) Equipment GA, Layout, Design Calculations, interlock and other write-up, catalogues/literature etc. as required for clear understanding of the bid submitted.

f) High level project schedule network indicating target dates for intermediate milestones and final commissioning of FGD Plant Equipment & auxiliaries; This network shall be supplemented by a detailed write-up on proposed sequence and method of execution for project implementation, deployment schedule for Key personnel with their bio-data, schedule of construction machinery etc.

g) Subvendor List for the Equipment, as mentioned in Annexure-1, for approval by Owner/Consultant.

8.00.00 CONTRACT STAGE DOCUMENT SUBMISSION AND APPROVAL PROCEDURE

8.01.00 Owner's Engineering schedule shall be submitted by the Bidder as indicated in the specification. Owner's Engineering schedule shall be developed in format as desired by the Owner/consultant.

The documents shall be divided into two categories: a) for approval and b) for information/further Owner's Engineering and co-ordination by the Consultant.

In preparing this schedule, the Bidder shall allow one (1) week from date of receipt for review and comments by the Consultant for each submission of a document.

This document submission schedule shall require acceptance by the Owner/Consultant.

Bidder shall also develop and submit a Master drawing list to the Owner/consultant.

8.02.00 All contract documents shall be marked with the name of the Owner, the Project, the specification title and number and the unit designation.

All dimensions shall be in metric units.

All notes, markings etc. shall be in English.

8.03.00 Documents/Drawings, submitted during tender stage, shall be revalidated or revised as required and submitted as certified contract document for approval/information of the Owner/Consultant.

8.04.00 Unless specified otherwise, the following categories of documents/drawings would require approval of the Owner/Consultant:

a) System scheme and Process & instrumentation Diagrams (P & IDs).

b) Design basis documents / memoranda / calculations justifying sizing and selection of equipment, vessels, tanks, piping, valves & specialities as well as the process parameters.

c) Equipment data sheets and general arrangement drawings.

d) Materials of construction.

e) General Arrangement and Layout drawings.

f) Typical control schemes, circuit diagrams, drive/ feeder-wise control scheme showing all external interfaces.

g) Control System Configuration

h) Shop Inspection and Testing Procedures, Test Set-up & Instrumentation, Acceptance Criteria and Codes / Standards followed, correction curves / charts, etc.

i) Performance Test Procedures, Instrumentation, Acceptance Criteria and Codes / Standards followed, correction curves / charts, etc.

j) Schedules covering equipment delivery schedules, erection, testing and commissioning schedules at L1 and L2 levels.

8.05.00 Unless specified otherwise, the following categories of documents / drawings would be treated for information/further Owner's Engineering by the Owner/Consultant. The Bidder shall, however, incorporate all additional information and clarifications in these documents/ drawings as and when desired by the Owner/ Consultant.

a) Equipment foundation drawings.

b) Equipment cross-section drawings, product literature etc. which are of proprietary nature.

c) Predicted performance curves of equipment.

d) Various bills of quantity, schedules etc.

e) Piping fabrication drawings, isometrics etc.

f) Panel wiring diagrams.

g) Instruction/Operation manuals.

h) Service manuals and trouble shooting guide for C & I system including field instruments.

i) Operation logic diagrams.

j) Cable schedule and interconnection chart.

In essence, the Bidder is solely responsible for corrections and adequacy of design & Owner's Engineering for documents under this category.

8.06.00 Upon review, the Consultant shall put his remarks and one of the following action stamps on the drawing / document:

1) Approved.

2) Approved as noted, resubmission required.

3) Commented, resubmission required.

4) For information/reference only.

For action stamps in category (2) & (3), documents must be resubmitted for review by the Owner/Consultant.

Except for action stamp under category (3), the Bidder can proceed with manufacturing and other sequential activities for those areas of a drawing/document. .

The Consultant may accord approval in category (2) or (3) in more than one submission of a document till he is satisfied that the intent of the specification has been fully complied with. The Bidder shall be responsible for delay in such cases and no extension of time shall ordinarily be allowed on such grounds.

The Bidder's work shall be in strict accordance with the finally approved drawings and no deviation shall be permitted without written approval of the Consultant.

8.07.00 Except key plan/general yard plan, any layout drawing requiring scrutiny shall not be drawn to a scale less than 1:50.

8.08.00 For review by the Consultant, the Bidder shall furnish three (3) prints of each drawing (only for first submission). There upon all transaction of drawings including reviewed comments and stamping shall be done in soft. All transaction of drawings shall be accompanied by a reference letter mentioning the date, revision no. and document status. Only on receiving the Approval Stamping, bidder shall distribute 6 sets of drawings (2 at NLCIL corporate office and 4 sets at NLCIL site office). The Bidder shall furnish three (3) CDs of all as built/final drawings for Owner/Consultant site.

8.09.00 In case of contradiction between the stipulations above and those stated elsewhere in the specification, the more stringent stipulations shall prevail.

ANNEXURE-1

FINALIZATION OF SUB VENDORS

General

a. The successful Bidder is responsible for performance/guarantee of the complete package including bought out items and out sourced processes. The Bidder will supply the equipment/component/system from the Purchaser/Consultant approved sub vendors only.

b. The Bidder has to necessarily indicate in their bid, their proposed sub vendors for the items listed below. Sufficient number of sub vendors may be proposed to meet their need.

c. The proposed list of sub vendors furnished by the Bidder will be reviewed during Techno Commercial/Pre-award discussions by Purchaser/Consultant and the sub vendors will be categorized as below.

   i. **Category – I: Sub vendors accepted.** The acceptance will be based on past experience of Purchaser/Consultant.

   ii. **Category – II: Sub vendors enlisted for future acceptance**. Such acceptance will be based on the various details regarding capacity, capability, experience etc of the sub-vendor proposed by the successful Bidder. It is the responsibility of the successful Bidder to get the details of the sub vendors under category II, compiled and submitted to Purchaser/consultant for scrutiny and acceptance. The acceptance criteria are mentioned below. However, Purchaser reserves the right to accept or reject any of the proposed vendors based on information available with them.

d. The consolidated list of sub vendors under category I and category II will be made available to all the qualified Bidders before price cover opening.

e. Purchaser may consider the Bidder's proposal for inclusion of new sub vendors, if any during post award stage for approval, based on merits, in the overall interest of the Package, after establishing that the sub vendors proposed meet the acceptance criteria specified. However, price advantage if any, arising out of inclusion of new sub vendors will be passed on to the Purchaser.

f. Subsequent to approval of main sub vendor for main system after verifying the acceptance criteria, the main sub vendor will be allowed to choose his sub vendors for the sub system provided they meet the technical stipulation as per the contract requirements.

g. For all other components/equipments/systems which are not figuring in the following list or in the additional list furnished by the Bidder in their bid, Bidder's standard practice of selection of vendors may be carried out.

Acceptance Criteria for Sub Vendors:

i) For all Mechanical, Electrical, Control and Instrumentation (Except for items mentioned under ii and iii below)

For Class I Items:

Bidder to furnish documentary evidence to show that similar or higher capacity component/equipment / system has been supplied by the vendor or their associate/collaborator and the same has been operating satisfactorily for two years. The documentary evidence will be in the form of Performance certificates furnished by the end user.

For Class II Items:

Bidder to furnish documentary evidence to show that similar or higher capacity component/equipment / system has been supplied by the vendor The documentary evidence will be in the form of Material Receipt Certificate or Site Inspection Report, etc from the end user for having received the material by the end user.

The component/equipment / system covered under Class I and Class II are furnished below for Mechanical, Electrical, Control and Instrumentation.

ii) For FGD integral control system

(a) In case the Bidder is the Manufacturer of **control system**

1. The offered control system must have been successfully supplied, erected, tested and commissioned in power plant. The system offered should be same as has been rendered to the unit running successfully as mentioned above with proven performance and/ or improved version of the same
2. Bidder shall furnish all required information to fully satisfy Purchaser / Consultant regarding successful operation and high reliability of products / systems furnished.

(b) In case the Bidder is not a Manufacturer of control system, he shall associate with a Vendor who shall satisfy the Clause (a) above.

iii) For Programmable Logic Controller (PLC) / Control System

(a) In case the Bidder is the Manufacturer of PLC:

1. The offered PLC must have been successfully supplied, erected, tested and commissioned for one such system having minimum capacity of 1000 digital inputs in power plants and which should have been in satisfactory operation for not less than two years as on the original date of tender opening.

2. Bidder shall furnish all required information to fully satisfy Purchaser / Consultant regarding successful operation and

high reliability of products / systems furnished.

(b) In case the Bidder is not a Manufacturer of PLC, he shall associate with a Vendor who shall satisfy the above Clause (a)

iv) For all civil items

(a) It should confirm to relevant Indian/international Standards.

(b) It should be of reputed makes supplied to similar construction / infrastructure projects.

(c) The Bidder should furnish documentary evidence to prove (a) and (b) above

v) For Cement:

(a) It should confirm to relevant Indian /International Standards.

(b) It should be of reputed makes supplied to similar construction/infrastructure projects.

(c) For Cement, minimum quantity of supply shall be 2500 MT for single project.

(d) The Bidder should furnish documentary evidence to prove (a), (b) and (c) above.

vi) For structural steel & reinforcement steel:

(a) The quality shall confirm to Indian Standard/International Standards.

(b) The Firm should have been in the market for a minimum period of 3 years as on the original date of Tender opening and should have supplied & used the structural steel/reinforced steel in any industrial project.

(c) For reinforcement steel- minimum quantity of supply & used shall be 1000MT for a single project.

(d) The Bidder should furnish documentary evidence to prove (a) (b) and (c) above

vii) For Structural steel (for use in civil & structural buildings only):

(a) The quality shall confirm to relevant Indian Standard/International standards.

(b) The firm should have been in the market for a minimum period of 3 years as on the original date of tender opening and should have supplied & used the structural steel in any industrial project.

(c) For Structural steel- minimum quantity of supply & used shall be 1000 MT for a single project.

(d) The Bidder should furnish documentary evidence to prove (a),(b) and (c) above.

viii) For Welding Electrodes:

(a) The welding electrodes should be confirming to AWS and related BIS.
(b) The Firm should have executed orders for the supply of electrodes for an order value not less than Rs. 3 lakhs in a calendar year for any or all sizes of the subject electrode within last three(3) years as on the original scheduled date of tender opening..
(c) The Bidder should furnish documentary evidence to prove (a) & (b) above

ACCEPTANCE CRITERIA FOR SUB CONTRACTORS

ix) For Mechanical and Electrical works:

Contractor to furnish documentary evidence to prove that similar mechanical / electrical erection and installation work had been carried out by the Sub contractor.

x) For Control and Instrumentation works:

(a) In case the C&I vendor is engaging a sub contractor for C&I works Documentation proof shall be furnished in the form of Bid award copy and performance certificate (End user's certificate) to show that similar C&I erection & installation activities were carried out and the job completed satisfactorily by the C&I sub contractor.

(b) For Control Room Architecture: The sub-contractor shall have already executed at least three (3) FGD plant Control Rooms for super critical units in India or abroad with similar operating parameters. Documentary proof shall be furnished for the same.

xi) For Civil & Structural works:

The main Contractor may engage one or more sub contractor for carrying out Civil & Structural works. However, the Civil sub-contractor shall have the following qualifying requirements.

For Civil Works:

a) He shall have experience in carrying out civil engineering works for Industrial buildings / equipment foundations / high-rise buildings (3 storeys and more) etc.,

b) He should have executed not less than 10000 Cu.M of R.C.C work in a single agreement.

c) The work in Sl. Nos (a) & (b) should have been completed within the past 7 years, as on the original scheduled date of tender opening.

d) Bidder to furnish necessary documentary evidence to prove the above requirements and get approval from the Purchaser, prior to engaging them for civil works.

For Structural works:

a) He shall have experience in carrying out structural engineering works for Industrial buildings / Power plant structures / high-rise buildings etc.,

b) Any structural steel works of quantity not less than 2000 MT in a single agreement.

c) The work in Sl. Nos (a) to (b) should have been completed within the past 7 years, as on the original scheduled date of tender opening.

d) Bidder to furnish necessary documentary evidence to prove the above requirements and get approval from the Purchaser, prior to engaging them for structural works.

LIST OF EQUIPMENTS – Mechanical

i) Class I items: Items for which Performance certificates shall be furnished for approval of Category II sub vendors during detail engineering

(a) Technological Items

Sl.No	Item Description	Sub Vendors
1.	Limestone Crusher	
2.	Bucket Elevator	
3.	Wet Ball Mills	
4.	Flue Gas Booster fans	
5.	Absorbers	
6.	Oxidation Air Compressors	
7.	All types of Limestone and Gypsum Slurry Pumps	
8.	Ball charging devices	
9.	All types of Hydrocyclones	
10.	Vacuum Belt filter	
11.	Vacuum Pumps	
12.	All types water, waste water and filtrate pumps	
13.	Limestone and Gypsum conveyor components	
14.	Waste water treatment system components	
15.	Seal Air Fans	

16.	All types of Vacuum/Pressure vessels	
17.	Mist Eliminator	
18.	Vibration Isolation System	

(b) Air Conditioning & Ventilation System

Sl. No	Item Description	Sub Vendors
1.	Air Conditioning System	
2.	Ventilation System	

(c) Handling & Hoisting

Sl. No	Item Description	Sub Vendors
1.	Elevators	
2.	Double Girder EOT Cranes	
3.	Single Girder Underslung Crane/EOT crane	

(d) DG Set

Sl. No	Item Description	Sub Vendors
1.	DG Set Assemblers.	

ii) Class II items: The documentary evidence for approval of Category II sub vendors shall be in the form of Material Receipt Certificate or Site Inspection Report, etc from the end user for having received the material by the end user.

(a) Technological Items

Sl. No	Item Description	Sub Vendors
1.	Flue Gas Dampers / Gates	
2.	Air and Flue Gas Ducting	
3.	Vibrating Feeders	
4.	Suspended Magnets	
5.	Belt Weighers	
6.	Weigh Belt feeders	
7.	Dry Fog Dust Suppression system	
8.	Dust Extraction system	
9.	Dust Suppression with Plain Water	
10.	Diesel engine	
11.	Slurry Tanks	
12.	Misc. Tanks	

13.	Ball Valves	
14.	Butterfly Valves	
15.	Steam Trap	
16.	Gate/Globe/ Non Return Valves	
17.	Rubber Expansion Joints	
18.	Safety Valve	
19.	Piping	
20.	Agitators	
21.	Strainers	
22.	Submersible Pumps	
23.	Sump Pumps	
24.	Air Release Valves	
25.	Aluminium sheet	
26.	Thermal Insulation	
27.	Welding electrodes	

(b) HANDLING & HOISTING

Sl. No	Item Description	Sub Vendors
1	Electric Hoists	
2.	Manual Hoists	

(c) Ventilation and Air conditioning

Sl. No	Item Description	Sub Vendors
1.	Split Air Conditioner/Package air conditioner.	

LIST OF EQUIPMENTS –Electrical

Class I items:

Sl. No	Item Description	Sub Vendors
1.	63MVA, 220/11KV FGD Transformer	
2.	Auxiliary Transformers (Oil Filled)	
3.	415 V Switchgear (PCC/PMCC/ MCC)	
4.	ACB	
5.	Auxiliary Relays	
6.	Battery Charger (FC/FCBC)	
7.	Electrical Actuators	
8.	Electro Mechanical Relays	
9.	H.T. Motors	
10.	H.T. Power Cables (XLPE)	
11.	HT Busduct (Segregated Phase)	
12.	HT Switchboard 11KV, 3.3KV	

13.	L.T. Motors (AC & DC)	
14.	Lighting Transformer	
15.	LT Busduct (Non-Segregated Phase)	
16.	LT Control Cables	
17.	LT Power Cables(XLPE)	
18.	LT Trailing Cables	
19.	LT Transformer (Dry Type)	
20.	MLDB/PDB/ACDB/WDB/ELDB / DCDB / LCP / LPBS / DCLDB	
21.	Neutral Grounding Resistors (NGR)	
22.	Numerical Protection Relays	
23.	Plante Battery	
24.	UPS	
25.	Variable Frequency Drive (VFD)	
26.	VCB	

II) Class II items:

Sl. No	Item Description	Sub Vendors
1.	AC/DC Control Contactors	
2.	AC/DC Power Contactors	
3.	Cable Glands	
4.	Cable Lugs	
5.	Cable Termination & Jointing Kits	
6.	Cable Trays	
7.	Control Transformers	
8.	Current Measuring Modules	
9.	Energy Meters/Multi Function Meters	
10.	High Mast	
11.	Intelligent Controllers	
12.	LED Lighting	
13.	Lighting Fixtures (Flame Proof)	
14.	Lighting Fixtures (General)	
15.	MCCB/MPCB/MCB	
16.	Meters (Analog/Digital)	
17.	Street Light Poles	
18.	Transducer	
19.	CT/PT	

LIST OF EQUIPMENTS – CONTROL & INSTRUMENTATION

Class – I items:

Sl. No	Item Description	Sub Vendors
1.	DDCMIS/PLC System	
2.	Vibration Monitoring System	
3.	Operating stations/Work Stations	
4.	Printers	
5.	Industrial Grade Ethernet Switches	
6.	Smart Transmitter (P, L, F, DP)	

Sl. No	Item Description	Sub Vendors
7.	Temperature Transmitter	
8.	Thermocouples/ RTDs	
9.	Level Transmitters (Displacer Type)	
10.	Level Transmitters (Ultrasonic, Radar type)	
11.	Flow Elements	
12.	pH Analyser	
13.	Sulphur Dioxide (SO_2) Analyzer	
14.	Instrument Cables	
15.	Thermocouple cable	
16.	Fibre optic cable	
17.	Control Valves with Smart Positioner	

Class II items:

Sl. No	Item Description	Sub Vendors
1.	Junction Boxes	
2.	LIE / LIR	
3.	Panels/ cabinets	
4.	Control desk, workstation tables, printer tables and chairs, file racks, document storages	
5.	Terminal Blocks	
6.	AC to DC Convertor (for Control cabinets)	
7.	Interposing Relays	
8.	Proximity sensor/switch	
9.	Pressure Gauges/DP Gauge	
10.	Temperature Gauges	
11.	Pressure & Differential Pressure Switches, Temperature Switches	
12.	Level Switches (Float , Displacer Type, Capacitance) & Level Gauges	
13.	Level Switches (RF type)	
14.	Level Switches (Conductivity type)	
15.	Flow Switch	
16.	Flow Meters (All type)	
17.	Sight Flow Indicator/Rota Meter	
18.	I/P Converters	
19.	Air Filter Regulator	
20.	Solenoid Valves	
21.	Power Cylinders	
22.	Industrial grade Firewall	
23.	Bulk Material Handling Switches like Pull cord, Zero speed, Belt sway, Chute block, etc.	

LIST OF EQUIPMENTS – Civil & Structural Supply Portion

a. Building Materials

Sl. No	Item Description	Sub Vendors
1.	Flush doors	
2.	Plywood products, particle boards	
3.	Steel doors, windows and ventilators / Pressed door, including accessories	
4.	Aluminium doors, windows, partitions	
5.	FRP Doors including all accessories	
6.	Water proofing compounds/construction chemicals	
7.	Paints and distempers	
8.	Hardware Fittings & Fixtures	
9.	Metallic Floor Hardener	
10.	Water Stops – (PVC/Rubber)	
11.	Expansion Joints	
12.	Water proof cement paints and exterior emulsion paints	
13	Metal cladding system & Metal deck plate for supporting RCC roof	
14	Glazing glass / Wired glass	
15.	Tiles	
16.	Hardeners	
17	PU Coating	
18	Plasticizer	
19	SS Pipes	
20	Door Closer	

b. Sanitary and Water Supply Work

Sl. No	Item Description	Sub Vendors
1.	PVC Pipes & UPVC Pipes and Specials	
2.	G.I. Pipes & Specials	

Sl. No	Item Description	Sub Vendors
3.	W.C. Pan Wash Basin, Urinals Sink Low down flushing Cistern & EWC	
4.	Colour/White Glazed Tiles, Heavy Duty Ceramic tiles and Vitrified Tiles.	

c. RCC Items

Sl. No	Item Description	Sub Vendors
1.	Cement	
2.	Reinforcement Steel	

d. Structural Steel

Sl. No	Item Description	Sub Vendors
1.	Structural Steel	

ANNEXURE –XII

OPERATION AND MAINTENANCE SERVICES

1.0 OPERATION AND MAINTENANCE SERVICES

The bidder scope also covers the Operation and Maintenance (O&M) services for Preventive and Breakdown maintenance from the date of successful commissioning upto 6 months. The date of start of O&M services shall be communicated to successful bidder by BHEL site personnel.

Bidder to note that the spares and consumables (except chemicals i.e. Lime, Organosulfide FeCL3 & PE) required for maintenance of the equipment during this O&M period shall be in bidder's scope of supply. Bidder shall use only genuine parts as mentioned in O&M Manual. Any damage or malfunction caused by the use of unauthentic parts or unqualified personnel shall be responsibility of bidder and as a consequence of above bidder is required to replenish the unauthorised part and abridge the qualified person without any commercial implication to BHEL.

O&M Services scope also covers all regular maintenance by trained service engineers and supply of genuine parts and lubricants as per the original equipment manufacturer's recommendations.

For the purpose of Operation of waste water treatment plant, One-day shall be considered as 24 hours i.e. 3 shifts of 8 hours each. The waste water treatment plant (along with related accessories) shall be operated on Round-the-clock basis on all the days including Sundays and Public Holidays meeting outlet guarantee parameter.

O & M Personnel should be acquainted with local language. Governmental / Statutory approval w.r.t. O&M service as applicable shall be in bidder's scope.

Total duration of the Operation and Maintenance services has been envisaged for Six (6) months for complete waste water treatment plant included in price format/specification. The duration of operation & maintenance services can be increased or decreased as per requirement and payment in such case shall be made on pro-rata basis.

The operation and maintenance services can be continuous or intermittent as per site requirement for complete waste water treatment plant identified in price format/specification.

Bidder has to compulsorily maintain log book for the O & M staff engaged for O&M jobs and submit to Engineer in charge for certification for realization of the bills. After certification of the bill by Engineer in charge of BHEL, bidder shall claim the amount after completion of minimum 30 days.

Depending on start of O&M services, there is a possibility that some period of O&M services and Warranty period may overlap. However, it is clarified that any maintenance required or any spare of waste water treatment plant required to be replaced during Warranty period (as part of warranty clause requirement) shall not be made part of O&M Services. Bidder may take care of this fact while working out the prices of O&M services.

The vendor shall deploy following minimum manpower for Operation of waste water treatment plant.

i. One qualified and experienced waste water treatment plant operator per shift on "Round the Clock" basis throughout the period for all the days including Sundays & Public Holidays.

There must be minimum 30 minutes overlapping between two shift operators to get familiarize with the status of waste water treatment plant.

ii. Two Helper per shift on " Round the Clock" basis throughout period for all the days including Sundays and Public Holidays. The helper shall assist the waste water treatment plant Operator in day to day operation of waste water treatment plant and accessories and shall assist him for keeping waste water treatment plant equipment's in neat and tidy condition.

iii. Wages of all manpower deployed for O&M shall be borne by bidder.

1.1 Responsibility of waste water treatment plant **Operator**

i. Waste water treatment plant operator shall be responsible for proper sequential operation including operation of standby equipment in a predefined sequence and stopping the same (when necessary) as per the procedural practice. In case of any abnormality (like non availability of power supply at incomer of plant), he shall immediately report the matter to BHEL site Engineer for further action. Similarly, any malfunctioning in the system shall be immediately resolved by operator with suitable corrective action irrespective of time of occurrence of malfunctioning / abnormality in the system in consultation with BHEL site Engineer. A log book of all such outrages shall be maintained by operator, which shall be shared with BHEL site engineer on periodic basis.

ii. Operator shall take reading of all the parameters periodically as per requirement which shall be mutually discussed and finalised with BHEL site engineer. However, the frequency of taking the reading may change based upon instruction from BHEL site Engineer. All the readings shall be recorded in a logbook register.

1.2 Responsibility of Helper.

i. The helper shall assist operator for day to day smooth operation. He shall be responsible for keeping all the equipment's in clean and tidy condition. He shall also carry out general cleaning of all equipment's including Electrical & Control Panels (Part of system), etc. on regular basis.

ii. The helper shall work under the control of operator and shall always ensure that unusable junk materials are not allowed to be kept in area. Under such eventuality, he will report the matter to Plant Operator, who in turn will take suitable action including reporting the matter to BHEL site Engineer.

1.2.1 All the log book registers shall be arranged by vendor. Log book register duly paged and bounded will be maintained in good condition by vendor.

1.2.2 All the necessary tools & tackles and other materials, required for operation shall be kept by vendor under the control of operator, which shall be handed over to customer in new condition. Required testing instruments should also be always available with Plant Operator.

1.2.3 In case of any operator / helper being on leave, vendor shall immediately take advance action and provide substitution so that minimum manpower as indicated above is not reduced on any day. In case a particular shift duty, Operator or helper does not turn up

due to any reasons, the earlier duty person shall continue to make sure that plant never remains unattended.

2.0 Maintenance of waste water treatment plant

i. Maintenance work under scope of the vendor shall broadly include but in no way limited to the following:

a) Preventive maintenance of the plant.

b) Servicing of equipment's at regular interval

c) Attending to complaints.

d) Replacement of worn out or defective components

e) Replacing of consumables like greases, oil, lubricants, servo fluids/control fluids, gases, reagents for analysers and etc as and when required.

No consumable or any other items of waste water treatment plant shall be arranged by Customer & BHEL and no extra payment shall be made by customer & BHEL in this regard.

ii. Vendor shall be responsible at all time, during the entire period of contract for satisfactory performance (including accessories) with zero down time. During emergency or breakdown, vendor's Engineer along with related technicians shall be available immediately even though it may be beyond normal working hours or on public holidays till the plant is restored back into normal satisfactory condition. Response time for attending breakdown complaints shall not exceed 2 hours.

iii. Defective / worn out components shall be replaced only by genuine and original parts. OEM or its authorized dealer's invoice shall be submitted as proof of using genuine parts. All common spares required for plant shall normally be kept available in the plant by the vendor. However, for critical spares, the same shall be made available in not more than 72 hours from the time of break-down requiring such spare.

iv. Preventive Maintenance, servicing of equipment's and accessories etc. shall be done by vendor in a planned manner in consultation with concerned BHEL engineer. Preventive maintenance and service should be done as per the recommendations / guidelines of various OEMs

v. Vendor shall arrange and maintain separate logbook register for services / maintenance. Record of work done for services/maintenance repairs etc. shall be recorded by vendor's engineer in this register. This register shall always be with updated records & shall be produced to BHEL engineer on weekly basis or as & when required by him.

vi. Vendor shall arrange and maintain sufficient stock of spares and consumable at site. Similarly, all necessary tools & instruments required for the purpose of servicing / maintenance / routine testing etc. shall also be arranged by vendor and should be available at site at all times.

vii. Repairs / servicing works shall normally be done by vendor at site up to maximum possible extent. However, in case any equipment or accessories is essentially required

to be taken by vendor out of the plant premises for repairing / servicing, all necessary arrangements including to and fro transportation shall be the responsibility of vendor. Vendor shall also inform concerned BHEL & customer's engineer for doing procedural formalities (like issue of gate pass etc.), prior to taking out the materials out of Plant premises.

viii. In case bidder fails to supply the spares required for maintenance of the equipment, same shall be provided by BHEL at Bidders risk and cost.

ix. Vendor shall be fully responsible for safety of his personal at all times. Vendor shall also be responsible for taking all safety precautions at all the times, especially during servicing / preventive maintenance and repairs.

x. Technicians & helpers engaged by the vendor shall wear uniform with nameplate for easy identification, while being within plant premises

xi. Vendor's engineer shall be focal point for BHEL & customer. He shall report to BHEL engineer on daily basis, for taking necessary instructions and to update the status of plant

xii. If any damage to the equipment and its accessories has happened due to improper maintenance by bidder, same shall be recovered from the bidder.

xiii. Bidder is to arrange all the safety gears like helmets, air plugs, safety shoes, googles, Personal Protection Equipment (PPE)] comprising PVC protection suits with hoods, rubber boots, face visors and thick PVC gauntlets shall also be provided by bidder etc. during the maintenance for the O&M Staff. The safety items are only over and above the safety items as included in safety items included in Section IA datasheet A.

xiv. Fabrication and erection of platform/extra support for maintenance of any type of equipment, if felt necessary during operation and maintenance of the system, has to be done by the bidder.

Notes:

1. The bidder shall take approval from Engineer-in charge of BHEL by submitting organization Chart of O&M staff for this site clearly indicating man power deployment with their educational background & experience with supporting documents.

2. The bidder shall be solely and wholly responsible for safety and security of workers engaged in the job and the BHEL property. In case of any accident the contractor shall pay proper compensation to the workers as per workmen's compensation act and repair/replace BHEL property at their own cost & arrangement. The bidder shall also make adequate provision of insurance for their workers at their own cost to cover them against the risk of accident.

3. The bidder and their workers engaged in the job shall follow all safety rules at the time of execution of work. It shall be responsibility of the bidder to supply all safety equipment as necessary to its O&M staff.
4. Beyond general shift if any trouble/breakdown occurs in the plant, Maintenance team must reach the plant without any delay along with Engineer/Site In-charge.
5. No Person from the list of manpower shall leave the plant site without prior permission from the Engineer in charge of BHEL.

6. However, in operation part, if any person is absent, substitute must be given immediately otherwise proportionate deduction will be made.
7. The replacement / substitute personnel for maintenance, manpower shall have the same educational qualification and experience.
8. If any additional manpower is required during O&M whatsoever under the scope of contract the same shall be made available by bidder in time within the cost. To cater the need of time bound maintenance jobs, the bidder shall depute additional manpower without any cost implication to BHEL
9. During execution of work if any personnel is found not suitable for the job or his presence inside premises is felt undesirable, the personnel has to be replaced within 15 days by bidder.
10. BHEL will not be responsible for payment towards idle labour charges

Statutory Compliance by the bidder:

All Statutory compliances related to Labour, Health & Safety, Quality & Environment protection and insurance shall be as GCC.

COPY RIGHT AND CONFIDENTIAL
The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED
it must not be used directly or indirectly in any way detrimental to the interest of the company.

DRAWING No. PE-DG-483-164-A001

CUSTOMER'S DRAWING No.

SERVICE WATER LINE

OVER HEAD SERVICE WATER STORAGE TANK

SERVICE WATER

FOR EQUIPMENT FLUSHING

LIME

RECIRCULATION LINE

AGITATOR (TYP.)

LIME DOSING TANK

40 NB

LIME DOSING PUMPS FOR GYPSUM DESATURATION TANK & TREATED WATER TANK 2X100%

FGD WASTE WATER INLET

80 NB

BHEL

BIDDER

GYPSUM DESATURATION CUM EQUALIZATION TANK

TO SLUDGE PIT

TO SLUDGE SUMP

FROM UNLOADING TANKER

CUSTOMER

FECL3 UNLOADING PUMPS 2X100%

FECL3 STORAGE TANK

ORGANOSULFIDE TANK

ORGANOSULFIDE DOSING PUMPS 2X100%

FECL3 DOSING TANK

FECL3 DOSING PUMPS 2X100%

SAFETY SHOWER CUM EYE FOUNTAIN

BIDDER

POTABLE WATER

BHEL

ORGANOSULFIDE REACTION TANK

COAGULANT TANK

SECONDARY CLARIFIER FEED PUMPS 2X100%

P.E. DOSING TANK

PRIMARY CLARIFIER 1X100%

PE DOSING PUMP(2X100%) FOR THICKENER AND CENTRIFUGE

PE DOSING PUMP(2X100%) FOR SECONDARY CLARIFIER

CLEAR WATER

CENTERIFUGE 1X100%

SOLID CAKE DISPOSAL (BY CUSTOMER)

SECONDARY CLARIFIER 1X100%

AIR BLOWERS (2X100% Cap)

FILTER

SILENCER

THICKENER

SLUDGE

TREATED WATER STORAGE TANK

TREATED WATER TRANSFER PUMPS 2X100%

TO OUTFALL LINE

THICKENED SLUDGE COLLECTION PIT

SLUDGE COLLECTION PIT

LEGEND

	GATE VALVE
	BALL VALVE
	BUTTERFLY VALVE
	PRESSURE RELIEF VALVE
	NON RETURN VALVE
	MOTOR OPERATED
	DIAPHRAGM VALVE NORMALLY OPEN / NORMALLY CLOSED
	'Y' TYPE STRAINER
	FUNNEL
LI	LEVEL INDICATOR
PG	PRESSURE GAUGE
LT	LEVEL TRANSMITER
	PLUG VALVE
	AIR LINE
	FLOAT VALVE
	AIR BLOWER
	CENTRIFUGAL PUMP
	SCREW PUMP HORIZONTAL
	DISSOLVING BASKET
	DOSING PUMP
	SCREW PUMP VERTICAL
FI	FLOW INDICATOR
FE	FLOW ELEMENT
	FILLING CONNECTION FOR CHEMICALS
TT	TEMPERATURE TRANSMITTER
TE	TEMPERATURE ELEMENT
AE	CONDUCTIVITY ANALYSER
AE	OIL ANALYSER
AE	COD BOD ANALYSER
AE	TURBIDITY ANALYSER
AE	TOTAL SUSPENDED SOLID ANALYSER
EQMS	EFFLUENT QUALITY MONITORING SYSTEM

NOTES.

1. PIPE LINE SIZE INDICATED ARE IN mm (NB).
2. MINIMUM REQUIREMENT OF VALVES, INSTRUMENTATION ETC. HAS BEEN SHOWN IN P&I DIAGRAM. BIDDER SHOULD FURNISH COMPLETE SCHEME IN ALL RESPECTS INCLUDING ALL INSTRUMENTS, VALVES ETC. FOR SMOOTH, SAFE, EFFICIENT,TROUBLE FREE OPERATION OF PLANT FOR BHEL / CUSTOMER APPROVAL DURING DETAILED ENGINEERING.
3. SUITABLE PERMANENT FLUSHING CONNECTION SHALL BE PROVIDED FOR ALL PIPELINES CARRYING SLUDGE AND CHEMICAL LINES. IN CASE, ADEQUATE PRESSURE IS NOT AVAILABLE, SEPARATE BOOSTER PUMPS (2X100%) SHALL BE PROVIDED BY BIDDER FOR THE SAME.
4. ALL THE PIPE AND VALVE SIZES AND ANY OTHER SIZES INDICATED IN THE DRAWING ARE MINIMUM REQUIREMENT. PIPE & VALVES SIZES SHELL BE INCREASED WHERE EVER REQUIRED TO MEET THE SYSTEM REQUIREMENT.
5. ALL EQUIPMENT, PIPING SHOWN IN THIS P & ID ARE IN BIDDERS SCOPE UNLESS OTHERWISE EXCLUSIVELY EXCLUDED.
6. OVER FLOW & DRAINS FROM VARIOUS CHEMICAL TANKS & FLOOR WASH DRAINS OF CHEMICAL HOUSE BUILDING SHALL BE LED TO CLARIFIER SLUDGE SUMP.
7. THE INSTRUMENTS, VALVES, PIPING, FITTINGS, ETC SHOWN IN P & ID ARE MINIMUM. THE ADDITIONAL VALVES, INSTRUMENTS, PIPING, FITTINGS ETC. SHALL ALSO BE INCLUDED AS INDICATED ELSEWHERE IN THE SPECIFICATION & BASED ON SYSTEM REQUIREMENT. THE P&ID TO BE READ IN CONJUNCTION WITH THE TECHNICAL DETAILS SPECIFIED IN OTHER PART OF TECHNICAL SPECIFICATION.

REV	DATE	ALTD	CHD	APPD

REV	DATE	ALTD	CHD	APPD

JOB No. 483

STATUS CONTRACT

DISTRIBUTION

TO

No.OFF

PROJECT

NTPL 2X500 MW FGD PROJECT

ENGG / SUB CONTRACTOR

BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

DEPT CODE		NAME	SIGN	DATE
A	DRN	DK		02-7-2021
	DESN	VS		02-7-2021
	CHD	AKS/ JP		02-7-2021
	APPD	SB		02-7-2021

TITLE

P& ID FOR WASTE WATER TREATMENT PLANT

MPL	C	MSE	I	MAX	E	DEPT.
						SIGN
						DATE

SCALE NTS

DRAWING No. PE-DG-483-164-A001

SHEET 01 OF 01 REV 00

SIZE-A1

COMPUTER FILE NAME :

DATASHEET-A

(FGD- WASTE WATER TREATMENT PLANT)

DATA SHEET – A

1.	**GYPSUM DESATURATION CUM EQUALISATION TANK**	
1.1	Number required	One (1) No.
1.2	Material of construction & Type	RCC & Vertical with rectangular bottom
1.3	Effective Capacity	21 m^3, Retention time: 1hr
1.4	Agitator along with drive motor and all other accessories	One (1) No, MOC :SS316L
2.	**CLARIFIERS HRSCC (HIGH RECOVERY SOLID CONTACT CLARIFIER)**	
2.1	Number	One (1) [(1X100%) number] PRIMARY One (1) [(1X100%) number] SECONDARY
2.2	Capacity	Primary Clarifier -21 Cum/Hr (Inlet to clarifier) Secondary Clarifier-As per system requirement (output of primary clarifier)
2.3	Type	High Rate Solids Contact Type Clarifier (HRSCC).
2.4	MOC	RCC
2.5	Side water depth	Minimum 3 Meter (approx.) or as per supplier's recommendation, whichever is higher
2.6	Rise rate	Based on system requirement but not exceeded 3 m3/ m2/ hr.
2.7	MOC of pipe from inlet channel to clarifier	HDPE pipe encased with concrete for buried portion.
2.8	Sludge Blow Off	By gravity through telescopic stand-pipe for continuous discharge and through manual operated blow-off valve for intermittent.
2.9	Sludge Blow Off- Pipe Material	CI class A as per IS: 1536
2.10	Platform with hand railing	Shall be provided by bidder (1 meter wide all along HRSCC)
2.11	Rake bridge	Shall be provided by bidder
2.12	**CLARIFIER SCRAPPERS**	
2.12.1	Number required	One per clarifier.
2.12.2	Material	Mild steel (MS) with 5 mm FRP coating (poly vinyl ester resin) on wetted parts.
2.12.3	Traction drive	Slow speed motor driven through reduction gear unit or VFD as per manufacturer's std.
2.13	**SUITABLE ACCESSORIES**	
2.13.1	Access ladder, platform, staircase, hand railings etc.	Shall be provided by bidder
2.13.2	Walkway	Shall be provided by bidder with hand railings around launder periphery of width 1000 mm.
2.13.3	Electrical requirements	For each HRSCC, one (1) Distribution Board to be located on HRSCC bridge for all drives of HRSCC bridge assembly.
3.	**ORGANOSULFIDE REACTION TANK**	
3.1	Number required	One (1) No.
3.2	Material of construction	RCC & Vertical with rectangular bottom with Acid alkali resistant tiling/ lining inside
3.3	Capacity	11.5 m3, Retention time: 30min
3.4	Agitator along with drive motor, reduction gear and all other accessories	One (1) No, MOC: SS316L

4.	**COAGULATION TANK**	
4.1	Number required	One (1) No.
4.2	MOC & Construction type	RCC, Vertical with rectangular bottom
4.3	Capacity	To suit system requirement, Retention time: 20min
4.4	Agitator along with drive motor, reduction gear and all other accessories	One (1) No, MOC : CS with 3 mm FRP coating (poly vinyl ester resin) on wetted parts.
5.	**SLUDGE COLLECTION PIT**	
5.1	Number	One (1) with two compartments (Underground)
5.2	Effective Capacity	1 hr holding of sludge of each compartment
5.3	Dimension	Suitable
5.4	Material	RCC
6.	**AIR BLOWER FOR SLUDGE COLLECTION PIT &THICKENED SLUDGE COLLECTION PIT**	
6.1	Number	Two (1W+1S)
6.2	Type	Centrifugal /Twin Lobe Type
6.3	Duty	Intermittent
6.4	Capacity & Head	As required
6.5	MOC of casing and lobes	CI as per IS 210 FG 260
6.6	MOC of shaft	Carbon steel BS-970 En-8/ANSI-I045
6.7	Accessories Required	Acoustic Enclosures. Suction Filter, Silencer, relief Valve etc
6.8	Location	Outdoor
7.	**THICKENER**	
7.1	Type	Circular (Center Drive Mechanism).
7.2	Number of units	1 no., Above ground
7.3	Capacity	As per system requirement
7.4	MOC of Thickener	RCC
7.5	Full bridge	MOC: MS Epoxy
7.6	Scrapper rake	Mild steel (MS) with 5 mm FRP coating (poly vinyl ester resin) on wetted parts.
7.7	Torque switch for alarm and for tipping	Shall be Provided by bidder
8.	**THICKENED SLUDGE COLLECTION PIT**	
8.1	Number	One (1) with two compartments (Underground)
8.2	Capacity (effective)	1 hr holding of sludge each compartment
8.3	Dimension	Suitable
8.4	Material	RCC
9.	**CENTRIFUGE**	
9.1	No. Of units	1No. (1x100%)
9.2	Capacity	As Required
9.3	Screening at inlet	Required
9.4	• Centrate	To be discharged at thickener inlet
	• Drive	Hydraulic coupling to dampen the initial acceleration.

9.5	**MOC**	
9.6	Bowl & scrapper material	Duplex SS (Minimum S32205)
9.7	All wetted parts	
10.	**TREATED WATER STORAGE TANK**	
10.1	Number	One (1), above ground
10.2	Effective Capacity Minimum	82 m3
10.3	Material	MS Rubber lined (MSRL)
11.	**CHEMICAL HOUSE**	
11.1	Number	One (1)
11.2	Type	One storey building of civil construction.
11.3	Building dimensions	As per requirement
11.4	Details of Chemical House	Single storey building to house MCC, control room, toilet block, chemical storage area & dosing facility
12.	**OVERHEAD TANK**	
12.1	Number	One (1).
12.2	Type	RCC, Above ground, On top of chemical house
12.3	Capacity	12 hour Water requirement for chemical preparation for clarifiers, centrifuge & thickener, flushing of pumps, sludge & chemical lines, along with overall 20% margin
13.	**WEIGHING SCALE FOR CHEMICAL**	
13.1	Type	Platform & dial type./electronic type
13.2	Number	One of 0-500 Kg
14.	**ELECTRIC HOIST FOR CHEMICAL HOUSE**	
14.1	Type	Electric operated with trailing cable
14.2	Number	One(1).
14.3	Capacity	2 T
14.4	Design Standard	IS:3938 Class 2
15.	**CHEMICAL DOSING**	
15.1	**$FeCl_3$ DOSING SYSTEM (@ 40 ppm)**	
	a) FeCl3 storage Tank	Number-One (1) number with 2 nos. 80 NB hose pipe 10 meter each. Capacity- Tanks shall be sized for 30days requirement, Material of construction- MSRL (Design code BS-EN 12285-part 2) Type: Horizontal cylindrical
	b) FeCl3 dosing Tank	Number-One (1) number Capacity- tank shall be sized for 8 hrs requirement, Material of construction- FRP/PP Agitator along with drive motor and all other accessories One (1) no., MOC : MS FRP
	c) FeCl3 dosing pump	Number-Two(2)nos., (1W+1S), Type: Positive displacement pump, Capacity: To suit system requirement, MOC: PP
15.2	**PE DOSING SYSTEM (@2ppm)**	
	a) PE dosing tanks	One (1) No. Adequate to hold the quantity required for 8 hours of simultaneous operation of Secondary clarifier, thickener & centrifuge with 2 ppm dosing with a solution strength of 2%.,MOC: FRP/HDPE/PP, Agitator along with drive motor and all other accessories : One (1) No, MOC: SS316L
	b) PE dosing pumps	Number- Two (2) numbers (1W+1S) common for Thickener and

		Centrifuge Number- Two (2) numbers (1W+1S) for Secondary clarifier Positive displacement type, Capacity: To suit system requirement, MOC: All wetted parts SS 316.		
15.3	**LIME PREPARATION & DOSING SYSTEM**			
	a) Lime Dosing Tank	Number-One (1) number lime solution dosing tanks. Capacity- To hold lime solution (of about 6% W/V concentration) for 8 hours requirement of all the clarifiers operating at its design capacity and treated water tank. Design dosage rate of 1500 ppm minimum. Material- RCC. with two (2) coats of bitumastic paint over two (2) coats of primer. Dissolving basket -SS 316, Motorized Stirrer (MOC (impeller & Shaft)-SS316L)		
	b) Pump	Number- Two (2) numbers (1W+1S) lime solution dosing pump. To cater requirement of gypsum desaturation cum treated water storage tank, Type – Horizontal screw pump, Capacity- As per system requirement. MOC: SS316 (All Wetted parts)		
15.4	**ORGANOSULFIDE DOSING SYSTEM (@ 10 ppm)**			
	a) Organosulfide dosing Tank	Number- One (1) number. Capacity- To hold coagulant for 8 hours requirement of all the clarifiers operating at design capacity and a design dosage rate of 2 ppm minimum. Material- PP/HDPE/MSRL, Motorized Stirrer (MOC (impeller & Shaft)-SS316L- One (1) number		
	b) Organosulfide dosing pump	Number-Two(2) nos., (1W+1S), Type: Positive displacement pump, Capacity: To suit system requirement, MOC: PP		
16.	**MATERIAL OF CONSTRUCTION OF PIPING AND FITTINGS**			
16.1	MOC of Piping and fittings of handling waste water	HDPE		
16.2	MOC of Piping and fittings of Chemical dosing	CPVC Sch 80, Minimum PN10/ 150 class		
16.3	a) MOC of Piping of Service Water	Above 150 mm NB	Below 150 mm NB	
		IS-3589 with minimum pipe thickness of 6 mm	IS-1239 Heavy Grade	
	b) MOC of Fittings of Service Water	Pipe Sizes > 65 mm NB	Pipe Sizes < 50 mm NB	
		ASTM-A-234 Gr. WPB	ASTM-A-105 or as compatible with IS:1239	
16.4	a) MOC of Piping of Service and instrument Air	Above 150 mm NB	Below 80 mm NB	
		Stainless steel as per ASTM A-312 Gr. 304 as per schedule 10S, ANSI B-36.19.	Stainless Steel as per ASTM A-312 Gr. 304 as per schedule 40S ANSI B36.19	
16.5	b) MOC of Fittings of Service and instrument Air	Above 150 mm NB	Below 80 mm NB	
		ASTM-A-351-CF8 or ASTM-A-403 WP304	ASTM-A-182 F304	
17.	**MATERIAL OF CONSTRUCTION OF VALVES**			
17.1	MOC of Valves for waste water handling application	Duplex Stainless Steel (Minimum S32205)		
17.2	MOC of Valves for Chemical dosing	CPVC Minimum PN10/ 150 class		
17.3	MOC of Service and Instrument Air.	Stainless steel body Ball/ Check Valve		
17.4	MOC of Service water	Less than equal to 50NB	For 65mm NB to 300mm NB	Above 300mm NB
17.5		Steel body gate/globe/Check	Cast iron body Gate/Globe/Check	Cast iron body butterfly valve

		valve	valve		
18.	**MOC and type of the pumps shall be as per the following details:**				
	Pump Description	**Quantity**	**Pump Type**	**Capacity (min)**	**Material of Construction**
18.1	Treated water transfer pumps	Two (2X100%)	Horizontal centrifugal pump, Impeller type: Closed	Flow: 30 CuM/Hr. (each). Head: 90 MWC (minimum)	Casing: Duplex SS (Minimum S32205) Wearing rings/Neck rings: Duplex SS (Minimum S32205) Wetted Fasteners (Nut,bolt etc): Duplex SS (Minimum S32205) Impeller: Duplex SS (Minimum S32205) Shaft: Duplex SS (Minimum S32205)
18.2	Thickener feed pumps	Two (2X100%)	Vertical Screw pump	Flow: As per system requirement, Head: As per system requirement,	Casing: Duplex SS (Minimum S32205) Wetted Fasteners (Nut,bolt etc): Duplex SS (Minimum S32205) Wetted parts): Duplex SS (Minimum S32205)
18.3	Centrifuge feed pumps	Two (2X100%)	Vertical Screw pump	Flow: As per system requirement, Head: As per system requirement,	Casing: Duplex SS (Minimum S32205) Wetted Fasteners (Nut,bolt etc): Duplex SS (Minimum S32205) Wetted parts): Duplex SS (Minimum S32205)
18.4	Secondary clarifier feed pump	Two (2X100%)	Horizontal centrifugal pump Impeller type: Closed	Flow: 21 CuM/Hr. (each). Head: As per system requirement,	Casing: Duplex SS (Minimum S32205) Wearing rings/Neck rings: Duplex SS (Minimum S32205) Wetted Fasteners (Nut,bolt etc): Duplex SS (Minimum S32205) Impeller: Duplex SS (Minimum S32205) Shaft: Duplex SS (Minimum S32205)
18.5	$FeCl_3$ unloading pump	Two (2X100%)	Horizontal Centrifugal Type	Capacity 10 Cum/ hr. and Head :20MWC	all wetted parts PP/PTFE

TECHNICAL DATA SHEET:

ELECTRIC HOIST:

Sl. No.	DESCRIPTION	TECHNICAL PARTICULARS
1.0	Type	Steel wire electric hoist with electrically operated trolley as per IS 3938. Class 2 duty(Indoor duty)
2.0	Type of service	Indoor
3.0	Design ambient temperature	50 Deg C
4.0	Operating speed	
4.1	Hoisting speed	3 M/min
4.2	Trolley speed	15 M/min
5.0	Type of transmission	Through electric motor and gear box
6.0	Wire rope	
6.1	Construction/ core	6x36 construction, fibre core
6.2	Code	IS: 2266
6.3	Number of falls	Min. 4
6.4	Factor of safety	Not less than 5.
7.0	Load hook and block	Normalized hook only.
7.1 **R1**	Type of load hook	Shank type swiveling with safety latch
7.2	Load hook code	IS: 15560
7.3	Load hook material	Forged steel
7.4	Hook suspension	Thrust bearing
7.5	Material of block suspension	Fabricated from steel plate, Material: IS: 2062
8.0	Gearing	
8.1	Type	Spur/ Helical
8.2	Gear material	Gear: EN 9/ 55C8/20MnCr5 Pinion: EN19/EN24/45C8/55C8
8.3	Lubrication	Oil splash/ grease lubricated
8.4	Bearing type	Antifriction ball/ roller
9.0	Trolley drive	
9.1	Wheel	Single flanged taper thread
9.2	Wheel confirm to (Std./ Code)	IS: 3938
9.3	Wheel material	Forged steel.
9.4	Bearing type	Antifriction ball/ roller
9.5	Hardness	Max. HARDNESS 200 BHN
10.0	SHEAVE	
10.1	Material	Fabricated from cast steel/ steel plate IS: 2062 GR A/B or B/ CS GR 280-520 IS: 1030/ as per IS: 3938
10.2	Bearing type	Antifriction ball/ roller
11.0	BRAKE (HOIST & TROLLEY)	
11.1	Type	DCEM brakes disc/ shoe type (fail to safety).
11.2	Capacity	As per IS: 3938.
11.3	Number	One number for each motor.
11.4	RATING	150% of rated torque for hoisting 100% of rated torque for travelling
12.0	ROPE DRUM	Drum shall have minimum one spare groove when this hook is at its highest position.
12.1	Material	Fabricated from carbon steel as per IS: 2062, GR B and stress relieved/ seamless pipe as per ASTM A106/ 53 GR A/B.
12.2	Flange/ Flangeless	Flanged

13.0	DSL	Shrouded bus bar GI conductor type DSL	
14.0	MOTORS		
14.1	Rating	Motor ratings shall be 15% over the maximum power requirement. Service class of motor shall be “4” as per IS 3938.	
14.2	Type	Sq. cage induction, TEFC, S4 duty, 40% CDF.	
14.3	Number of start	150 starts/hr.	
14.4	Voltage, phase and frequency	415V +/- 10%, 3 phase, 50 Hz, 4 wire.	
14.5	Class of insulation	Class “F” and temperature rise limited to class B.	
14.6	Type of enclosure	TEFC	
14.7	Degree of protection provided for enclosure	IP-55	
15.0	LIMIT SWITCHS (automatic reset type)	Hoisting	Trolley
15.1	Type	Snap action type	Two way lever type
15.2	Degree of protection	IP-55	
16.0	Pendent push button	Up /down / forward / Reverse push buttons along with Start/stop and emergency push button shall be provided on the pendent. Indicative marking for easy operation shall be provided.	
17.0	Control transformer	One no. for each hoist (1x100%)	
18.0	Isolating switch	One No. isolating switch shall be provided for each electric hoist. Location of isolating switch shall be at respective operating floor of the area.	
19.0 **R1**	Power cables	1100 V grade PVC insulated stranded aluminium conductor cable of suitable size not less than 2.5 sq.mm nominal equivalent copper area of cross-section.	
20.0	Control cable	All control and auxiliary circuit wiring shall be done with 1100 V grade PVC insulated, 2.5 sq.mm stranded copper conductor.	
21.0	Control panel		
21.1	Material & Size	Protective and control panels shall have IP-54 gasketed enclosure, fabricated from sheet steel, minimum 2 mm thick, suitably reinforced to provide structural rigidity.	
21.2	Location	Mounted with respective hoists.	
22.0	Control voltage	110 V	
23.0	Painting	As per manufacturing standard	

MANUAL HOIST

- Design and duty of main hoist & cross travel machinery shall be in accordance with class-2 as per IS: 3832 (latest edition), for indoor duty application.
- Hook shall be plain shank type and shall conform to IS 15560.
- The hook shall be Swiveling type fitted with a locking device.
- The chain pulley block shall be fitted with an automatic mechanical ratchet and pawl arrangement to prevent self- lowering of load.
- The chain pulley blocks shall be with or without the travelling trolley depending upon the layout requirement and intended use.
- Hoisting and travel motion (if applicable) shall be thru endless chains.
- Equipment shall be designed for operation in non- hazardous area.
- Load chain (where applicable) shall be of grade T(8) as per IS:6216 and Hand chain shall be as per IS:2129 (Part-I) grade 30.
- Trolley frame - Cast steel / Mild steel
- Gears (Trolley) -Machine cut cast steel / Forged steel / C40 / C50 as per IS 3681/4460
- Trolley wheel- Forged / cast steel / C40 with minimum 200BHN and single flanged to suit standard I beam section.

- Brake - Screw and disc friction type /Ratchet & pawl type
- Painting shall be as per manufacturer's standard
- Hoisting effort for hoists up to 3 tones capacity shall not be more than 20 kg.
- Effort for trolley motion for hoists upto 3 tonnes capacity shall not be more than 43 Kg.

FIRST ANGLE PROJECTION

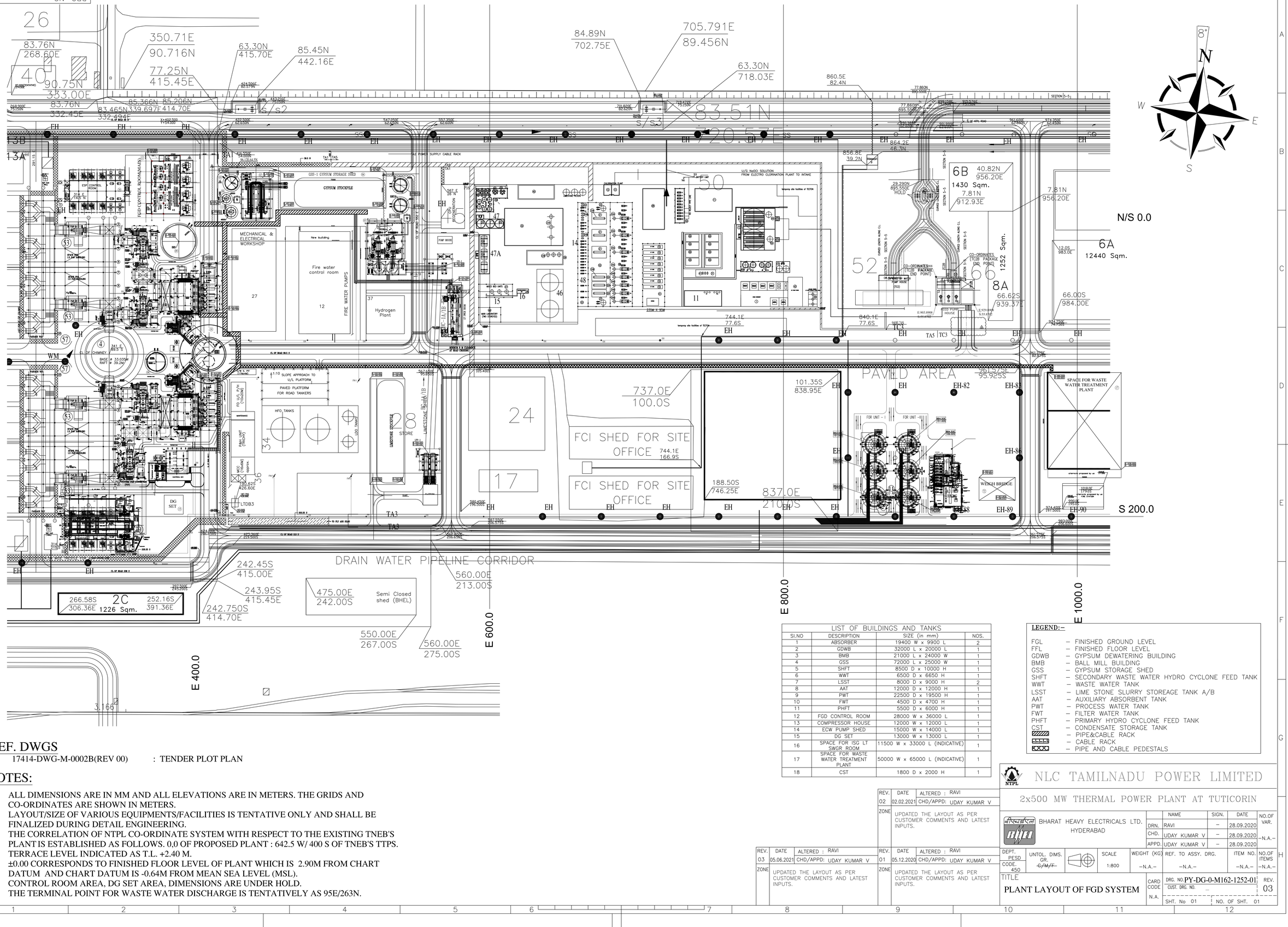
(ALL DIMENSIONS ARE IN mm)

DRG. NO. PY-DG-0-M162-1252-01

SHT. 1 OF 1

THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY

GENERAL DIMENSIONAL LIMITS,FITS & TOLERANCES AS PER HY0230261



REF. DWGS

1. 17414-DWG-M-0002B(REV 00) : TENDER PLOT PLAN

NOTES:

1. ALL DIMENSIONS ARE IN MM AND ALL ELEVATIONS ARE IN METERS. THE GRIDS AND CO-ORDINATES ARE SHOWN IN METERS.
2. LAYOUT/SIZE OF VARIOUS EQUIPMENTS/FACILITIES IS TENTATIVE ONLY AND SHALL BE FINALIZED DURING DETAIL ENGINEERING.
3. THE CORRELATION OF NTPL CO-ORDINATE SYSTEM WITH RESPECT TO THE EXISTING TNEB'S PLANT IS ESTABLISHED AS FOLLOWS. 0,0 OF PROPOSED PLANT : 642.5 W/ 400 S OF TNEB'S TTPS.
4. TERRACE LEVEL INDICATED AS T.L. +2.40 M.
5. ±0.00 CORRESPONDS TO FINISHED FLOOR LEVEL OF PLANT WHICH IS 2.90M FROM CHART DATUM AND CHART DATUM IS -0.64M FROM MEAN SEA LEVEL (MSL).
6. CONTROL ROOM AREA, DG SET AREA, DIMENSIONS ARE UNDER HOLD.
7. THE TERMINAL POINT FOR WASTE WATER DISCHARGE IS TENTATIVELY AS 95E/263N.

LIST OF BUILDINGS AND TANKS

SI.NO	DESCRIPTION	SIZE (in mm)	NOS.
1	ABSORBER	19400 W x 9900 L	2
2	GDWB	32000 L x 20000 L	1
3	BMB	21000 L x 24000 W	1
4	GSS	72000 L x 25000 W	1
5	SHFT	8500 D x 10000 H	1
6	WWT	6500 D x 6650 H	1
7	LSST	8000 D x 9000 H	2
8	AAT	12000 D x 12000 H	1
9	PWT	22500 D x 19500 H	1
10	FWT	4500 D x 4700 H	1
11	PHFT	5500 D x 6000 H	1
12	FGD CONTROL ROOM	28000 W x 36000 L	1
13	COMPRESSOR HOUSE	12000 W x 12000 L	1
14	ECW PUMP SHED	15000 W x 14000 L	1
15	DG SET	13000 W x 13000 L	1
16	SPACE FOR ISG LT SWGR ROOM	11500 W x 33000 L (INDICATIVE)	1
17	SPACE FOR WASTE WATER TREATMENT PLANT	50000 W x 65000 L (INDICATIVE)	1
18	CST	1800 D x 2000 H	1

LEGEND:–

FGL	– FINISHED GROUND LEVEL
FFL	– FINISHED FLOOR LEVEL
GDWB	– GYPSUM DEWATERING BUILDING
BMB	– BALL MILL BUILDING
GSS	– GYPSUM STORAGE SHED
SHFT	– SECONDARY WASTE WATER HYDRO CYCLONE FEED TANK
WWT	– WASTE WATER TANK
LSST	– LIME STONE SLURRY STOREAGE TANK A/B
AAT	– AUXILIARY ABSORBENT TANK
PWT	– PROCESS WATER TANK
FWT	– FILTER WATER TANK
PHFT	– PRIMARY HYDRO CYCLONE FEED TANK
CST	– CONDENSATE STORAGE TANK
	– PIPE&CABLE RACK
	– CABLE RACK
	– PIPE AND CABLE PEDESTALS

REV.	DATE	ALTERED : RAVI
02	02.02.2021	CHD/APPD: UDAY KUMAR V
ZONE	UPDATED THE LAYOUT AS PER CUSTOMER COMMENTS AND LATEST INPUTS.	

REV.	DATE	ALTERED : RAVI
03	05.06.2021	CHD/APPD: UDAY KUMAR V
ZONE	UPDATED THE LAYOUT AS PER CUSTOMER COMMENTS AND LATEST INPUTS.	

REV.	DATE	ALTERED : RAVI
01	05.12.2020	CHD/APPD: UDAY KUMAR V
ZONE	UPDATED THE LAYOUT AS PER CUSTOMER COMMENTS AND LATEST INPUTS.	

NTPL

NLC TAMILNADU POWER LIMITED

2x500 MW THERMAL POWER PLANT AT TUTICORIN

BHARAT HEAVY ELECTRICALS LTD. HYDERABAD

	NAME	SIGN.	DATE	NO.OF VAR.
DRN.	RAVI	–	28.09.2020	–N.A.–
CHD.	UDAY KUMAR V	–	28.09.2020	
APPD.	UDAY KUMAR V	–	28.09.2020	

DEPT.	UNTOL. DIMS.	SCALE	WEIGHT (KG)	REF. TO ASSY. DRG.	ITEM NO.	NO.OF ITEMS
PESD	GR.	1:800	–N.A.–	–N.A.–	–N.A.–	–N.A.–
CODE. 450	~~C/M/F~~					

TITLE: PLANT LAYOUT OF FGD SYSTEM

CARD CODE: N.A.

DRG. NO. PY-DG-0-M162-1252-01 REV. 03

CUST. DRG. NO. –

SHT. No 01 NO. OF SHT. 01

SUBSECTION-IB

SPECIFIC TECHNICAL REQUIREMENTS (ELECTRICAL)

1.0 **EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:**

a) Services and equipment as per "Electrical Scope between BHEL and Vendor".

b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The same shall be provided by the bidder without any extra charge.

c) Supply of mandatory spares as specified in the specifications of mechanical equipments.

d) Electrical load requirement for WASTE WATER TREATMENT PLANT **.**

e) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.

f) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer/BHEL approval without any commercial and delivery implications to BHEL

g) Various drawings, data sheets as per required format, Quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc shall be furnished as specified at contract stage. All documents shall be subject to customer/BHEL approval without any commercial implication to BHEL.

h) Motor shall meet minimum requirement of motor specification.

i) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.

2.0 **EQUIPMENT & SERVICES TO BE PROVIDED BY PURCHASER FOR ELECTRICAL & TERMINAL POINTS:**

Refer "Electrical Scope between BHEL and Vendor".

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

3.1 The electrical specification without any deviation from the technical/quality assurance requirements stipulated shall be deemed to be complied by the bidder in case bidder furnishes the overall compliance of package technical specification in the form of compliance certificate/No deviation certificate.

3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer.

4.0 List of enclosures :

a) Electrical scope between BHEL & vendor

b) Customer specification for Motors

c) Customer cabling spec (to be referred by vendor for their scope of work (as per Electrical scope between BHEL & vendor)).

d) Quality plan for motors & Customer quality assurance plan format

e) Datasheet A and C for LT Motors (Annexure-I)

f) Electrical Load data format (Annexure –II)

g) BHEL cable listing format (Annexure –III)

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGES: WASTE WATER TREATMENT PLANT

SCOPE OF VENDOR: SUPPLY & SUPERVISION OF VENDOR'S EQUIPMENT

PROJECT: 2X500MW NTPL TUTICORIN FGD

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415 V Switchgear	BHEL	BHEL	For all LT motor & Auxiliary supply, 415 V AC (3 ph. 4 wire)/240 V AC (supply feeder) shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor.
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motor.
3	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	 BHEL BHEL BHEL	 BHEL Vendor BHEL	1. For 3.b) & c): Sizes of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL) in the form of cable listing. Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Termination at BHEL equipment terminals by BHEL. 3. Termination at Vendor equipment terminals by Vendor.
4	Junction box for control & instrumentation cable	Vendor	Vendor	Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 10-12 mtrs) and trunk cable.
5	Any special type of cable like compensating, co-axial, prefab, MICC etc.	Vendor	Vendor	
6	Cable trays, accessories & cable trays supporting system 100/ 50 mm cable trays/ Conduits/ Galvanised steel cable troughs for local cabling	BHEL Vendor	BHEL Vendor	Local cabling from nearby main route cable tray (BHEL scope) to equipment terminal (vendor's scope) shall be through 100/ 50 mm. cable trays/ conduits/ Galvanised steel cable troughs, as per approved layout drawing during contract stage.
7	a. Cable glands b. Lugs and bimetallic strip for equipment supplied by Vendor	Vendor Vendor	Vendor Vendor	a. Double compression Ni-Cr plated brass cable glands b. Solder less crimping type heavy duty tinned copper lugs for power and control cables.
8	Conduit and conduit accessories for cabling between equipment supplied by vendor	Vendor	Vendor	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537.
9	Lighting	BHEL	BHEL	

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGES: WASTE WATER TREATMENT PLANT
SCOPE OF VENDOR: SUPPLY & SUPERVISION OF VENDOR'S EQUIPMENT
PROJECT: 2X500MW NTPL TUTICORIN FGD

10	Equipment grounding (including electronic earthing) & lightning protection	BHEL	BHEL	
11	Below grade grounding	BHEL	BHEL	
12	LT Motors with base plate and foundation hardware.	Vendor	Vendor	Makes shall be subject to customer/ BHEL approval at contract stage.
13	Mandatory spares	Vendor	-	Vendor to quote as per specification.
14	Recommended O & M spares	Vendor	-	As specified elsewhere in specification
15	Any other equipment/ material/ service required for completeness of system based on system offered by the vendor (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	
16	a) Input cable schedules (Control & Screened Control Cables) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable and electronic earthing cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
17	Electrical Equipment & cable tray layout drawings	Vendor	-	Vendor to furnish drawing (both in print form as well as in AUTOCAD) of WWTP bldg layout clearly indicating all motors, panels, JB's etc. which require cabling along with their terminal box/location/ Foundation etc.
18	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

NOTES:

1. Make of all electrical equipment/ items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.
3. In case the requirement of Junction Box arises on account of Power Cable size mis-match due to vendor engineering at later stage, vendor shall supply the Junction Box for suitable termination.

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
		CUSTOMER :		QP NO.: PE-QP-999-Q-006, REV-02	DATE: 17.04.2020
		PROJECT:		PO NO.:	DATE:
		ITEM: AC ELECT. MOTORS UPTO 55KW (LV (415V))	SYSTEM:	SECTION: II	SHEET 1 of 2

S. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	*	AGENCY			REMARKS
1	2	3	4	5	6		7	8	9	D	**			
					M	C/ N					M	C	N	
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	-	MFG. SPEC.	MFG. SPEC.	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	VISUAL	100%	-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	LOG BOOK		P	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	-	MFG.SPEC./	MFG.SPEC.	LOG BOOK		P	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	-	MFG. SPEC/ APPROVED DATASHEET	MFG. SPEC/ APPROVED DATASHEET	LOG BOOK	✓	P	V	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST	MA	VISUAL	100%	-	IS-325 / IS-12615/ APPROVED DATA SHEET	IS-325 / IS-12615/ APPROVED DATA SHEET	TEST/ INSPN. REPORT	✓	P	V *	-	* NOTE -1
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	-	APPROVED DRG/ DATA SHEET	APPROVED DRG/ DATA SHEET	TEST/ INSPN. REPORT	✓	P	V *	-	* NOTE -1 & NOTE-2

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KUSHWAHA	Checked by:	Kunal Gandhi	KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	RITESH KUMAR JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:
		CUSTOMER :		QP NO.: PE-QP-999-Q-006, REV-02	DATE: 17.04.2020
		PROJECT:		PO NO.:	DATE:
		ITEM: AC ELECT. MOTORS UPTO 55KW (LV (415V))	SYSTEM:	SECTION: II	SHEET 2 of 2

		3.NAMEPLATE DETAILS	MA	VISUAL	100%	-	IS-325 / IS-12615 / APPROVED DATA SHEET	SAME AS COL. 7	TEST/ INSPN. REPORT	✓	P	V	-	
4.0	PACKING	SURFACE FINISH & COMPLETENESS	MA	VISUAL	100%	100%	AS PER MFG. STANDARD / (#)	AS PER MFG. STANDARD / (#).	INSPC. REPORT	✓	P	W	-	(#) REFER NOTE-8

NOTES:
1. Routine tests on 100% motors shall be done by the vendor. However, BHEL/ Customer shall witness routine tests on random samples. The sampling plan shall be mutually agreed upon.
2. For exhaust/ventilation fan motors of rating up to 1.5 KW, only routine test certificates shall be furnished for scrutiny.
3. In case test certificates for these tests on similar type, size and design of motor from independent laboratory are available, the same is valid for 5 years.
4. BHEL reserves the right to perform repeat test, if required.
5. After packing and prior to issue MDCC, photographs of items to be despatched shall be sent to BHEL for review.
6. In case of any changes in QP commented by customer at contract stage, same shall be carried out by bidder without any implication to BHEL/ Customer.
7. Project specific QP to be developed based on customer requirement.
8. For export job, BHEL technical specification for seaworthy packing to be followed.
9. Packing shall be suitable for storage at site in tropical climate conditions.
10. Latest revision/ year of issue of all the standards (IS/ ASME/ IEC etc.) indicated in QP shall be referred.

LEGENDS:

*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,
** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, B: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **C**: CUSTOMER,
P: PERFORM, **W**: WITNESS, **V:** VERIFICATION, AS APPROPRIATE
MA: MAJOR, **MI**: MINOR**, CR:** CRITICAL
D: DOCUMENTATION

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	RITESH KUMAR JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

बीएचईएल BHEL	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN	SPEC. NO :	DATE:17.04.2020
		CUSTOMER :	QP NO.: PE-QP-999-Q-007, REV-04	
		PROJECT:	PO NO.:	
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V)) SYSTEM:	SECTION: II	SHEET 1 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.0	RAW MATERIAL & BOUGHT OUT CONTROL													
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	LOG BOOK		P	-	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	SAMPLE	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	TEST REPORT		P/V	-		
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%	-		FREE FROM CRACKS, UN-EVENNESS ETC.	TEST REPORT		P	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	TC		P/V	-	-	PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%	-	MANUFACTURER'S DRG./SPEC	FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK		P/V	-		
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	TC		P/V	-		HEAT NO. SHALL BE VERIFIED
		3.DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG.	MANUFACTURER'S DRG.	LOG BOOK		P/V	-		
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	-	MANUFACTURER'S DRG./SPEC	MANUFACTURER'S DRG./SPEC	LOG BOOK		P/V	-		

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:17.04.2020
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 2 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		P	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S DRG./ STD.	TC		P/V	-		
		3. DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S DRG.	LOG BOOK		P/V	-		
		4.INTERNAL FLAWS	CR	ULTRASONIC TEST	100%	-	ASTM-A388	MANUFACTURER'S STD.	INSPECTION REPORT	✔	P/W	V	-	FOR DIA OF 55 MM & ABOVE
1.6	SPACE HEATERS, CONNEC-TORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	100%	-	MANUFACTURER'S DRG./STD.	MANUFACTURER'S DRG./STD.	INSPECTION REPORT		P/V	-	-	
		2. PHYSICAL COND.	MA	VISUAL	100%	-	MANUFACTURER'S DRG./STD.	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	INSPECTION REPORT		P/V	-	-	
		3.DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG./ STD	MANUFACTURER'S DRG. / STD.	INSPECTION REPORT		P/V	-	-	
		4.PERFORMANCE/ CALIBRATION	MA	TEST	100%	-	MANUFACTURER'S DRG./ STD	MANUFACTURER'S DRG. / STD.	TEST REPORT		P/V	-	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:17.04.2020
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 3 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC.	MA	VISUAL	100%	-	-	NO VISUAL DEFECTS	TEST REPORT		P/V	-	-	
		2.DIMENSION(BORE DIA, WALL THICKNESS, BDV AS RECEIVED, BDV AFTER FOLDING AT 180°	MA	TEST	SAMPLE	-	MANUFACTURER'S STD.	MANUFACTURER'S STD.	LOG BOOK AND OR SUPPLIER'S TC		P/V	-	-	
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND.	MA	VISUAL	100%	-	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK		P	-	-	
		2.DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG. .	MANUFACTURER'S DRG.	LOG BOOK		P/V	-	-	
		3. ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	SAMPLE	-	MANUFACTURER'S DRG./ STD.	MANUFACTURER'S DRG./ STD.	TC		P/V	-	-	
1.9	CONDUCTORS	1. SURFACE FINISH	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		*P/V	-	-	* MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY
		2.ELECT. PROP, & MECH. PROP	MA	ELECT. & MECH.TEST	SAMPLES	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S / SPEC.	TC & VENDOR'S TEST REPORTS		P/V	-	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	DATE:17.04.2020
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 4 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLES	-	MANUFACTURER'S DRG./ SPEC.	MANUFACTURER'S / SPEC.	LOG BOOK		P/V	-	-	
1.10	BEARINGS	1.MAKE & TYPE	MA	VISUAL	100%	-	MANUFACTURER'S DRG./ APPROVED DATASHEET	MANUFACTURER'S DRG./ APPROVED DATASHEET	LOG BOOK		P/V	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	APPROVED DATASHEET	APPROVED DATASHEET/ BEARING MANUF'S CATALOGUES	LOG BOOK		P/V	-	-	
		3.SURFACE FINISH	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		P/V	-	-	
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND.	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	LOG BOOK		P	-	-	
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	SAMPLE	-	MANUFACTURER'S STD./ APPROVED DATASHEET	MANUFACTURER'S STD./ APPROVED DATASHEET	LOG BOOK		P/V	-	-	
		4.HV/IR	MA	-DO-	100%	-	MANUFACTURER'S STD./ APPROVED DATASHEET	MANUFACTURER'S STD./ APPROVED DATASHEET	LOG BOOK		P/V	-	-	
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	-	MANUFACTURER'S DRG/SPECS	MANUFACTURER'S DRG./ SPECS.	LOG BOOK		P	-	-	
		2.SURFACE COND.	MA	VISUAL	100%	-	-	FREE FROM VISUAL DEFECTS	LOG BOOK		P	-	-	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	LOG BOOK		P	-	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:17.04.2020
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 5 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
2.0	IN PROCESS													
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNESS	MA	VISUAL	100%	-	MANUFACTURER'S DRG	GOOD FINISH	LOG BOOK		P/W	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	LOG BOOK		P	-	-	
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-	-DO-	GOOD FINISH	LOG BOOK		P	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	100%	-	MANUFACTURER'S DRG	MANUFACTURER'S DRG	LOG BOOK		P	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	100%	-	MANUFACTURER'S STD./ ASTM-E165	MANUFACTURER'S STD./ APPROVED DATASHEET.	LOG BOOK	✔	P	V	-	
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		3.SHADE	MA	VISUAL	SAMPLE	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	SAMPLE	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	DATE:17.04.2020
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 6 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	-	MANUFACTURER'S STD.	MANUFACTURER'S STD.	LOG BOOK		P	-	-	
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-	MANUFACTURER'S STD.	MANUFACTURER'S STD.	LOG BOOK		P	-	-	
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		2.CLEANLINESS	CR	VISUAL	100%	-	MANUFACTURER'S STD./APPROVED DATASHEET	MANUFACTURER'S STD./APPROVED DATASHEET	LOG BOOK		P	-	-	
		3.IR+HV-IR	CR	ELECT. TEST	100%	-	IS-325/IS-12615/IEC-60034 PART-1	IS-325//IS-12615/IEC-60034 PART-1	TEST/INSPC. REPORT	✔	P	V	-	
		4.RESISTANCE	CR	ELECT. TEST	100%	-	IS-325/IS-12615/IEC-60034 PART-1	IS-325//IS-12615/IEC-60034 PART-1	TEST/INSPC. REPORT	✔	P	V	-	
		5.INTERTURN INSULATION	CR	ELECT. TEST	100%	-	IS-325/IS-12615/IEC-60034 PART-1	IS-325//IS-12615/IEC-60034 PART-1	TEST/INSPC. REPORT		P	-	-	
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
		3.NO. OF DIPS	MA	PROCESS CHECK	CONTINUOUS	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK	✔	P	V	-	THREE DIPS TO BE GIVEN

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:17.04.2020
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 7 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
		4.DURATION	MA	PROCESS CHECK	CONTINUOUS	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK	✔	P	V	-	
2.7	COMPLETE STATOR ASSEMBLY	1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS	CR	VISUAL	100%	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	LOG BOOK		P	-	-	
		2.SOUNDNESS	CR	MALLET TEST & UT	100%	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	TEST/INSPC. REPORT	✔	P	V	-	
		3.HV	MA	ELECT. TEST	100%	-	MANUFACTURER'S STANDARD	MANUFACTURER'S STANDARD	TEST/INSPC. REPORT	✔	P	V	-	
2.9	COMPLETE ROTOR ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	100%	-	MANUFACTURER'S SPEC./ ISO 1940	MANUFACTURER'S DWG.	LOG BOOK		P	-	-	
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	TEST/INSPC. REPORT	✔	P	V	-	
2.10	ASSEMBLY	1.ALIGNMENT	MA	MEAS.	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		2.WORKMANSHIP	MA	VISUAL	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		3.AXIAL PLAY	MA	MEAS.	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK	✔	P	V	-	
		4.DIMENSIONS	MA	MEAS.	100%	-	MANUFACTURER'S DRG./ MANUFACTURER'S SPEC.	MANUFACTURER'S DRG./ MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK		P	-	-	
		6. RTD, BTD & SPACE HEATER MOUNTING.	MA	VISUAL	100%	-	MANUFACTURER'S SPEC.	MANUFACTURER'S SPEC.	LOG BOOK	✔	P	V	-	

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:17.04.2020
	CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	
	PROJECT:		PO NO.:	
	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 8 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS	MA	ELECT.TEST	1/TYPE/SIZE	1/TYPE/SIZE	IS-325/IS-12615/APPROVED DATASHEET	IS-325/IS-12615/APPROVED DATASHEET	TEST REPORT	✔	P	W*	-	* NOTE - 1
		2.ROUTINE TESTS INCLUDING SPECIAL TEST	MA	ELECT.TEST	100%	-	IS-325/IS-12615/APPROVED DATASHEET	IS-325/IS-12615/APPROVED DATASHEET	TEST REPORT	✔	P	V$	-	$ NOTE - 2
		3.VIBRATION & NOISE LEVEL	MA	ELECT.TEST	100%	-	IS: 12075 / IEC 60034-14 & IS-12065	IS: 12075 / IEC 60034-14 & IS-12065	TEST REPORT	✔	P	V$	-	$ NOTE - 2
		4.OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET &	TEST/INSPC. REPORT	✔	P	W	-	
		5.DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	-	IEC 60034-5/IS-12615	APPROVED DATASHEET	TC	✔	P	V	-	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	ELECT. & MECH. TEST	100%	-	IS-325/IS-12615/IEC-60034 PART-1/IS: 12802	IS-325/IS-12615/IEC-60034 PART-1/IS: 12802	TC	✔	P	V$	-	$ NOTE - 2
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	ELECT. & MECH. TEST	100%	-	IS-325/IS-12615/IEC-60034 PART-1	IS-325/IS-12615/IEC-60034 PART-1	TC	✔	P	V$	-	$ NOTE - 2
		8. NAME PLATE DETAILS	MA	VISUAL	100%	-	IS-325/IS-12615& DATA SHEET	IS-325//IS-12615 & DATA SHEET	TEST/INSPC. REPORT	✔	P	V$	-	$ NOTE - 2
		9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	-	IS 2148 / IEC 60079-1	IS 2148 / IEC 60079-1	TC	✔	P	V	-	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	SAMPLE	APPROVED DATASHEET	APPROVED DATASHEET	TC	✔	P	W$	-	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY $ NOTE - 2

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

	MANUFACTURER/ BIDDER/ SUPPLIER NAME & ADDRESS	STANDARD QUALITY PLAN		SPEC. NO :	DATE:17.04.2020
		CUSTOMER :		QP NO.: PE-QP-999-Q-007, REV-04	
		PROJECT:		PO NO.:	
		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV (415V))	SYSTEM:	SECTION: II	SHEET 9 OF 9

Sl No.	Component & Operations	Characteristics	Class	Type of Check	Quantum Of check		Reference Document	Acceptance NORMS	FORMAT OF RECORD		AGENCY			
1	2	3	4	5	6		7	8	9	*	**			
					M	C/N				D	M	C	N	
4.0	PACKING	SURFACE FINISH & COMPLETENESS	MA	VISUAL	100%	100%	AS PER MANUFACT. STANDARD / (#)	AS PER MANUFACT. STANDARD / (#)	INSPC. REPORT	✔	P	W	-	(#): REFER NOTE-8

NOTES:

1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED.

2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL/CUSTOMER SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON.

3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THE SAME IS VALID FOR 5 YEARS.

4 BHEL RESERVES THE RIGHT TO PERFORM REPEAT TEST, IF REQUIRED.

5 AFTER PACKING AND PRIOR TO ISSUE MDCC, PHOTOGRAPHS OF ITEMS TO BE DESPATCHED SHALL BE SENT TO BHEL PURCHASE GROUP FOR REVIEW.

6 IN CASE , ANY CHANGES IN QP COMMENTED BY CUSTOMER AT CONTRACT STAGE SHALL BE CARRIED OUT BY BIDDER WITHOUT ANY IMPLICATION TO BHEL/ CUSTOMER.

7 PROJECT SPECIFIC QP TO BE DEVELOPED BASED ON CUSTOMER REQUIREMENT.

8 FOR EXPORT JOB, BHEL TECHNICAL SPECIFICATION FOR SEAWORTHY PACKING TO BE FOLLOWED.

9 PACKING SHALL BE SUITABLE FOR STORAGE AT SITE IN TROPICAL CLIMATE CONDITIONS.

10 LATEST REVISION/ YEAR OF ISSUE OF ALL THE STANDARDS (IS/ ASME/ IEC ETC.) INDICATED IN QP SHALL BE REFERRED.

LEGENDS:

*RECORDS, INDENTIFIED WITH "TICK"(√) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION,

** **M**: SUPPLIER/ MANUFACTURER/ SUB-SUPPLIER, B: MAIN SUPPLIER/ BHEL/ THIRD PARTY INSPECTION AGENCY, **C**: CUSTOMER,

P: PERFORM. **W**: WITNESS. **V**: VERIFICATION. AS APPROPRIATE

MA: MAJOR, **MI**: MINOR, **CR**: CRITICAL

D: DOCUMENT

BHEL					
ENGINEERING			QUALITY		
	Sign & Date	Name		Sign & Date	Name
Prepared by:	HEMA KUSHWAHA	HEMA KHUSHWAHA	Checked by:		KUNAL GANDHI
Reviewed by:	PRAVEEN DUTTA	PRAVEEN DUTTA	Reviewed by:	RITESH KUMAR JAISWAL	R K JAISWAL

BIDDER/ SUPPLIER	
Sign & Date	
Seal	

FOR CUSTOMER REVIEW & APPROVAL			
Doc No:			
	Sign & Date	Name	Seal
Reviewed by:			
Approved by:			

ANNEXURE-I : FORMAT OF QUALITY ASSURANCE PROGRAMME

Name of Company/ Successful Bidder	NAME OF CONTRACT PACKAGE			QUALITY PLAN FOR						
	Package No. : _____ Bidderr : _____			QP No. : _____ Date _____ Rev.No.: _____ Date _____						
Sl. No.	Component & Operation	Characteristics	Class	Type of Check	Quantum of Check	Reference Document	Acceptance Norm	Format of Record	Agency	Remarks

ANNEXURE-II: MANUFACTURING QUALITY PLAN

MFGR.'s LOGO	MANUFACTURER'S NAME AND ADDRESS	MANUFACTURING QUALITY PLAN	PROJECT : PACKAGE : CONTRACT NO. : MAIN-SUPPLIER :
		ITEM : SUB-SYSTEM:	QP NO.: REV. NO.: DATE: PAGE: …. OF….

SL. NO	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
										M	C	L	
1.	2.	3.	4.	5.	6.	7.	8.	9.	D*	10.			11.

LEGEND: * RECORDS, INDENTIFIED WITH "TICK" (√) WILL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION.
** **M:** MANUFACTURER/SUB-SUPPLIER
C: SUPPLIER/NOMINATED INSPECTION AGENCY, L: PURCHASER
P: PERFORM **W**: WITNESS AND **V:** VERIFICATION. AS APPROPRIATE,

CHP: PURCHASER WILL IDENTIFIED IN COLUM "N"

DOC. NO.: REV……
CAT…..

MANUFACTURER/ SUB-SUPPLIER	MAIN-SUPPLIER	FOR PURCHASER USE	REVIEWED BY	APPROVED BY	APPROVAL SEAL
SIGNATURE					

DATASHEET-A

ANNEXURE-I

1.0	Design ambient temperature		:	50 °C
2.0	Maximum acceptable kW rating of LV motor		:	160 KW *
3.0	Installation (Indoors/ Outdoors)		:	As required
4.0	Details of supply system			
	a)	Rated voltage (with variation)	:	415V ± 10%
	b)	Rated frequency (with variation)	:	50 Hz + 5 % to - 5%
	c)	Combined voltage & freq. variation	:	10% (sum of absolute values)
	d)	System fault level at rated voltage	:	50 kA for 1 sec
	e)	Short time rating for terminal boxes		
		○ Above 90 kW (Breaker Controlled)	:	50 KA for 0.25 sec.
		○ 90 kW and below (Contactor Controlled)	:	50 KA protected by HRC fuse
	f)	LV System grounding	:	Solidly
5.0	Winding & Insulation		:	Class F with temp rise limited to class B
6.0	Minimum voltage for starting (As percentage of rated voltage)		:	80%
7.0	Power cables data		:	Shall be given during detailed engg.
8.0	Earth Conductor Size & Material		:	Shall be given during detailed engg.
9.0	Space heater supply (for motors >=30kw)		:	240 V, 1ϕ, 50 Hz
10.0	Rating up to which Single phase motor		:	Acceptable below 0.2 kW
11.0	Locked rotor current			
	a)	Limit as percentage of FLC	:	As per IS 12615
12.0	Makes		:	BHEL/ Customer approval (Package owner to take care)
13.0	Paint shade		:	Blue (RAL 5015) – Corrosion proof
14.0	Degree Of protection for motor/ terminal box		:	Degree of protection for various enclosures as per IEC60034-05 shall be as follows:-

i) Indoor motors - IP 23
ii) Outdoor motors - IP 55
iii) Cable box-indoor area - IP 23
iv) Cable Box-Outdoor area - IP 55

*** LT motors of continuous duty shall be energy efficient IE3 class conforming to IS-12615**

15.0 TESTING REQUIREMENTS: IN LINE WITH SPECIFICATION

S. No.	Description	Data to be filled by successful bidder
A.	**General**	
1	Manufacturer & country of origin	
2	Motor type	
3	Type of starting	
4	Name of the equipment driven by motor & Quantity	
5	Maximum Power requirement of driven equipment	
6	Rated speed of Driven Equipment	
7	Design ambient temperature	
B.	**Design and Performance Data**	
1	Frame size & type designation	
2	Type of duty	
3	Rated Voltage	
4	Permissible variation for	
5	a Voltage	
6	b Frequency	
7	c) Combined voltage & frequency	
8	Rated output at design ambient temp (by resistance method)	
9	Synchronous speed & Rated slip	
10	Minimum permissible starting voltage	
11	Starting time in sec with mechanism coupled	
12	a) At rated voltage	
13	b) At min starting voltage	
14	Locked rotor current as percentage of FLC (including IS tolerance)	
15	Torque	
	a) Starting	
	b) Maximum	
16	Permissible temp rise at rated output over ambient temp & method	
17	Noise level at 1.0 m (dB	
18	Amplitude of vibration	
19	Efficiency & P.F. at rated voltage & frequency	
	a) At 100% load	
	c) At 75% load	

S. No.	Description	Data to be filled by successful bidder
	c) At starting	
C.	**Constructional Features**	
1	Method of connection of motor driven equipment	
2	Applicable Standard	
3	DOP of Enclosure	
4	Method of cooling	
5	Class of insulation	
6	Main terminal box	
	a) Type	
	b) Power Cable details (Conductor, size, armour/unarmour)	
	c) Cable Gland & lugs details (Size, type & material)	
	d) Permissible Fault level (kArms & duration in sec)	
7	Space heater details (Voltage & watts)	
8	Flame proof motor details (if applicable)	
	a) Enclosure	
	b) suitability for hazardous area	
	i Zone	O / I / II
	ii Group	IIA / IIB / IIC
9	No. of Stator winding	
10	Winding connection	
11	Kind of rotor winding	
12	Kind of bearings	
13	Direction of rotation when viewed from NDE	
14	Paint Shade & type	
15	Net weight of motor	
16	Outline mounting drawing No (To be enclosed as annexure)	
D.	**Characteristic curves/ drawings** (To be enclosed for motors of rating ≥ 55KW)	
	a) Torque speed characteristic	
	b) Thermal withstand characteristic	
	c) Current vs time	
	d) Speed vs time	

LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/ INTT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	BOARD NO.	CABLE		BLOCK CABLE DRG. No.	CONTROL CODE	REMARKS	LOAD No.	VERIFICATION FROM MOTOR DATASHEET (Y/N)	KKS NO
	NAME PLATE	MAX. CONT. DEMAND (MCR)		RUNNING	STANDBY								SIZE CODE	NOs						
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
																				ANNEXURE-II

NOTES: 1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)/ CUSTOMER

2. ABBREVIATIONS : * VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (cc): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V

: ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTER CONTROLLED)

		PROJECT TITLE	2x500 MW NLC Tamil Nadu Power Ltd.	NAME		DATA FILLED UP ON	
		SYSTEM	WASTE WATER TREATMENT PLANT	SIGN.		DATA ENTERED ON	
		DEPTT. / SECTION	MAUX	SHEET 1 OF 1	REV. 00	DE'S SIGN. & DATE	

CABLE SCHEDULE FORMAT

ANNEXURE III

UNITCABLENO	FROM	TO	PURPOSE	CABLE SCOPE (BHEL PEM/ VENDOR)	REMARKS	CABLESIZE	PATHCABLENO	TENTATIVE CABLE LENGTH

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGE: ELECTRIC HOIST FOR WASTE WATER TREATMENT PLANT

PROJECT : 2X500 MW NTPL TUTICORIN FGD

SCOPE OF VENDOR: SUPPLY , ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

S. NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	Isolating Switch	Vendor	Vendor	BHEL will provide one number 415 V (3ph, 4W) supply feeder only up to isolating switches for cranes. Any other voltage level (AC/DC) required will be derived by the vendor. Motor starter shall be part of crane control panel.
2	Power cables, control cables, screened control cables and any special cables (if required) between equipment supplied by vendor.	Vendor	Vendor	Cable from supply feeder to isolating switch shall be in BHEL scope.
3	Cabling material (cable trays, accessories, cable tray supporting system, conduits etc).	Vendor	Vendor	
4	Equipment Earthing	Vendor	Vendor	All equipment metallic enclosures / frames, metal structure etc. shall be grounded at two points each to the nearest grounding points / risers provided by BHEL.
5	Motors	Vendor	Vendor	
6	Cable glands and lugs for equipment supplied by vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power & control cables.
7	a) Input cable schedules (C & I) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
8	Equipment layout drawings	Vendor	-	
9	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

SUBSECTION-IC

SPECIFIC TECHNICAL REQUIREMENTS (CONTROL & INSTRUMENTATION)

Specific Technical Requirements (C&I):

1.0 WASTE WATER TREATMENT PLANT (WWTP) shall be operated from DCS (DCS-BHEL Scope of supply) through operator work stations.

2.0 Bidder to supply all the instruments (LT, LG, PT, DPT, DPG, PG, pH analyser etc.) required for the package along with necessary fittings, accessories and valve manifold etc. All instruments shall be provided with durable epoxy coating for housing and all exposed surfaces of the instruments. All the instruments shall be corrosive resistive coating and suitable for sea water applications.

3.0 The requirements given are to be read in conjunction with detailed Technical specification enclosed.

4.0 The scope of C&I cables and their erection and commissioning shall be referred in Electrical scope sheet defined in Electrical specification.

5.0 All the instruments PG/DPG/DPT/PT etc. as applicable shall have chemical/ diaphragm seal.

6.0 All field instruments enclosure shall be IP-65. Local panel/cabinet enclosure shall be IP-55, unless otherwise specified.

All transmitters shall be smart type and shall have 4-20mA DC signal with superimposed digital communication (HART). Each Temperature element shall be complemented with temperature transmitters, compensating cable, JB/rack & other erection hardware.

7.0 The solenoid operated valves shall have limit switches for open/ close feedback. Operating coil voltage of solenoid valve shall be 24 V DC.

8.0 BLANK

9.0 All the root valves shall be in bidder’s scope. Double root valve shall be provided for all pressure tapings where the pressure exceeds 40kg/cm2.

10.0 The junction boxes for termination of instruments /actuator limit switches/solenoid valve limit switches etc. are in bidder’s scope. Bidder to provide all erection hardware including junction boxes, local panel, canopies, structural steel as required. At least 20% spare unused terminals shall be provided everywhere including local junction boxes, instrument racks/enclosures, termination/marshalling cabinets, etc.

11.0 240 VAC shall be provided by BHEL at a single point, further distribution to various instruments/equipment’s shall be in Bidder's scope. Bidder to include the necessary power distribution board in his scope. ACDB, any power supply other than the above, if required for any instrument/ equipment has to be derived from the above supply & all the necessary hardware for the same shall be in Bidder's scope.

12.0 Bidder to furnish electrical/UPS load data during detailed engineering.

13.0 Electrical Actuators shall be with integral starter.

14.0 Bidder to note that all the transmitters/instruments supplied by Bidder shall be rack mounted. The racks shall be preassembled and provided by Bidder. Also no instruments / analysers & JBs/Racks should be protruding on the walkway.

All transmitters shall be suitably grouped together and mounted inside (i) Local Instruments Enclosures (LIEs) in case of open areas of the plant and (ii) Local Instrument Racks (LIRs) in case of covered areas.

15.0 Each valve/instrument shall be fitted with a stainless steel or aluminium nameplate indicating the valve/instrument service and reference number.

16.0 Integral to equipment which are not indicated in the tender drawings, but are required for control, monitoring and operation of the equipment/plant system for which no P&IDs are enclosed, all the instruments shall be provided to meet the actual system requirements and meeting redundancy and other requirements under technical specifications subject to Employer's approval.

17.0 For critical binary and analog inputs required for protection and interlock purpose of other equipment (e.g. those interlocks which may result in loss of production, non-availability of a major equipment etc.), triple sensors shall be provided.

18.0 Temperature elements, electronic transmitters etc. are to be provided for all the cases. Use of process actuated switches is acceptable only in the cases as indicated in the tender drawings.

19.0 Single Input DIN rail mounting type temperature transmitters (mounted in JBs) shall be provided by the bidder for all temperature elements for control application.

20.0 Process connection & piping including LIE / LIR, all impulse piping, pneumatic piping/tubing, valves, valve manifolds, fittings and all other accessories shall be provided as on required basis for proper installation & completeness of impulse piping system and air supply system, as stipulated elsewhere in the specification.

21.0 The system shall be arranged so that the failure of any monitoring device or control components or spurious intermediate grounding in the signal path shall not open the signal loop nor cause the loss or malfunction of signal to other devices using the same signal.

22.0 To ensure availability, adequate redundancy in system design shall be provided at hardware, software and sensor level. For the protection system, independent sensing device shall be provided to ensure adequate safety of plant equipment.

23.0 The design of the control systems and related equipment's shall adhere to the principle of 'Fail Safe' Operation wherever safety of personnel / plant equipment is involved and shall not cause a hazardous condition. However, it shall also be ensured that occurrence of false trips is avoided /minimized.

24.0 All panels, desks, cabinets shall be provided with a continuous bare copper ground bus. The ground bus shall be bolted to the panel structure on bottom on both sides. The bolts shall face inside of panels. The system ground shall be isolated from the panel ground with suitable isolators. All internal component grounds or common shall be connected to the system ground, which shall be fabricated of copper flat (size 25mm x 6mm min., length as applicable).

25.0 Bidder to perform tests of C&I items/instruments/systems as per quality plans/type test attached in the specification.

26.0 The equipment shall be of modern, compact design incorporating the latest developments in proven technology. All instruments whether for local indication or remote transmission shall be of good quality and shall have an accuracy and repeatability appropriate to their duty.

27.0 Bidder shall provide Cable Schedule in BHEL excel format which shall be provided during detailed engineering. Also, Cable Interconnections for Complete System shall be in Bidders' scope. DCS side details for hardwired signals shall be furnished by BHEL during detailed engineering.

28.0 The make/model of various instruments/items/systems shall be subject to approval of owner/purchaser during detailed engineering stage. No commercial implication in this regard shall be acceptable. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with. In case of any contradiction most stringent clause/condition shall prevail.

29.0 Interface of MCC, field instruments, Solenoid valve/actuators etc. with DDCMIS based control system shall be as per Drive Control Philosophy enclosed

30.0 For codes & standards refer detailed specification.

31.0 Instrument installation and accessories required shall be in Bidder's scope. Vendor submitted 'Instrument Installation Diagram' shall be subject to customer approval during detail engineering without any commercial and time implication. The instruments for which Installation Diagram is not attached, vendor's Installation Diagram for such items will also be subject to customer approval during detail engineering without any commercial and delivery implication.

32.0 Drawings/Documents and data to be furnished after award of the contract shall be in line with MDL furnished elsewhere in the specification.

33.0 Editable & pdf copy of Drawings/Documents and data to be furnished after award of the contract: List of Drawings/Documents and data to be furnished by bidder after award of the contract are mentioned under section" List of Documents/Deliverables".

- GA & wiring diagram of local panel.
- IO list and drive list
- Power requirement.
- Local control panel & instruments data sheet.
- Instrument schedule
- Cable interconnection and cable schedule

- Alarm Schedule
- Control scheme
- Control write-up
- Any other document decided during detailed engineering

Notes:

1. The above given scope is indicative & minimum. Any item/ equipment not indicated above however required for the completeness of the system is to be supplied by bidder without any technical, commercial and delivery implication to BHEL.
2. Documents of C&I System shall be submitted to end user/owner for approval during detail engineering. Changes, if any, shall be accommodated by the bidder without any price/time implication.
3. In case of any discrepancy in subsection IC and Subsection IIC of the specification, subsection IC shall prevail.

04.	Diameter Ratio	:	Between 0.4 and 0.7
05.	Material	:	Stainless steel or better
06.	Thickness	:	Suitable for the application
07.	Meter run pipe	:	Same as pipe material
08.	Tapping	:	D and D/2
09.	Root valve	:	Globe type, Body same as main pipe material, trim ss or better
10.	Impulse pipe	:	Same material as main pipe upto root valve
11.	Document	:	Beta ratio calculation, assembly drawing and Flow vs. DP curve.
12.	Accessories	:	Meter run pipe, nipples and root valves. (Inspection port assembly for nozzles used in plant performance purpose)

Bidder shall submit certified flow calculation and differential pressure vs. flow curves for each element for Owner's approval. Sizing calculation, precise flow calculation for all the flow elements, fabrication and assembly drawings and installation drawings shall be submitted for Owner's approval. One Flow element of each type shall be calibrated in the test laboratory for validation of commutated flow calculations.

1.17.00 FGD System related Special Instruments

1.17.01 Conductivity Analyzer

A. **Sensor**

01.	Type of Cell	:	Flow through type / removable type (withdrawable with sealing valve)
02.	Conductivity Range	:	As per instrument schedule
03.	Cell Constant	:	0.01 / 0.1 / 1.0 depending upon range
04.	Temperature Compensation	:	Manual and Automatic (Integral) upto 0-100°C with PT-100 Sensor
05.	Process Connection	:	Screwed
06.	Wetted Parts	:	Electrodes SS 316L or better

			Insulators .KYNAR & VITON or better
07.	Pressure Rating	:	10 kg/cm^2
08.	Accessories	:	Vessel (SS 316) with ½" NPT connection.
09.	Cable	:	Upto transmitter in flexible conduct

B. **Transmitter**

01.	Type	:	Microprocessor based, Single stream with multi-range facility
02.	Mounting	:	Flush Panel
03.	Protection Class	:	IP-55 or better
04.	Output	:	4-20 mA DC (isolated) to a load of 600 ohms (min.)
05.	Display		i) Digital Display of process variable in Engineering Unit, Temperature, Alarm Status. ii) Back lit LCD iii) Character Height 12 mm
06.	Zero / Span Adjustment	:	Front Panel Membrane type Keyboard.
07.	Temperature Compensation	:	Manual or Automatic - selectable through keyboard
08.	Diagnostic	:	Self diagnosticprogramme for electronics, measuring electrode, open wiring etc.
09.	Alarm	:	Dual alarm set point (2 SPDT, high & low), hysterisis and time delay adjustable from membrane keyboard. Switch contact rating of 5 Amp, 240 VAC / 0.2 Amp, 220 VDC
10.	Enclosure	:	Die cast aluminium epoxy coated
11.	Cable Termination	:	Internal (cable entry through conduit)
12.	Accuracy	:	± 1.0 % of measured range

13.	Response time	:	Less than 5 sec.
14.	Stability	:	± 1.0 % of full scale / month non-cumulative
15.	Power Supply	:	240 V AC, 50 Hz
16.	Operating Temp.	:	0 -50°C
17.	Accessories	:	a) For cation conductivity analyzer Dual Ion-Exchange column, resin, etc. (minimum 12 months requirements). b) Phenolic Nameplate, cable gland

1.17.02 pH Analyzer

A. **Sensor**

01.	Type of Cell	:	Measuring and reference electrode combination with flow through type (polypropylene flow chambers).
02.	Process Connection	:	Screwed
03.	Type of measurement	:	Combination electrode
04.	Temperature Compensation	:	Automatic (Integral) upto 0-100°C with PT-100 Sensor
05.	Preamplifier	:	Integral or separate
06.	Range	:	0-14 pH
07.	Measuring Electrode	:	Glass
08.	Liquid Junction	:	Ceramic/Kyner or equivalent
09.	Pressure Rating	:	10 kg/cm^2
10.	Accessories	:	Vessel (SS 316) with ½" NPT connection
11.	Cable	:	Upto transmitter in flexible conduct

B. **Transmitter**

01.	Type	:	Microprocessor based, Single stream

			with adjustable range facility
02.	Mounting	:	Flush Panel
03.	Protection Class	:	IP – 55 or better
04.	Output	:	4-20 mA DC (isolated) to a load of 600 ohms (min.)
05.	Display		i) Digital Display of process variable in Engineering Unit, Temperature, Alarm Status. ii) Back lit LCD iii) Character Height 12 mm
06.	Calibration	:	Two-point calibration with standard buffer solutions.
07.	Temperature Compensation	:	Manual or Automatic - selectable through keyboard
08.	Diagnostic	:	Self diagnostic for **"**Calibration required**"/ "**Calibration O.K.**"**, electrode checking etc.
09.	Alarm	:	Dual alarm set point (2 SPDT, high & low), hysterisis and time delay adjustable from membrane keyboard. Switch contact rating of 5 Amp, 240 VAC / 0.2 Amp, 220 VDC
10.	Enclosure	:	Die cast aluminium epoxy coated
11.	Cable Termination	:	Internal (cable entry through conduit)
12.	Accuracy	:	± 0.03 pH or better
13.	Repeatability	:	± 0.02 pH or better
14.	Response Time	:	Less than 2 seconds or better
15.	Stability	:	± 0.001 pH / week
16.	Power Supply	:	240 V AC, 50 Hz
17.	Operating Temp.	:	0 - 50°C
18.	Accessories	:	a) Ultrasonic Electrode Cleaner for

uncleaned water.

b) Phenolic nameplate giving tag number, service, cable gland etc.

c) Pre-amplifier, special cable, ultrasonic cleaner, etc.

d) Buffer tablets.

19. Preferred feature — Self cleaning type sensor

1.17.03 **Turbidity Analyzer**

01.	Type	:	Light reflection principle
02.	Accuracy	:	2 % Low range 5 % High range
03.	Response Time	:	5 Min (max) [90% of Full Scale]
04.	Range	:	0-100, 0-200 NTU programmable
05.	No. of streams	:	Single
06.	Output signal :-		
	a) Analog	:	4-20 mA DC (isolated) into 600 ohms
	b) Binary	:	Field adjustable High and low PF contacts.
07.	Zero & span adjustment	:	Yes
08.	Ambient temperature	:	50ºC
09.	Indication	:	Digital
10.	Enclosure Type/ Material	:	Weather & dust proof (IP 55) Die cast aluminum
11.	Type of electronics	:	Microprocessor based
12.	Calibration	:	Auto & manual
13.	Error / Diagnostic	:	To be provided
14.	Mounting arrangement	:	Panel mounted
15.	Power supply	:	240V AC, 50 Hz, 1 Phase UPS

16. Other requirement : All chemical reagents

1.17.04 **Non - Nucleonic (Vibration) Type Density Meter:-**

A Application : Liquid Density measurement

Detector

1. Orientation : As per requirement
2. Case Material : SS 316L/ Cast Aluminum alloy
3. Wetted part material : SS 316L
4. Operating Principle : Vibration Density measurement

Convertor

1. Output : 4-20 mA DC isolated
2. Electrical Connection : ½" NPT3
3. Enclosure Class : IP 65
4. Local Display : Digital 5 digit, density display with temp. compensation
5. Accuracy : +/- 1%
6. Response time : < 1 minute
7. Power Supply : 230 V AC, +/- 10%, 50 Hz. From UPS

1.17.05 **Density Indicator**

01. Type : Hydrometer
02. Wetted part material : Polypropylene or better
03. Body material : Polypropylene or better
04. Sight Glass chamber : Borosilicate
05. Accessories : Protection guard, assembly fixing nuts & bolts, needle valves, vent plug etc..

22.01.00

COMMON REQUIREMENT FOR OTHER ANALYSERS

Sno	Features	Minimum Requirement
1.	Output signals	Analog 4-20 mA DC galvanically isolated.
2.	Zero & span Adjustment	To be provided with range selection facility
3.	Ambient temp	50 degC
4.	Sample Temperature	40 degC
5.	Indication	Digital Alphanumeric Display of reading in engineering units shall be provided.

6.	Type of Electronics	Microprocessor based with self-diagnostic
7.	Calibration	Manual
8.	Others	All interconnection tubing and cabling between sensor and analyzer / analyzer panel etc to be provided.
9.	Location of the Temp & flow measurement	Waste water treatment plant (Exact location to be decided by contractor in consultation with site)
10	Location of the Analyser cabinet/enclosure	
11	Accessories	All the accessories required for mounting the sensor/analyser are to be provided
12	Digital Signal Transmission	Each analyser shall have a provision for bidirectional soft connectivity over Modbus/RS232/RS485 with employer's central cloud server in addition to 4-20 ma connectivity to DDCMIS.
13	Compliance to standards	CPCB's (Central Pollution control Board) latest regulatory requirement prevailing at the time of execution of the contract.

22.04.00 BOD BIOLOGICAL OXYGEN DEMAND / COD CHEMICAL OXYGEN DEMAND ANALYSER

Principle	COD/BOD measurement by: Option A. Total Organic Carbon (TOC) measurement complying to US EPA 415.1 / 415.2 or equivalent standard for effluent/sewage/waste water. Option B. UV-VIS spectrometer measuring absorption in UV-VIS spectrum.
Measuring Range	0-50 mg/L for BOD, 0-500 mg/L for COD
Response Time	<= 15 min
Power	To be arranged by contractor
Cleaning	Self-cleaning (Automatic)
Accuracy	+/- 3%

22.05.00 OIL IN WATER ANALYSER

Principle	UV Fluorescence
Measuring Range	0 to 30 mg/l
Response Time	<= 60 sec
Power	To be arranged by the contractor.
Cleaning	Self-cleaning (Automatic)
Accuracy	+/- 5 % of full scale

22.06.00 TOTAL SUSPENDED SOLIDS – TSS ANALYSER

Principle	Light reflection principle
Measuring Range	0-500 mg/l
Response Time	<= 5 min
Power	To be arranged by bidder (Refer terminal point)
Cleaning	Self-cleaning (Automatic)
Accuracy	+/- 5%

22.07.00 ENCLOSURE/CABINETS / PANELS

The enclosure shall accommodate all Analyser. The enclosure shall provide protection from dust, humidity, precipitations, sunlight and environmental pollution. The material for the enclosure shall be of steel plate with minimum 2 mm thick frame and 1.6 mm thick CRCA steel sheet of protection IP 55 or better with safety lock of good quality. The lighting provision in the cabinet and the canopy for the cabinet is to be provided. The cabinets shall be designed such that the wet section and dry section are separate, the exact details shall be finalized during detailed engineering.

In order to ensure the healthy operation of the installed electronic modules, cards, analyzers, etc inside the enclosure during continuous operation, the enclosure shall be provided with Air conditioner unit .

SUBSECTION-II

GENERAL TECHNICAL REQUIREMENT

SUBSECTION-II A GENERAL TECHNICAL REQUIREMENT - MECHANICAL
SUBSECTION-II B GENERAL TECHNICAL REQUIREMENT - ELECTRICAL
SUBSECTION-II C GENERAL TECHNICAL REQUIREMENT - CONTROL & INSTRUMENTATION

SUBSECTION-II A

GENERAL TECHNICAL REQUIREMENT (MECHANICAL)

VOLUME : II-H

SECTION-II

HORIZONTAL CENTRIFUGAL PUMPS

1.00.00 INTRODUCTION

1.01.00 This section presents the general guidelines and details of horizontal centrifugal pumps to be procured under the scope of the Flue Gas Desulphurisation Package and shall not be limited to the pumps specified under Clause no. 3.00.00 below. For other horizontal centrifugal pump in the scope of Flue Gas Desulphurisation Package, these general guidelines as specified hereinafter shall be followed.

2.00.00 CODES AND STANDARDS

2.01.00 The design, manufacture and performance of the horizontal centrifugal pumps as specified hereinafter, shall comply with the requirements of the following codes and standards and shall include all the latest amendments subsequent to the year of publication as mentioned below.

2.01.01	IS-6595 Part-2/ 1993	:	Horizontal Centrifugal pumps for clear, cold and fresh water.
2.01.02	IS-5120/1977	:	Technical requirements for Rotodynamic special Purpose pumps.
2.01.03	IS-5639/1970	:	Pumps for handling chemicals & corrosive liquids.
2.01.04	IS-5659/1970	:	Pumps for process water.
2.01.05	IS-6536/1972	:	Pumps for handling volatile liquids.
2.01.06	IS-9137/1978	:	Code for acceptance tests for centrifugal, mixed flow and axial flow pumps - Class 'C'.
2.01.07	ISO 3555/1977 BS 5316/1977 Part 2	:	Acceptance tests for centrifugal, mixed flow and axial flow pumps - Class 'B' tests.
2.01.08	ISO 2548/1973 BS 5316/1976 Part 1	:	- Do - Class 'C' tests.
2.01.09	API-610/1989	:	Centrifugal pumps for general refinery services.

2.01.10 Standards of the Hydraulic Institute of USA (1983).

2.01.11 PTC 8.2/1965 : Power Test Codes - Centrifugal pumps.

2.02.00 In case of any contradiction with the above standards and annexure, the stipulations in the annexure shall prevail and shall be binding to the Contractor.

3.00.00 SCOPE OF WORKS

3.01.00 Scope of Supply

The scope of supply under this section shall be as below. Items specifically not mentioned but deemed necessary by the Tenderer for making the system completely reliable and efficient shall also be included.

3.01.01 Equipment for Limestone based FGD system

i) 4 x 100% Limestone slurry circulation pumps (two (2) for each circulation tank).

ii) 4 x 100% Limestone slurry distribution pumps (two (2) for each slurry storage tank).

iii) 2 x 100% Limestone slurry recirculation pumps for each level. Alternatively, one spare spray level with 1 x 100% pump for each level.

iv) 4 x 100% Gypsum Bleed Pumps (two (2) for each absorber).

v) 2 x 100% Emergency slurry pumps.

vi) 4 x 100% Cloth wash pumps (two (2) for each vacuum belt filter)

vii) 4 x 100% Cake wash pumps (two (2) for each vacuum belt filter)

viii) 4 x 100% Filtrate Pump (two (2) for each vacuum belt filter)

ix) 2 x 100% Filtrate Water Pump

x) 2 x 100% Process Water Pumps.

xi) 2 x 100% Flue Gas Quenching Water Pumps

xii) 2 x 100% Mist Eliminator Wash Water Pumps.

xiii) 2 x 100% Waste water hydro- cyclone feed pumps

xiv) 2 x 100% Waste water transfer pumps

xv) 2 x 100% Waste water disposal pumps

xvi) Any other horizontal centrifugal pump included by the Bidder within the scope of Flue Gas Desulphurisation Package.

3.01.02 **Equipment Accessories**

Each pump set shall be supplied with the following accessories as a minimum:

i) Couplings of approved design to connect pump shaft directly with the motor shaft.

ii) Sets of base plates, support plates, grounding pads, lifting lugs, eyebolts, nuts etc for each pump and motor set.

iii) Slip-on type drilled steel flanges of proper rating for both suction and discharge connections of each pump set. All the counter-flanges shall be complete with requisite number of bolts, nuts, gaskets etc.

iv) Air release cocks and drain plugs for each pump set.

v) Discharge line pressure gauge and suction line pressure/vacuum gauges complete with isolating cocks for each pump set.

vi) All internal/integral piping with valves, fittings, and pressure gauges for lubrication, cooling and sealing, wherever applicable, shall be tapped of directly from respective pump discharge.

3.02.00 For details regarding Scope of Services and works Lead Specification Volume-IIA of this specification shall be referred.

4.00.00 **PERFORMANCE REQUIREMENT**

4.01.00 Performance requirements for the pumps shall be as guided by Section-I and Section-II of this Volume and by the annexure enclosed with this section.

4.02.00 Pumps shall preferably be designed to have the best efficiency at the specified duty point. The pumps shall be suitable for continuous operation at any point within the "Range of Operation" as stipulated in the annexure attached with this Section.

4.03.00 Pumps shall preferably have a continuously rising head-capacity characteristic from the specified duty point towards shut-off point, the maximum being at shut-off to enable parallel operation.

Under all circumstances, the 'range of operation' of the pumps shall exclude any unstable operating zone of the head - capacity curve.

4.04.00 Wherever specified in the annexure attached to this section, pumps of each category shall be suitable for parallel operation. The head vs. capacity, the BHP vs. capacity characteristics etc. shall be identical to ensure equal load sharing and trouble-free operation of any pump when the other pump(s) working in parallel with it trip.

4.05.00 The pump set along with the drive motor shall run smooth without undue noise and vibration. Acceptable peak-to-peak vibration limits shall be generally guided by the Hydraulic Institute Standards of USA.

5.00.00 **DESIGN AND CONSTRUCTION**

5.01.00 **Pump Casing**

5.01.01 Pump casing shall be provided with adequate number of vents and priming connections with valves unless the pump is made self-venting and priming. Casing drain, as required, shall be provided complete with drain valves.

5.01.02 Pump design must ensure that the nozzles are capable of withstanding external reactions not less than those specified in API-610.

5.01.03 In cases where an expansion joint is located at pump discharge, the pump assembly will be subjected to an additional thrust which will be transmitted to the foundation. This additional thrust shall be taken into the consideration of pump design.

5.02.00 **Impeller**

5.02.01 The rotor assembly shall be dynamically balanced and designed with critical speed substantially above the operating speed.

5.03.00 **Wearing Rings**

5.03.01 Replaceable type wearing rings shall be furnished to prevent damage to impeller and casing.

5.04.00 **Shaft**

5.04.01 Shaft size shall be selected considering that the critical speed shall be away from the operating speed as recommended in applicable Code/Standard. The critical speed shall also be at least 10% away from runaway speed.

5.05.00 **Shaft Sleeves**

5.05.01 Renewable type fine finished shaft sleeves shall be provided at the stuffing boxes/mechanical seals. Length of the shaft sleeves must extend beyond the other faces of gland packing or seal end plate so as to distinguish between the leakage past shaft and shaft sleeve and that past the seals/glands.

5.05.02 Shaft sleeves shall be properly fastened to the shaft to prevent any leakage or loosening. Shaft and shaft sleeve assembly should ensure concentric rotation.

5.06.00 **Bearings**

5.06.01 Bearings shall be easily accessible without disturbing the pump assembly. A drain plug shall be provided at the bottom of each bearing housing.

5.06.02 Heavy-duty sleeve/ball/roller type bearings shall be provided to take care of the radial loads.

5.06.03 In case of sleeve type radial bearings; axial thrust shall be absorbed in suitable hydraulic devices and/or thrust bearings.

5.06.04 Bearings and hydraulic devices (if provided for balancing axial thrust) shall be of adequate design for taking the entire pump load arising from all probable conditions of continuous operation, as specified in the annexure. Life of the bearings shall be guided by the design standard of the pump or as specified in annexure. Thrust bearing shall be capable of running continuously at maximum load.

5.06.05 The bearings shall be oil/grease lubricated. Suitable lubricating arrangement for the bearings shall be furnished with the pump complete all accessories like pump, filters, pipings, fittings, valves, interlocking and supervising instruments etc. as necessary and specified in the annexure. The design shall be such that the bearing lubricant does not contaminate the liquid being pumped.

5.07.00 **Stuffing Boxes**

5.07.01 Stuffing box design shall permit replacement of packing without removing any part other than the gland.

5.07.02 Stuffing boxes shall be sealed / cooled by the fluid being pumped/external clear water, as specified in the annexure. All necessary pumps, piping, fittings, valves, instruments etc. as required for safe and trouble-free operation of the pumps and as specified in the annexure shall be included in the scope of supply.

5.08.00 **Mechanical Seals**

5.08.01 Mechanical seals shall be provided if specified in the annexure. The pump supplier shall co-ordinate with the seal maker in establishing the circulation rate for maintaining a stable film at the seal face in the chamber. The seal piping system shall form an integral part of the pump assembly.

5.08.02 When handling liquids near their boiling point, suitable arrangement for external cooling shall be provided so as to prevent flashing at the seal faces.

5.08.03 For the seals under vacuum service, the seal design must ensure sealing against atmospheric pressure, even when the pumps are not operating.

5.09.00 **Drive Unit**

5.09.01 The pumps shall be driven by electric motor or other driving equipment like diesel engine etc. directly coupled or through a gear box/belt drives, as specified in the annexure. A heavy duty coupling along with coupling guard shall be provided between the pump and drive unit (except for belt drives).

5.09.02 Unless otherwise specified in annexure, drive unit power rating shall be the maximum of the following requirements.

a) 15% margin over the pump shaft input power at the rated duty point.

b) 5% margin over the maximum pump shaft input power required within the 'Range of Operation'.

c) Pump shaft input power required considering the overloading of the pump assuming single pump operation in the event of tripping of one or more of the pumps operating in parallel.

6.00.00 **INSPECTION AND TESTING**

6.01.00 The Contractor shall carry out the following specific tests and inspections to ensure that the equipment furnished lies in strict conformance with the specification and also in accordance with applicable codes/standards and good engineering practice.

a) Identification and Testing

i) All materials used for pump construction shall be of tested quality. Material shall be tested as per the relevant standards and test certificates shall be made available to the Owner.

ii) Tests for each pump included under this section shall include but not be limited to the following:

- The entire surface of the impeller castings shall be subjected to Dye Penetration Test as per ASTM Specification no.: E165 65.
- Shaft shall be subjected to Dye Penetration and Ultrasonic Tests
- Wearing rings shall be subjected to Dye Penetration Test.
- Verification of material, witnessing of pouring, casting and inspection of finalized fabricated/cast castings.
- Inspection of finished castings for impeller and verification of materials.
- Inspection of pump shaft and verification of material.
- Witnessing of NDT/review of NDT reports.
- Static balancing test for impeller and dynamic balancing of complete rotating parts as per ISO-1940.
- Complete Inspection of assembled pump.

b) **Hydrostatic Testing**

The pump casing shall be hydrostatically tested at 150% of the shut-off pressure. Pressure shall be maintained for a period of not less than one (1) hour. While arriving at the above values maximum suction pressure shall be taken into account.

c) **Performance Test at Shop**

i) Each pump shall have to be tested to determine the performance curves of the pumps. These tests are to be conducted in presence of Owner's representative as per the requirements of the Standards of Hydraulic Institute of USA (ASME-Power Test Code PTC 8.2/BS-599) or any other equivalent standard but the tolerances on head discharge and power shall be as specified in HIS, USA.

ii) Performance tests are to be conducted to cover the entire range of operation of the pumps. These shall be carried out to span 130% of rated capacity up to pump shut-off condition. A minimum of five combinations of head and capacity are to be achieved during testing to establish the performance curves, including the design capacity point, shut-off point and the two extremities of the range of operation as specified in the annexure. After completion of performance test, all pumps shall be stripped down for inspection of internals.

iii) Tests shall be conducted with actual drive motors being furnished.

iv) NPSH tests are to be conducted on one pump of each type at 3% head drop conditions, if specified in the pump annexure.

v) Mechanical run test shall be carried out on all pumps to determine the vibration levels, noise levels etc. This test shall be conducted at site also. However, test value at site shall be used for the acceptance of the equipment.

7.00.00 DRAWING, DATA AND INFORMATION REQUIRED

7.01.00 The Bidder shall submit the following along with his formal proposal besides the different information required as indicated elsewhere in this section.

7.01.01 Drawings

a) General arrangement drawings showing the principal dimensions, weight and location of the suction and discharge connections of the pumps offered. Details of lubrication and sealing arrangement shall be included.

b) Typical cross-section drawing showing various components of the pumps offered, materials of construction etc.

7.01.02 Data and Curves

a) Determination of pump total dynamic head and rated capacity as per guidelines specified in Section-I and II of this Volume. Detailed calculations shall be shown by the Bidder.

b) Anticipated performance curves showing the following characteristics:

i) Capacity vs. head.

ii) Capacity vs. power.

iii) Capacity vs. efficiency.

iv) Capacity vs. NPSH required.

v) System resistance curves.

c) Speed vs. torque curve of the pump corresponding to recommended mode of pump starting superimposed on speed vs. torque curves of the drive unit corresponding to 80%, 90%, 100% of the rated voltage (applicable only in the cases of pumps with drive motor power rating of 100 KW and above).

d) Completely filled-in Technical particulars enclosed under Volume-III of this specification.

7.02.00 The successful Bidder shall furnish the following drawings/data for Purchaser/Engineer's approval after award of the Contract.

7.02.01 Final versions of all the drawings, documents as specified in Clause no. 7.01.00 above.

7.02.02 Pump foundation details along with all design loads, direction and points of application.

7.02.03 Test reports, test certificates and other particulars.

7.02.04 All other applicable drawings and documents as specified in Volume IIA ('Lead Specification') and Volume IIB of this specification.

ANNEXURE-I

DATA SPECIFICATION SHEET- HORIZONTAL CENTRIFUGAL PUMPS

Sl.No.	Description	Pumps handling Slurry	Pumps handling corrosive liquids#	Pumps handling Clear Water
1.	Designation	Refer clause no. 3,00,00		
2.	Duty	Continuous/ Intermittent	Continuous/ Intermittent	Continuous
3.	Location	Indoor/ Outdoor, but should be suitable for outdoor operation		
4.	Number of Pumps required	Refer Sections I and II		
5.	Number of pumps working	Refer Sections I and II		
6.	Number of pumps standby	Refer Sections I and II		
7.	Number of pumps working in parallel	All pumps should be suitable for parallel operation		
8.	Liquid handled	Corrosive Limestone/Gypsum slurry	Various corrosive liquids	Clarified Water
9.	Analysis	By bidder		Refer Volume IIA
10.	Design Temperature	By bidder		Ambient
11.	Suction Lift/ Head available (MLC)	Flooded suction shall be ensured		
12.	Pump Performance Requirements			
a)	Rated Capacity (Cu.m/hr)	To be computed by the Bidder as per guidelines stipulated in Sections-I & II		

Sl.No.	Description	Pumps handling Slurry	Pumps handling corrosive liquids#	Pumps handling Clear Water
b)	Total Dynamic Head as per IS-5120 at Rated Capacity (MLC)	<---------- Do ---------->		
c)	Rated Speed (rpm) Max	1500	1500	1500
d)	Noise Level	For details refer Vol-IIA, Section-V		
e)	Impeller tip speed	Not to exceed 12 m/s.		
f)	Permissible Tolerance in Rated Capacity (%)	<---------- As per applicable code ---------->		
g)	Permissible Tolerance in Efficiency at Rated Capacity (%)	<---------- No Negative tolerance ---------->		
h)	Range of Operations	<---------- Preferably 40% to 130% of Rated Capacity ---------->		
13.	Design Standard	<---------- Hydraulic Institute Standard /IS-5120/ Equivalent Standard ---------->		
14.	Impeller Type	Semi-open	Closed	Closed
15.	Type of Gland Lubrication and Sealing	Forced water	By bidder	Self-water
16.	Shaft Sealing Arrangement	<---------- Mechanical Seal ----------→		
17.	Type of Pump-motor Connection	Direct		
18.	Type of Coupling	Flexible		

Sl.No.	Description	Pumps handling Slurry	Pumps handling corrosive liquids#	Pumps handling Clear Water
19.	Mode of Pump Starting	Discharge Valve Fully Closed. However, the pumps should be capable of starting with discharge valve fully open		
20.	Material of Construction			
a)	Casing	Cast Iron/Cast steel/ Silicon carbide	Duplex Stainless steel	2% Ni CI Grade 260
b)	Casing Liner	Replaceable rubber/ elastomer liners		
c)	Diffuser	<---------- Do ---------->		Fabricated CS as per IS 2062
d)	Impeller	<---------- Do ---------->	Duplex Stainless steel	SS 304
e)	Wearing Rings	<----------By bidder, suitable for the fluid handled---------->		
f)	Shaft	Stainless AISI-410	Duplex Stainless steel	EN 8
g)	Shaft Sleeve	Hardened Stainless Steel	Duplex Stainless steel	Hardened Stainless Steel
h)	Mechanical Seal	<---------- Manufacturer's Standard suitable for liquid handled ---------->		
i)	Base Plate	IS-2062		
j)	Wetted Fasteners	Stainless Steel AISI-304	Duplex Stainless steel	Stainless Steel AISI-304

Sl.No.	Description	Pumps handling Slurry	Pumps handling corrosive liquids#	Pumps handling Clear Water
21.	Supply of Accessories & Services			
a)	Base Plate	Yes	Yes	Yes
b)	Foundation Bolts, Nuts, Sleeves etc.	Yes	Yes	Yes
c)	Suction and Discharge Companion Flanges with Bolts, Nuts and Gaskets	Yes	Yes	Yes
d)	Gland Sealing and Cooling Arrangement	Yes	Yes	Yes
e)	Bearing Lubrication and Cooling Arrangement	Yes	Yes	Yes
f)	Suction and discharge pressure Indicator	Yes, along with Diaphragm Seal		Yes
g)	Priming Connection with 3-way SS Isolating Valve	Yes	Yes	Yes
h)	Pump-motor Coupling Guard	Yes	Yes	Yes
i)	Vent with 3-way Isolating Valve	Yes	Yes	Yes
j)	Drain Connection with Valve	Yes	Yes	Yes
k)	Eye-bolts, Lifting Tackle etc.	Yes	Yes	Yes
22.	Inspection and Testing	<---------- As per Clause no. 6.00.00 of this Section ---------->		

FGD Waste Water shall be considered as corrosive liquid.

VOLUME: II-B

SECTION-IV

ATMOSPHERIC STEEL STORAGE TANKS

CONTENTS

CLAUSE NO.	DESCRIPTION	PAGE NO.
1.00.00	INTRODUCTION	1
2.00.00	CODES AND STANDARDS	1
3.00.00	SCOPE OF SUPPLY AND SERVICES	2
4.00.00	DESIGN AND CONSTRUCTION	2
5.00.00	TANK ACCESSORIES	3
6.00.00	INSTALLATION	4
7.00.00	INSPECTION AND TESTING	4
8.00.00	CLEANING, PROTECTION AND PAINTING	5
9.00.00	DRAWING, DATA AND INFORMATION REQUIRED	5

ATTACHMENT

ANNEXURE-I	DATA SPECIFICATION SHEET FOR ATMOSPHERIC STEEL STORAGE TANKS AND ACCESSORIES	7

VOLUME: II-B

SECTION-IV

ATMOSPHERIC STEEL STORAGE TANK

1.00.00 INTRODUCTION

1.01.00 The specification is intended to cover the requirement of design, fabrication, installation, supply of accessories, testing and commissioning of atmospheric steel storage tanks for Flue Gas Desulphurization system.

2.00.00 CODES AND STANDARDS

3.02.00 The design, manufacture and testing of the tanks shall comply with the requirements of the latest revisions of one or more of the following standards as applicable

2.02.01 IS-803: Code of practice for design, fabrication and erection of vertical mild steel cylindrical welded oil storage tank.

2.02.02 IS-816 : Code of practice for use of metal arc welding for general construction in mild steel.

2.02.03 IS-817: Code of practice for training & testing of metal arc welders.

2.02.04 IS-823: Code of procedure for manual metal arc welding of mild steel.

2.02.05 API-620: Recommended rules for design and construction of large welded, low pressure storage tanks.

2.02.06 API-650: Welded steel tank for oil storage.

2.02.07 API-2000: Venting Atmospheric and Low-Pressure Storage Tanks.

2.02.08 The materials of the various components shall conform to those specified in Data Specification Sheet.

2.02.09 In case of any contradiction with the aforesaid standards and the stipulations of the Technical Specification and Data Specification Sheets the stipulations of Technical Specification and Data Specification Sheets shall prevail.

2.02.10 In case of any contradiction between the technical specification and the data specification sheet, stipulations of the later shall prevail.

2.02.11 Tank capacity should be certified by the Department of Weights and Measures.

3.00.00 SCOPE OF SUPPLY AND SERVICES

3.01.00 The scope of supply and applicable standard for all the material required for fabrication and erection of tank shall be as indicated in the attached Data Specification Sheet - Annexure-I.

3.02.00 The plates as required for the fabrication of the steel tanks along with all structural supports, staircases, ladder, platforms, etc. will be supplied by the Bidder.

3.03.00 For details regarding Scope of Services and works Lead Specification Volume-IIA of this specification shall be referred.

4.00.00 DESIGN & CONSTRUCTION

4.01.00 Tanks shall be suitably constructed for safe, proper and continuous storage of liquid described in Data Specification Sheet. The design code, material standard, size and other details shall be as per the Data Specification Sheet. The tank foundation shall be high enough to reduce idle storage volume of tanks.

4.02.00 Tanks for storage of inflammable liquids shall be in accordance with the requirement specified in Indian Petroleum and Explosive rules. Before commencing the erection/construction, the relevant drawings/documents shall be got approved by Directorate of Explosive, Govt. of India.

4.03.00 For cylindrical tanks, the plates shall be cold rolled through plate bending machine by several number of passes to true curvature.

4.04.00 Vessel seams shall be so positioned that they do not pass through vessel connections. For cylindrical vessels consisting of more than two sections, longitudinal seams shall be offset.

4.05.00 Where possible, the inside seam weld shall be ground smooth, suitable for application of corrosion resistant primer.

4.06.00 Proper means shall be provided against the chance of over-turning effect of wind on an empty vertical cylindrical tank having a shell height greater than the diameter. Anchorage of tanks shall be done when "C", a dimensionless figure exceeds 0.66 where :

C = 2M/dw, for vertical cylindrical tanks
Where, M = Overturning moment due to wind, kg-m.

d = Diameter of shell, m

w = Weight of shell and portion of roof supported by shell, kg.

4.07.00 Due consideration for wind load and/or earthquake effect shall be given by the Contractor in the design of tanks as specified in API 650. Data for wind load and earthquake shall be taken as indicated in the Data Specification Sheet/lead specification. Maximum allowable stresses for design loadings combined with wind or earthquake shall not exceed 133% of stress permitted for the design loading condition but in no case shall exceed 80% of minimum specified yield strength of the material.

4.08.00 For tanks of diameter 4.75 m and thickness less than 6 mm or of diameter larger than 4.75 m added structural supports in the form of rafters shall be provided.

4.09.00 Reinforcement pads in tank connections shall be provided as per applicable code & the reinforced connection shall be completely pre-assembled into a shell plate. The completed assembly including the connection shall be thermally stress-relieved as per API Standard 620 if so specified in the Data Specification Sheet.

4.10.00 The joint efficiency factor to be adopted for design calculation shall be in accordance with the Data Specification Sheet. In absence of any such data this figure shall be taken as per applicable standard.

4.11.00 All welding shall be done as per IS:816, latest revision. All welds are to be continuous welds. Bidder shall clearly state in his offer the make and type of welding rods proposed by him for fabrication.

4.12.00 Sufficient air space is to be provided in the tank. Temperature expansion of fluid shall be taken into account.

4.13.00 The supply and return pipes shall be extended well inside (upto bottom) of the tank and wear plates shall be provided.

4.14.00 Tank Connections

4.14.01 Bidder shall furnish all piping material required for the tank connections.

4.14.02 Unless otherwise specified, for all flanged connections bidder shall furnish suitable counter flanges and the necessary nuts, bolts, gasket. Blank flanges shall be provided on spare connections.

4.14.03 Flange faces of all nozzles shall be machined square with the nozzle centerlines.

4.14.04 Unless otherwise stated, bolts and nuts shall be of hexagonal head conforming to ASTM A 193 Gr.2H & ASTM A 194 Gr.B7.

4.14.05 The material and thickness of gaskets shall be suitable for the specified service. On completion of hydraulic test, contractor shall replace the gaskets used during testing at his own cost.

5.00.00 TANK ACCESSORIES

5.01.00 The tanks shall be provided with accessories as indicated in the Data Specification Sheet. All the accessories shall conform to relevant Indian Standard and as specified. The following broad guideline are given for some of the accessories.

5.02.00 Conservation Vent Valve

Where continuous venting to atmosphere directly is not permitted for the stored liquid, a conservation vent valve or a breather of approved make and design shall be provided on each of the vent/ overflow connections of the tanks as specified.

The conservation vent valves where provided, shall be designed to relieve the pressure or vacuum corresponding to plus or minus 65mm water gauge in the space above liquid in the tank. Detail cross-sectional drawing indicating materials of construction shall be submitted.

5.03.00 Instrumentations

All other accessories, fittings and tank connections including level switches, etc. shall generally be as specified and as required by sound engineering practice. Level switches shall be mounted on standpipes and not directly on tank shell.

6.00.00 INSTALLATION

6.01.00 When installation of tank is specified, the recommendation regarding installation in IS:803 shall be followed in general. In addition to those recommendations, the following shall also be taken care of.

6.02.00 All fabricated parts, before assembly, shall be transported by the Contractor to the tank installation site. All preliminary work and fabrication in part or full shall be done at the Contractor's fabrication yard or shop as much as possible to suit his transportation arrangement subject to Purchaser's approval.

6.03.00 All material before final installation over the foundation at the respective locality shall be inspected and repaired as necessary to ensure that any damage received during transportation is corrected before erection to the satisfaction of the Engineer. Particular attention shall be given towards removal of buckles and other form of distortion in shell and bottom plates. Irregularities and dirt which would prevent metal-to-metal contact at the jointing faces shall be removed.

6.04.00 The finished tank head for cylindrical tank shall be crowned from the outer periphery to the center with a slope of around 1: 16.

Sufficient number of plugged holes shall be provided in the bottom plate of the vertical tanks for bottom testing as specified in IS:803.

6.05.00 Welding sequence shall be adopted in such a way so as to minimize the distortion due to weld shrinkage. Contractor shall indicate in his drawing the sequence of welding proposed by him which should meet prior approval of Purchaser.

6.06.00 During construction period, the tanks and the sections shall be suitably anchored and tied by guy-wires etc. to avoid blowing/ toppling/Sliding due to gusty wind.

7.00.00 INSPECTION & TESTING

7.01.00 Inspection and testing shall be carried out as per relevant code and approved Quality Assurance Plans.

7.02.00 For tank and Vessels:

7.02.01 Material Tests (Chemical Analysis, Mechanical Tests & other tests) as per applicable material standard of all components (plates, forgings etc)

7.02.02 Only Qualified welders as per approved WPS and PQR shall be deployed for fabrication of tanks.

7.02.03 Dimensional checks, during in-process and final inspection, shall be carried out for alignments, circularity, verticality, orientation of connections, slope of bottom plate etc.

7.02.04 NDT on weld joints shall be done as per relevant / applicable standard. However, minimum requirement of NDT, as given below, shall be complied:

a. 100% DPT on root run (butt welds / back-gouged welds).
b. 100% DPT on all finished welds.
c. RT on butt welded seams (which shall cover all 'T' / Cross joints) as per design code / Standard.

7.02.05 All tanks shall be subjected to hydraulic test. Other tests, (as per relevant design standard), given below shall be applicable:

a. Vacuum test for bottom plate seam testing and annular plate.
b. Air / vacuum test for roof testing.

8.00.00 CLEANING, PROTECTION AND PAINTING

The equipment shall be surface cleaned and painted as per data specification sheet.

9.00.00 DRAWING, DATA AND INFORMATION REQUIRED

9.01.00 The bidder shall submit with his offer the following besides the different information required elsewhere in this specification.

9.01.01 GA/Outline drawings of the tanks indicating plate thickness, details of structural support, stiffeners and details of connection.

9.01.02 Illustrative literature and drawings for the tank accessories.

9.02.00 The successful bidder shall submit the following:

9.02.01 Detailed fabrication drawing showing the sizes, materials, weld preparations etc. furnishing all necessary information for fabrication, erection and painting of steel work in accordance with the provision of this specification.

9.02.02 Design calculation for plate thickness etc. considering all applicable loads, seismic effect, wind load etc., also calculations for selection of tank heating coils, suction heaters etc. as specified.

9.02.03 Test procedures for tanks, QAP & FQP.

9.02.04 Test certificates

9.02.05 Instruction Manuals for the accessories supplied specially covering maintenance, repair and replacement.

Technical particulars	Tanks Data
	Process Water tank
• All instrumentation including pressure gauge, temperature gauge, temperature and level instruments, level indicator, standpipes etc. as specified and as required	Yes
• Dip hatch	Yes
• Earthing pad	Yes
• Lightning Arrestor	Yes
• Insulation cleats	No
• Cleat for fixing fire water spray pipe	No.
• Nozzle for fire detector	No

VOLUME : II-D

SECTION - I

PIPING, VALVES AND SPECIALTIES

CONTENT

CLAUSE NO.	DESCRIPTION	PAGE NO.
1.00.00	INTRODUCTION	1
2.00.00	CODES AND STANDARDS	1
3.00.00	SCOPE OF SUPPLY AND SERVICES	3
4.00.00	DESIGN AND CONSTRUCTION	4
5.00.00	INSTALLATION	10
6.00.00	DRAWING, DATA AND INFORMATION REQUIRED	12

ATTACHMENTS

ANNEXURE-I	SPECIFICATION OF PIPES & FITTINGS	13
ANNEXURE-II	SERVICES OF VARIOUS CATEGORIES OF VALVES	16
ANNEXURE-III	SPECIFICATION OF GATE/GLOBE/CHECK/BALL VALVES	17
ANNEXURE-IV	SPECIFICATION OF BUTTERFLY VALVE	19

VOLUME : II-D

SECTION-I

PIPING, VALVES AND SPECIALTIES

1.00.00 INTRODUCTION

This section covers technical requirements of all piping, associated valves and specialties that include but is not limited to the following systems.

1.01.00 Slurry Piping – shall consist of all Slurry piping within the Flue Gas Desulphurisation system such as Limestone slurry, Gypsum slurry, etc

1.02.00 Process Piping – shall consist of various categories of piping as required for operation of the FGD Plant.

1.03.00 Service Air System - shall consist of distribution of Service air for general housekeeping terminated at hose valves at buildings/ facilities of the FGD Plant.

1.04.00 Instrument Air System - shall consist of distribution of instrument quality air to pneumatically operated instruments/ valves/dampers of the FGD Plant.

1.05.00 Service water system (clarified quality) from Terminal Points to Storage tank and subsequent distribution points for process use.

1.06.00 Drinking Water System - from Terminal Point to auxiliary buildings included under FGD package.

1.07.00 Fire water system - from Terminal Points to distribution points for emergency cooling.

1.08.00 Demineralised Closed Cycle Cooling Water System – from Terminal points to and from equipment coolers within FGD Plant.

1.09.00 Waste water – shall consist of waste water generated in the FGD Plant upto Terminal point.

1.10.00 Any other low pressure piping as found necessary during detail engineering stage shall also be included.

2.00.00 CODES AND STANDARDS

2.01.00 In addition to the requirements spelt out in Volume IIA (Lead Specification), Section-V, of this specification, the design, manufacture, inspection and testing of the piping, fittings, valves and specialties covered under this specification shall conform, in general, to the standards and codes (latest edition) mentioned below :

2.01.01 IS-1239 [Part-I & II] : Mild steel tubes, tubular and other wrought steel fittings.

2.01.02	IS-3589	:	Electrically welded steel pipes for water, gas and sewage (150 to 2000 mm nominal diameter).
2.01.03	IS-554	:	Dimensions for pipe threads where pressure tight joints are required on the threads.
2.01.04	IS-1363 [Part-I & II]	:	Hexagonal head bolts, screws and nuts (size range M5 M36)
2.01.05	IS-1364	:	Precision and Semi-precision hexagon bolts, screws, nuts and lock nuts (diameter range 6 to 39 mm).
2.01.06	IS-3138	:	Hexagon bolts & nuts (M42 to M150).
2.01.07	IS-5312	:	Swing check type reflux (non-return) valves.
2.01.08	IS-2379	:	Colour code for the identification of pipelines.
2.01.09	IS-2016	:	Plain washers.
2.01.10	IS-2712	:	Compressed asbestos fibre jointing.
2.01.11	ANSI B-16.5	:	Steel pipe flanges and flanged fittings.
2.01.12	ANSI B-16.9	:	Wrought steel Butt welding flanged.
2.01.13	ANSI B-16.11	:	Forged steel fittings, Socket-welding and Threaded.
2.01.14	ANSI B-16.34	:	Steel Valves - Flanged and Butt Welding Ends
2.01.15	ASME B-36-10	:	Welded & Seamless Wrought steel Pipe
2.01.16	ASME B 36-19	:	Stainless Steel Pipe
2.01.17	ANSI B-36.10	:	Steel pipes thickness.
2.01.18	ANSI B-31.1	:	Code for Pressure Piping - "Power Piping".
2.01.19	IBR	:	Indian Boiler Regulations, with latest amendment.
2.01.20	API-600	:	Steel gate valves.
2.01.21	BS-2633	:	Class I Arc welding of ferrite steel pipe work for carrying fluids.
2.01.22	BS-534	:	Specification for steel pipes and specials for water and sewage.
2.01.23	BS-5351	:	Specification for Ball valves.
2.01.24	AWWA-C-504	:	Specification for Butterfly valves.

2.01.25 AWWA-C-208 : Dimension for fabricated steel water pipe fittings.

2.02.00 Other international codes and standards may also be offered by bidder. However, same may be subject to acceptance by the Owner/Consultant.

3.00.00 **SCOPE OF SUPPLY AND SERVICES**

3.01.00 The equipment and materials to be supplied under this section shall include but not be limited to the following:

a) Supply of all low pressure piping including bends, elbows, tees, branches, laterals, crosses, reducing union, couplings, caps, saddles, shoes, flanges, blank flanges, Y-pieces etc. as required for the piping system under the scope of this section.

b) Matching pipes, matching pieces like reducers/expanders etc., counter flanges with bolts, nuts, washers, temporary and permanent gaskets, threaded union etc. for all terminals of other packages as required.

c) Supply and machining work of flanges, pipe spools and matching pipes to connect flow measuring orifices/nozzles with the main pipe work.

d) All isolating and regulating valves, non-return valves, steam/air traps, relief/safety valves (wherever applicable), strainers, pressure reducing orifices etc. complete with the counter flanges and matching connecting pieces as required within the terminal points of entire low pressure piping system.

e) Anchors, hangers and supports, etc. as required. Any platform necessary for maintenance and operation of valve and equipment located 1.5 m above any permanent floor or platform with access ladders, supporting structures etc.

f) All secondary structural steel members required for pipe supports from building steel structures and from embedded steel wherever provided including pipe supports in trenches. However, trench piping should be avoided to the extent possible.

g) Funnels, tundishes for drips and drains including all miscellaneous drain piping and drain piping from tundish outlet up to drain points. All drain and vent lines shall be conveniently terminated to floor drain points/permanent drain trenches.

h) Flanges, counter flanges, blank flanges, bolts, nuts, washers, temporary and permanent gaskets, fasteners caps etc. as required for interconnecting piping, valves & fittings as well as for terminal points.

i) Cleaning and Painting of all piping, valves & specialties at manufacturer's shop.

3.02.00 Following general requirements shall however be included:

a) Instrument Connections including instruments, root valves, sensing lines etc.

b) Pipe stubs and blanking plates etc. required for chemical cleaning and hydro testing.

For conducting acceptance test, the required pressure, temperature, flow measurement points shall be provided.

3.03.00 All miscellaneous instruments as per approved P &ID during detail engineering stage.

3.04.00 For details regarding Scope of Services and works, Lead Specification Volume-IIA of this specification shall be referred.

3.05.00 **Terminal Points**

For terminal points, refer Volume-IIA (Lead Specification), Section-IV, of this specification.

4.00.00 **DESIGN AND CONSTRUCTION**

4.01.00 **General Considerations**

4.01.01 The piping systems included in this section shall be designed to operate continuously without replacement during the plant service life of 30 years.

4.01.02 The piping system shall be complete in every respect and in accordance with the highest standard of workmanship. Any item of the section on which the Bidder is in doubt shall be referred to the Owner for clarification.

4.01.03 All design and fabrication shall be in accordance with Codes / standards as specified.

4.01.04 No pipe work shall be run in trenches carrying electrical cables.

4.01.05 Pipe size above 50 NB shall be shop fabricated and of size 50 NB and below shall be field run.

4.01.06 All piping shall be identified by means of colour strips and by adequate lettering, conveniently spaced and located. Identification colours and lettering shall be as approved.

4.01.07 Air release and drain branches shall be provided wherever necessary depending upon the layout and arrangement so that the drains and air release valves are located for easy operation.

4.01.08 Unless otherwise specified, all pipe work shall be suitable for a minimum pressure of 10.0 kg/sq. cm(g) at 80°C or as required by the design of the different piping system, if higher.

4.01.09 **Drain Pipe work**

a) Low pressure drains shall have an isolating valve at the point of take-off from the pipe or vessel to be drained, or as near as possible for conventional operation.

b) Unless otherwise stated, all drain piping shall be of 25 mm NB minimum and all vent pipings shall be of 15 mm NB size minimum. For pipes up to 50mm NB, pipe wall thickness shall be as per schedule 80 of ANSI B36.10.

c) Unless otherwise stated, wherever a main or branch of any pipeline is terminated with a valve, such terminal valve shall be provided with a blank flange/blanking cap at the free end.

4.01.10 Specification of pipes used in different services included in the L.P piping section has been detailed in Annexure-I of this section.

4.02.00 **Material Specification**

4.02.01 Materials for pipes and fittings shall be as stipulated in Annexure-I of this section. In case bidder wants to offer alternative piping material, same may be accepted by the Owner/Consultant provided the offered material is superior than the material specified for the intended service.

4.02.02 Pipe attachments for supports, anchors and restraints, which are coming in direct contact with pipes shall have similar materials as the piping concerned. All other materials of supports, anchors and restraints shall be of tested quality and as per manufacturer's standards.

4.03.00 **Fabrication**

All pipes above 50 NB shall have butt-welded connections as per ANSI B 16.25 with a minimum of flanged joints necessary for maintenance. Piping of sizes 50 NB and below shall have socket welded connections as per ANSI B 16.11. Where flanges are adjacent to welded fittings, weld neck flanges shall be used.

Branches shall, in general, be formed by welding. Standard fittings may be used in positions and for sizes where approval has been given in detail drawings. Pipe bends and tees shall be truly cylindrical and of uniform section. all welded branches shall be reinforced where needed as per the applicable codes/regulations.

4.03.01 Piping shall be fabricated in the shop in the largest transportable sections to minimise the number of field weld joints. The choice of field weld joints locations shall be based on the traverse of the pipe through walls, floors, sleeves or other restrictive areas. Support attachments for major piping shall be done at shop.

4.03.02 All pipe bends shall be made true to angle with no negative tolerance and shall have a smooth surface free of flat spots, crease and corrugations. A cross section through any bent portion of the pipe shall be true in diameter, within

plus or minus 3% of the pipe diameter. Pipe bends shall be made from straight pipe pieces of sufficiently higher thickness so that after thinning, the minimum thickness of bends shall not be less than the minimum thickness required for the straight pipe. Thinning allowance shall be considered as per the relevant Code.

4.03.03 For bends in pipes straight piece of pipes shall be bent by the Bidder to required bend radius. However, forged bends (Bend radius = 1.5 x pipe diameter) wherever required shall be provided at no extra cost.

4.03.04 The ends of Pipe and welded fittings shall be beveled according to details shown in the relevant piping code. All welding shall be made in such a manner that complete fusion and penetration are obtained without an excessive amount of filler metal beyond root area. The reinforcement shall be applied in such a manner that it shall have a smooth contour merging gradually with the surface of adjacent pipe and welded fittings. Backing rings shall not be used on any pipe welds, unless otherwise approved by the Owner.

4.03.05 **Cutting and Beveling**

a) Carbon steel piping - End preparation for butt welding shall be done by machining/flame cutting.

b) Socket welding - Socket weld and preparation shall be done by saw or machine cutting.

4.04.00 **Hangers, Supports, Anchors**

Normally pipe supports and anchors shall be selected at those points in the buildings where provision has been made for the loads imposed. The cutting of floor/roof beams or the reinforcement in slabs will not be permitted. Piping attached to a plant item shall be supported in such a way that the weight of the piping is not taken by the plant item.

4.04.01 Support spacing shall be as per good engineering practice. However in no case it shall be less than support spacing stipulated in ANSI B31.1.

4.04.02 Accurate weight balance calculations shall be made to determine the required supporting force at each hanger location and the pipe weight load at each equipment connection.

4.04.03 All large pipes and all long pipes shall have at least two supports each arranged so that any length of pipe or valve may be removed without any additional supports being required.

4.04.04 Support steel shall be of structural quality. Perforated strap, wire or chain shall not be used. Support components shall be connected to support steel by welding, by bolting or by beam clamps. Bolt holes shall be drilled, not burned. Support components may be bolted to concrete using approved concrete anchors.

4.05.00 **Valves and Accessories**

4.05.01 **General Requirements**

a) All valves shall be of approved make and type and shall have cast/forged bodies with covers and glands of approved construction and materials as specified in Annexures-II & III of this section. The valves shall be provided with electric motors/solenoids and actuators as required.

b) Valves and specialties to be supplied under this section will be used for various air and water services and will be located indoor/outdoor and on horizontal/vertical runs of the pipelines. However, mounting of valves in vertical pipe runs should be avoided as far as possible.

c) All valves shall, unless otherwise stated, have the internal diameter same as the internal diameter of the pipes to be joined.

d) Material, design, manufacture, testing etc. for all valves and specialties along with the accessories shall conform to the latest editions of codes

e) Gate valve and Ball valve have been specified with the intention of achieving isolation and tight shut-off. In full open condition, these valves should offer minimum of resistance to fluid flow.

f) Globe valves have been specified with the intention of achieving good control of fluid passing. The plug and seat will have therefore suitable profiles for obtaining such controlling action.

g) Check valves have been specified in order to prevent reverse flow through them.

h) All valves shall function smoothly without sticking, rubbing or vibration on opening or closing and shall be suitable for most stringent service conditions i.e. flow, temperature and pressure under which they may be required to operate.

i) By pass valves shall be provided for larger size valves as per standards followed and as felt necessary for smooth and easy operation, even though not specifically mentioned in the specification.

j) All flanged valves and specialties to be supplied under this section shall be provided with two (2) counter flanges, bolts, nuts, washers, gaskets etc.

k) All valves shall be of proven design and manufacture. Where valves are of similar size and type they shall be interchangeable with one another. Valves shall have welded or flanged connections subject to the Owner's approval.

l) All valves shall have outside screwed spindles and screwed thread of spindle shall not pass through or into the stuffing box. Where valves are

exposed to the weather, protective covers shall be provided for the spindles, which shall be subject to approval.

m) Gate, Globe and Ball valves shall be provided with the following accessories in addition to other standard items:

i) Hand wheel with embossed open and shut directions.

ii) Local position indicator.

iii) Motorised operation as specified by Owner/Consultant.

n) Gate valves, in addition shall be provided with following extra features :

i) Bypass valve for larger valves.

ii) Draining arrangement.

iii) Gear operators for valves 300 mm size and above for ease in operation.

iv) Motorised operation as specified by Owner/Consultant.

o) All gate and globe valves shall be rising stem type.

p) All valves shall be provided with hand-wheels, chain, operator, extended spindle and floor stand wherever required so that they can be operated manually by a single operator from the nearest operating floor either at a lower or higher elevation as the case may be. If such a valve is provided with integral bypass then similar arrangement shall be done for the bypass valve also.

q) All valves and specialties shall be provided with brass Tag Discs indicating Tag numbers and nomenclature of the valve including duty or service intended and the function of the valves specialties.

r) Stems shall preferably be arranged vertically with gland at the top, however, in no circumstances must the stem be inclined downward from horizontal or gland be at the bottom. Globe valves shall be installed with the pressure under the disc. Valves shall not be fitted in inverted position.

s) Where necessary, for accessibility, grease nipples shall be fitted at the end of extension piping and where possible these shall be grouped together and mounted on a common panel situated at a convenient position. A separate nipple shall be provided to lubricate each point. The Bidder shall supply the first fill of oil or grease for these parts. The Bidder shall supply a suitable manually operated grease gun for the standard type of nipple provided.

t) The spindles for all valves for use outside the building shall have weatherproof protection covers of approved construction.

u) All valves shall be fitted with indicators so that it may be readily seen whether the valves are open or shut. In the case of those valves fitted

with extended spindles, indicators shall be fitted both to the extended spindles and to the valve spindles.

v) Plastic or bakelite valve hand wheels will not be accepted.

w) All valves shall be closed by rotating the hand wheel in a clockwise direction when looking at the faces of the hand wheel. The face of each hand wheel shall be clearly marked with the words 'Open' and 'Shut' with arrows adjacent to indicate the direction of rotation to which each refers.

x) Wherever practicable heavy valves of total weight including actuator, drive motor, integral by-pass etc., equal to or greater than 500 kg. shall be provided with suitable lugs to permit direct suspension by hanger rod or direct resting on bottom support, as applicable.

y) Special attention shall be given to the operating mechanism for large size valves in order that quick and easy operation is obtained and maintenance is kept to a minimum.

z) Eyebolts shall be provided where necessary to facilitate handling heavy valves or parts of valves.

aa) The Bidder shall supply with his bid and in addition during the course of the Contract, comprehensive drawings showing the design of valves, test pressure and working pressure/temperatures. They should include a parts list referring to the various materials used in the valve construction.

bb) All sampling and root valves shall be of integral body bonnet type.

4.05.02 For Design Requirements for different valves please refer Annexure-II & III of this section.

4.06.00 **Safety/Relief Valves**

Safety/Relief valves shall be of direct spring loaded type and shall have a tight, positive and precision closing.

All safety valves shall be provided with manual lifting lever.

Valves used for air and any other compressive fluid shall be of pop type.

Safety/Relief valves shall be constructed and adjusted to permit the fluid to escape without increasing the pressure beyond 10% above the set blow off pressure. Valve shall reset at a pressure not less than 2.5% and more than 5% of the set pressure.

Releasing capacity of the safety/relief valves shall be as per the applicable codes and standards and shall be subject to the approval of the Owner/Consultant.

The seat and disk of safety valves shall be of suitable material to resist erosion. The seat of valve shall be fastened to the body of the valve in such a way that there is no possibility of the seat lifting.

4.07.00 **Hose pipe and Accessories**

4.07.01 Hose valves for service water system shall be Gate valves and service air system shall be Globe valves.

4.07.02 Hose pipes with fittings for Service Water System:

a) The water hose shall be as per IS-444 (Type-3).

b) Length of each hose shall be 15 metres.

c) For each hose, one end shall be fitted with M.S. female coupling with swiveling nuts and soft seating ring suitable for connection to male end of hose valve and other end shall be made threaded for joining with the swiveling nut of a second hose whereby two hose lengths may be joined.

4.07.03 **Hose pipes with fittings for Compressed air System**

a) The compressed air hose shall be as per IS-911 (Type 2).

b) The length and type of each end shall be similar to as specified in above clause no. (b & c) above.

5.00.00 **INSTALLATION**

5.01.00 All fittings like "T" pieces, flanges, reducers etc. shall be suitably matched with pipes for welding. The valves will have to be checked, cleaned or overhauled in full or in part before erection, after chemical cleaning and during commissioning.

5.02.00 Adjustments like removal of oval ties in pipes and opening or closing the fabricated bends of high pressure piping to suit the layout shall be considered part of work and the Erection Bidder is required to carry out such work as per instruction of Bidder/Owner, which shall include specified heat-treatment procedures, etc. also wherever required.

5.03.00 Certain adjustments in length may be necessary while erecting high pressure pipelines and the Contractor should remove the extra lengths to suit the final layout after preparing edges afresh and adopting specified heat treatment procedures.

5.04.00 Suspension for piping, pressure parts, etc., will be supplied in running lengths, which shall be cut to suitable sizes and adjusted as required.

5.05.00 All the valves, lifting equipments, actuators, power cylinders, etc., shall be serviced and lubricated to the satisfaction of Owner before erecting the same and also during pre- commissioning. Even after commissioning, the equipments, if there are problems in the operation, they have to be attended to by the Bidder

during the tenure of the contract. Welding or jointing of extension spindle for valves to suit the site conditions and operational flexibility shall be part of erection work.

5.06.00 All tubes and pipes shall be cleaned and blown with compressed air and shown to the Owner before lifting. Bigger size pipes should be cleaned with flexible wire brush, wherever necessary. After cleaning is over the end caps shall be put back in tube openings till such time they are welded to other tubes.

5.07.00 Fine fittings, drain piping, oil systems & other small bore piping have to be routed according to site conditions and hence shall be done only in position. As such, layout of small-bore piping shall be done as per site requirement. There is a possibility of slight change in routing the above pipelines even after completion of erection, which shall be carried out by the Bidder without any extra cost to the Owner. Work shall also include fabrication of small bends at site from straight lengths to suit the site conditions.

5.08.00 Welding of temporary supports, cleats, etc., on the building columns shall also be avoided. In case of absolute necessity, Erection Bidder shall take prior approval from Bidder/Owner. Further, any cutting or alteration of member of the structure or platform or other equipments shall not be done without specific prior approval of Owner.

5.09.00 Wherever piping erected by the Erection Bidder is connected to piping or equipment erected by some other agencies the joint at the connecting point shall be considered under this specification.

5.10.00

a) All piping shall be grouped wherever practicable and shall be routed to present a neat appearance.

b) The piping shall be arranged to provide clearance for the removal of equipment for maintenance and for easy access to valves, instruments and other piping accessories required for operational maintenance.

c) Piping shall be routed above ground unless otherwise specifically indicated/ approved by the Owner. In such special case, the piping may be arranged in trenches, or buried and properly protected as per AWWA Standards.

d) Overhead piping shall have a minimum overhead clearance of 2.5 meters above walkways and working areas and 8 meters above roadways unless otherwise approved by the Owner.

e) Drains shall be provided at all low points and vents at high points as per actual layout regardless of whether some have been shown in respective Tenders drawings or not. The pipelines shall be sloped towards the drain points.

5.11.00 All drips and drains for piping and equipment whether shown in the Tender drawings or not shall terminate on the ground floor up to station drain unless otherwise specified. Leading such drains up to station drainage is also the responsibility of the Bidder.

6.00.00 DRAWING, DATA AND INFORMATION REQUIRED

6.01.00 Drawings, data, Information to be furnished by the Bidder besides those already mentioned in Volume-IIA (Lead Specification) with the offer.

6.01.01 A complete list of all piping and fittings of various sizes with their quantities and details e.g. nominal size, O.D., I.D. (as applicable) thickness, design pressure, design temperature, material of construction/code/standards etc.

6.01.02 A complete list of all valves with their type, quantities & ratings.

6.01.03 Manufacturer's catalogue indicating complete range of available size and rating of pipes & fittings.

6.01.04 Descriptive literature on the manufacturing process and quality control procedures highlighting the manufacturing, fabricating and testing facilities available in the shop.

6.02.00 **After Award of Contract**

Detail drawings including fabrication drawings of all shop fabricated piping system indicating design parameters and complete bill of material (Relevant Standards and grades to be indicated) and information/data pertaining to the hydrostatic and non-destructive test requirements to be submitted progressively.

6.02.01 Detail dimensioned drawing of each valve, specialties, indicating tag no., pressure rating, manufacturing standard, the bill of materials and hydrostatic test pressures. The drawing shall include the end preparation details and shall indicate the position of the hand wheel/operator. Technical particulars of motor operators wherever applicable shall also be indicated.

6.02.02 General arrangement drawing for each hanger/support/anchor etc. indicating identification number, auxiliary supporting structural details, other details & information as required in the specification.

6.02.03 Wiring diagram for all limit switches of motor operated valves.

6.02.04 The loading data required for design of structures shall be furnished well in advance to suit Owner's project schedule.

ANNEXURE-I

SPECIFICATION OF PIPES & FITTINGS

Sl. No.	Services	Slurry Piping	Service Water and Deminerlised Cooling Water	Drinking Water (chlorinated)	Service and Instrument Air	Auxiliary Steam
1.0	**Material of Pipe**					
a)	Above 150 mm NB	IS-3589 with minimum pipe thickness of 6 mm and 5 mm thick rubber lining.	IS-3589 with minimum pipe thickness of 6 mm	IS-3589 with minimum pipe thickness of 6 mm, galvanized as per IS-4736	Stainless steel as per ASTM A-312 Gr. 304 as per schedule 10S, ANSI B-36.19.	Carbon Steel, ASTM A-106, Gr. B or C.
b)	80 to 150 mm NB	IS-1239 Heavy Grade with 5 mm thick rubber lining	IS-1239 Heavy Grade	IS-1239 Heavy Grade, galvanized as per IS-4736		
c)	Below 80 mm NB	FRP			Stainless Steel as per ASTM A-312 Gr. 304 as per schedule 40S ANSI B36.19	
2.0	**Construction**	ERW / Seamless	ERW / Seamless	ERW / Seamless	Seamless	Seamless
3.0	**Joints**			Pipe to pipe joint shall be with union as per IS:1239, Part-II.		
a)	65 mm NB and above	Flanged	Slip on Flange / butt weld	Screwed flange	Slip on Flange / butt weld	Slip on Flange / butt weld
b)	size 50 mm NB and below.		Socket weld	Screwed socket	Socket weld	Socket weld
4.0	**Fittings**					
4.1	Materials					

ANNEXURE-I

Sl. No.	Services	Slurry Piping	Service Water and Deminerlised Cooling Water	Drinking Water (chlorinated)	Service and Instrument Air	Auxiliary Steam
a)	Pipe Sizes ≥ 65 mm NB	ASTM-A-234 Gr. WPB with 5 mm thick rubber lining.	ASTM-A-234 Gr. WPB	ASTM-A-234 Gr. WPB galvanized as per IS-4736	ASTM-A-351-CF8 or ASTM-A-403 WP304	ASTM-A-234 Gr. WPB
b)	Pipe Sizes ≤ 50 mm NB	FRP	ASTM-A-105 or as compatible with IS:1239	ASTM-A-105 or as compatible with IS:1239 and galvanised as per IS-4736	ASTM-A-182 F304	ASTM-A-105
4.2	Construction	Welded/ Seamless				
a)	Pipe Sizes ≥ 65 mm NB		Welded/ Seamless	Welded/ Seamless	Welded/ Seamless	Welded/ Seamless
b)	Pipe Sizes ≤ 50 mm NB		Forged	Forged	Forged	Forged
4.3	Standard					
a)	Above 150 mm NB	ANSI-B-16.9/ For fabricated fitting AWWA-C-208	ANSI-B-16.9 / For fabricated fitting AWWA-C-208	ANSI-B-16.9	MSS-SP-43	ANSI-B-16.9
b)	80 to 150 mm NB	ANSI-B-16.11 or IS:1239, Part-II	ANSI-B-16.11 or IS:1239, Part-II	ANSI-B-16.11 or IS:1239, Part-II		
c)	Below 80 mm NB	As per applicable manufacturer's standard.			ANSI-B-16.11	ANSI-B-16.11
4.4	End details					
a)	Pipe Sizes ≥ 65 mm NB	Flanged	Butt welded as per ANSI-B-16.25	Screwed Flanged.	Slip - on flanges as per ANSI B16.5. Butt welded for Pipe fittings	Butt welded as per ANSI-B-16.25

ANNEXURE-I

Sl. No.	Services	Slurry Piping	Service Water and Deminerlised Cooling Water	Drinking Water (chlorinated)	Service and Instrument Air	Auxiliary Steam
					and flanged for valves and equipments.	
b)	Pipe Sizes ≤ 50 mm NB		Socket welded as per ANSI-B-16.11	Screwed socketed as per ANSI-B-16.11 or IS:1239, Part-II	Socket welded as per ANSE B16.11	Socket welded as per ANSI-B-16.11
5.0	**Flanges**	Applicable class as per ANSI-B-16.5 complete with nuts, bolts and gaskets	150 lb class as per ANSI-B-16.5 complete with nuts, bolts and gaskets	As per ANSI-B-16.5 pressure class 150lbs - galvanised- complete with nuts, bolts and gaskets.	As per ANSI-B-16.5, 150lb pressure class complete with nuts, bolts and gaskets. Material as per class 4.01.00.	Applicable class as per ANSI-B-16.5 complete with nuts, bolts and gaskets
	Pipes shall be hydrostatically tested according to the said code, for other Codes please refer Volume-IIA (Lead Specification), Section-V of this specification.					

Note:

1) **Piping system not covered in above table shall be as per Vendor's proven practice, subject to approval by Purchaser**
2) **For waste water handling system, all piping and fittings shall be HDPE material.**

ANNEXURE-II

SERVICES OF VARIOUS CATEGORIES OF VALVES

Valve Classification		Service		
A.	Cast iron body Gate/Globe/Check Valve	i)	Service Water (Clarified).	For sizes 65 mm NB to 300 mm NB.
		ii)	Drinking Water.	
B.	Stainless steel body Ball/ Check Valve	i)	Service and Instrument Air.	For all sizes.
C.	Steel Body Gate/ Globe/ Check Valves	i)	Service Water (Clarified).	For sizes less than and equal to 50 mm NB.
		ii)	Drinking Water	
		iii)	Auxiliary Steam	For all sizes
		iv)	Inhibited Demineralised Water for DMCW system	
D.	Cast Iron body butterfly valve		Service Water (Clarified).	For sizes above 300 mm NB
E.	Cast Steel Knife Gate/ Butterfly valves with rubber lining		Limestone/ Gypsum Slurry	For all sizes

ANNEXURE-III

SPECIFICATION OF GATE/GLOBE/CHECK/BALL VALVES

Sl. No.	Description	A. Cast Iron Body Gate/ Globe/Check Valve	B. Stainless steel Body Check/Ball Valve	C. Steel Body Gate/ Globe/Check Valve
1.0	**Valve Classification Code**	CIGC	SSGC	STGC
2.0	**Basic Design Code**			
2.1	Gate	i) IS 780 for 50 mm - 300 mm NB ii) IS2906 for 350 mm NB and above or as per MSS-SP-70		i) API 600 for 50mm NB and above /ANSI-B-16.34 ii) API 602 for size below 50mm NB/ANSI-B-16.34
2.2	Globe	MSS - SP - 85		BS-1873/ANSI-B-16.34
2.3	Check	IS-5312/MSS - SP -71	ANSI-B-16.34	BS-1868/ANSI B16.34
2.4	Ball		BS-5351	
3.0	**Pressure Class**	To be suitably chosen considering the pressure requirement. Refer Clause No. 4.01.08 in this regard.		
4.0	**Construction**	Cast body and bonnet / cover.	Forged body up to 50mm NB and Cast body above that.	
5.0	**Material**			
5.1	Body & Bonnet/ cover	IS 210 Gr. FG 260 or ASTM A216 Class B.	i) ASTM-A-182 F304 for Ball Valves ii) A351 CF8M for cast body check valves, iii) A 182 F304 for forged body check valves.	i) ASTM-A-216 Gr. WCB for cast body valves ii) ASTM-A-105 for forged body valves.
5.2	Trim / Disc.	IS-210 Gr. FG 260 or ASTM A216 Class B.	i) ASTM-A-182 F304 for Check valves ii) 351CF 8M for Ball valves.	i) 13% Cr Steel as per ASTM-A-182 Gr. F6 heat treated and hardened (min 250 HB) for cast body ii) ASTM-A-105 Hard faced

ANNEXURE-III

Sl. No.	Description	A. Cast Iron Body Gate/ Globe/Check Valve	B. Stainless steel Body Check/Ball Valve	C. Steel Body Gate/ Globe/Check Valve
				with Stellite (min 350 HB) for forged body.
5.3	Seating surface	13% Cr steel as per IS 1570.	For Ball valves PTFE seats and seals.	13% Cr. Steel as per ASTM-A-182 Gr. F6
6.0	**End Preparation**	Socket welded for size equal to and below 50 mm NB and flanged with counter flanges for 65 mm NB and above.		
7.0	**Testing**			
	a) Gate	i) As per IS - 780 for 50 mm - 300 mm NB	As per ANSI B-16.34	API-598
		ii) IS-2906 for sizes equal to and above 350 mm NB		
	b) Globe	Hydrostatic Test as per MSS-SP-85		BS-1873
	c) Check	IS-5312/MSS-SP-71		BS--1868

Note: For Waste water handling system, all valves shall be duplex stainless material.

ANNEXURE-IV

SPECIFICATION OF BUTTERFLY VALVE

1.0	Valve classification Code	:	CIBF
2.0	Basic Design Code	:	AWWA-C-504
3.0	Pressure	:	To be suitably chosen by the Bidder according to requirement, but not less than class 75A as per AWWA-C-504.
4.0	Construction	:	Cast Body and Disc
5.0	Material		
	a) Body	:	2% Ni Cast Iron as per IS-210 Gr. FG260 with 2% Ni.
	b) Valve Disc	:	-Do-
	c) Valve Shaft	:	Stainless Steel ASTM-A-479 type 304
	d) Seat ring	:	Clamping ring Stainless Steel ASTM-A-479 type 304
	e) Shaft Bearing	:	Ferrobestos LA-33
	f) Gland Packing	:	Impregnated Teflon
	g) Seal	:	Nitrile Rubber
6.0	End preparation	:	Flanged, Drilled as per ANSI B16.1. Necessary counter flange nuts, bolts, gaskets are to be provided with each valve.
7.0	Testing	:	As per AWWA-C-504. However valve disc strength for both forward reverse flow is to be carried out as per BS 5155. Certificate for proof of design test for similar type of valve is to be furnished.

Note:

1) For Slurry lines rubber lining/EPDM/equivalent protection to be provided.
2) For Waste water handling system, all valves shall be duplex stainless material.

SUBSECTION-II B

GENERAL TECHNICAL REQUIREMENTS (ELECTRICAL)

A.C. & D.C. MOTORS

1.00.00SCOPE

1.01.0 This specification covers the general requirements of the electric motors for Limestone based flue gas de-sulphurisation system.

1.02.00Motors shall be furnished in accordance with both this general specification and the accompanying driven equipment specification.

1.03.00 In case of any discrepancy, the driven equipment specification shall govern.

1.04.00 Recommended spare parts for three (3) years operation in addition to mandatory spares

2.00.00CODES & STANDARDS

2.01.00All motors shall conform to the latest applicable IS, IEC and CBIP Standards/Publications except when otherwise stated herein or in the driven equipment specification.

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

3.00.00SERVICE CONDITIONS

3.01.00The motors shall be installed in hot, humid and tropical atmosphere, highly polluted area.

3.02.00 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the annexure to this specification.

3.03.00 For motor installed outdoor and exposed to direct sunrays, the effect of solar heat shall be considered in the determination of the design ambient temperature.

4.00.00 TYPE AND RATING

4.01.00**A.C. Motors**

4.01.01 Motors shall be general purpose, constant speed, squirrel cage, three/single phase, induction type.

4.01.02All motors shall be either totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV) or closed air circuit air cooled (CACA) or closed air water

cooled (CACW) type. Temperature rise shall be limited to 70 deg C by resistance method for class F insulation.

4.01.03 All motors shall be rated for continuous duty (S1). They shall also be suitable for long period of inactivity.

4.01.04 All LT motor shall conform to minimum efficiency performance standards (MEPS) of IE3 mentioned in IS: 12615. All HT motors shall have efficiency and power factor higher than 90% and 0.83 power factor respectively.

4.01.05 The motor name plate rating at 50^0C shall have at least 15% margin for LT system and 10% margin for HT system, over the input power requirement of the driven equipment at rated duty point and also covering the maximum load demand of the driven equipment under entire operating range, including voltage and frequency variations, unless stated otherwise in driven equipment specification or in general electrical specification.

4.01.06 The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating, pull up, break down and full load torques are available for the intended service. The direction of rotation of motor and its cooling fan should be properly matched with the driven equipment.

4.02.00 **AC motor for VFD application**

4.02.01 Inverter duty motors are designed according to the requirements of IEC/TS- 60034 part 17 & part 25 or NEMA MG-1, Part-30, Part 31 and have performance characteristics match with the driven equipment and variable speed requirement.

4.02.02 Induction motors to be operated in adjustable-speed drive applications should be de-rated as per NEMA/IEC standard due to the reduction in cooling resulting from any reduction in operating speed and the effect of additional losses introduced by harmonics generated by the control.

4.02.03 Inverter duty motors shall have VPI/improved insulation systems that do not degrade readily due to transient voltage spikes and have an adequate thermal margin.

4.02.04 Inverter duty motors shall be self-ventilated without any auxiliary blower. Force ventilation shall be subject to purchaser approval.

4.02.05 Inverter motor shall be suitable for scalar (open loop) control, without any speed feedback signal, where fast response is not required. Vector (closed loop) control will be used with encoder if specified.

4.02.06 The breakdown torque at any frequency within the defined frequency range shall be not less than 150% of the rated torque at that frequency when rated voltage for that frequency is applied.

4.02.07 The motor should be capable of producing a breakaway torque of at least 140% of rated torque requiring not more than 150% rated current when the voltage

boost is adjusted to develop rated flux in the motor and when the inverter is able to produce the required minimum fundamental frequencies.

4.02.08 The motor shall be provided with insulated bearing on one side.

4.02.09 Normally the maximum safe speed shall be as per IEC/NEMA, however it should be co-ordinated with VSD requirement.

4.02.10 In case of a conflict, the requirement mentioned under clause no. 4.02.00 for motors for VFD application shall supersede the corresponding requirement for standard motors.

4.03.00 **D.C. Motors (If applicable)**

4.03.01 D.C. motor provided for emergency service shall be shunt wound type. It can also be of compound-wound type with the series field shorted.

4.03.02 Motor shall be sized for operation with fixed resistance starter for maximum reliability. Starter panel complete with all accessories shall be included in the scope of supply.

5.00.00 PERFORMANCE

5.01.00 **Running Requirements**

5.01.01 Motor shall run continuously at rated output over the entire range of voltage and frequency variations as given in the annexure.

5.01.02 The motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals. The mill motors shall be suitable for operating at 75% of rated voltage for one (1) minute

5.02.00 **Starting Requirements**

5.02.01 Motor shall be designed for direct on line starting at full voltage. Starting current shall not exceed 600% of full load current (subject to IS tolerance of 20%) for HT motors rated upto 1000kW. For HT motors above 1000kW upto 3000kW starting current shall not exceed 600% of full load current without any positive tolerance. For HT motors above 3000kW starting current shall not exceed 450% of full load current without any positive tolerance.

For LT motors the starting current shall be as per the limit mentioned in the relevant standard with IE-3 efficiency class. For D.C. Motors the starting current shall be limited to 2 times full load current.

5.02.02 The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage.

5.02.03 All motors (except mill motors) shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminals Mill motors shall start with rated load and accelerate to full speed with 85% of rated voltage.

5.02.04 Motor shall be capable of three equally spread starts per hour, two starts in quick succession from cold condition and one restart from hot condition.

Cold Motor Starting

Under specified voltage variations two (2) starts in quick succession and third start five (5) minutes thereafter, all with full load (including loaded equipment) of driven equipment. No additional start shall be made till lapse of further thirty (30) minutes.

(b) Hot Motor Starting

Under specified voltage variations, one (1) immediate and two (2) fifteen (15) minutes interval starts all with full load (including loaded equipment) of driven equipment. No additional start shall be made till lapse of further thirty (30) minutes.

(c) Motor shall also be suitable for three (3) equally spread starts per hour when the motor is under normal service condition.

5.02.05 Pump motor subject to reverse rotation shall be designed to withstand the stresses encountered when starting with non-energized shaft rotating at 125% rated speed in reverse direction.

5.03.00 **Stress During Bus Transfer**

5.03.01 Motors subjected to bus transfer shall be suitable for sudden application of 150% rated voltage during bus transfer, due to the phase difference between the incoming voltage and motor residual voltage.

5.03.02 The motor shall be designed to withstand any torsional and/or high current stresses, which may result, without experiencing any deterioration in the normal life and performance characteristics.

5.04.00 **Locked Rotor Withstand Time**

5.04.01 For motors with starting time up to 20 secs, starting time at minimum permissible voltage should be less than the locked rotor withstand time under hot condition at highest voltage limit by at least 2.5 secs.

For motors with starting time more than 20 secs. and upto 45 secs, starting time at minimum permissible voltage should be less than the locked rotor withstand time under hot condition at highest voltage limit by at least 5 secs.

For motors with starting time more than 45 secs, starting time at minimum permissible voltage should be less than the locked rotor withstand time under hot condition at highest voltage limit by at least 10% of the starting time.

5.04.02 To prevent unwanted tripping of a high inertia load at start-up, there may be need to shunt out the motor's overload trip device. Speed switches mounted

on the motor shaft may be provided in such case. Heating experienced during start-up must still be considered when sizing the motor.

5.04.03 Hot thermal withstand curve shall have a margin of at least 10% over the full load current of the motor to permit relay setting utilising motor rated capacity.

5.05.00 Torque Requirements

5.05.01 Accelerating torque at any speed with the lowest permissible starting voltage shall be at least 10% motor full load torque.

5.05.02 Pull out torque at rated voltage shall not be less than 205% of full load torque.

6.00.00 SPECIFIC REQUIREMENTS

6.01.00 **Enclosure**

6.01.01 All motor enclosures and terminal boxes shall conform to the degree of protection IP-55 unless otherwise specified. Motor for outdoor or semi-outdoor service shall be of weather-proof construction.

Motors, located inside a building and not directly exposed to coal dust or fly ash, could have screen protected drip proof enclosure conforming to IP-23.

6.01.02 Motor located in hazardous area shall have flameproof enclosure conforming to IS: 2148 /Equiv.

6.03.00 **Cooling**

6.03.01 The motor shall be self ventilated type, either totally enclosed fan cooled (TEFC) or closed air circuit air- cooled (CACA).

6.03.02 For large capacity motors, totally enclosed tube ventilated (TETV) may be considered for acceptance. In case of motors rated 3000kW and above, closed air circuit water cooled (CACW) motors may be offered for consideration before proceeding with design and manufacturing.

6.04.00 **Winding and Insulation**

6.04.01 All insulated winding shall be of copper.

6.04.02 HT and LT motors shall have Class F insulation with winding temperature limited to 120ºC. Windings shall be impregnated to make them non-hygroscopic and oil resistant. The lightning impulse and coil inter-turn insulation surge withstand level shall be as per IEC-60034 – Part 15.

6.05.00 **Tropical Protection**

6.05.01 All motors shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.

6.05.02 All fittings and hardwares shall be corrosion resistant.

6.06.00 **Bearings**

6.06.01 Motor rated above 1000kW shall have insulated bearings to prevent flow of shaft currents.

6.06.02 Vertical shaft motors shall be provided with thrust and guide bearings.

6.07.00 **Noise & Vibration**

6.07.01 The noise level shall not exceed 85 db (A) at 1.0 meters from the motor.

6.07.02 Peak amplitude of vibration shall be limited within the values prescribed in IS: 12075 / IEC 60034-14.

6.08.00 **Motor Terminal Box**

6.08.01 Motor terminal box shall be detachable type, made of cast iron or pressed steel and located in accordance with Indian Standards clearing the motor base-plate / foundation.

6.08.02 Terminal box shall be capable of being turned 360 Deg. in steps of 90 Deg., unless otherwise approved.

6.08.03 The terminal box shall be split type with removable cover with access to connections and shall have the same degree of protection as motor. Terminal box for all LT motors shall be diagonally split type.

6.08.04 The terminal box shall have sufficient space inside for termination / connection of XLPE (11000V/3300V) or XLPE (415V) insulated armoured aluminium cables. Where the specified main cable size demands, adopter / extension box of suitable size shall be provided as a part integral to the motor, for easy termination of the cable.

6.08.05 Terminals shall be stud or lead wire type, substantially constructed and thoroughly insulated from the frame.

6.08.06 The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor.

6.08.07 The terminal box shall be capable of withstanding maximum system fault current for a duration of 0.25 sec.

6.08.08 For 11000V and 3300V motor, the terminal box shall be phase-segregated type. The neutral leads shall be brought out in a separate terminal box (not necessarily phase segregated type) with shorting links for star connection.

6.08.09 Motor terminal box shall be furnished with suitable cable lugs and double compression brass glands to match with cable used.

6.08.10 The gland plate for single core cable shall be non-magnetic type.

6.08.11 Motors rated 1000kW and above shall be provided with neutral current transformers of PS class on each phase in a separate neutral terminal box for differential protection.

6.09.00 **Grounding**

6.09.01 The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GI bolts and washer.

6.09.02 The grounding connection shall be suitable for accommodation of ground conductors as follows:

Motor above 90KW	:	50 x 6 mm GS Flat
Motor above 30KW up to 90KW	:	25 x 6 mm GS Flat
Motor above 5KW up to 30KW	:	25 x 3 mm GS Flat
Motor up to 5KW	:	8 SWG GI Wire

6.09.03 The cable terminal box shall have a separate grounding pad.

6.10.00 **Rating Plate**

In addition to the minimum information required by IS, the following information shall be shown on motor rating plate:

a) Temperature rise in Deg.C under rated condition and method of measurement.

b) Degree of protection (IP No.).

c) Bearing identification no. and recommended lubricant.

d) Location of insulated bearings.

7.00.00 ACCESSORIES

7.01.00 **General**

Accessories shall be furnished, as listed below, or if otherwise required by driven equipment specification or application.

7.02.00 **Space Heater**

7.02.01 Motor of rating 30KW and above shall be provided with space heaters, suitably located for easy removal or replacement.

7.02.02 The space heater shall be rated 240V, 1 phase 50Hz and sized to maintain the motor internal temperature above dew point when the motor is idle.

7.03.00 **Temperature Detectors**

7.03.01 All 11000V and 3300V motors shall be provided with minimum four (4) numbers simplex or two (2) numbers duplex platinum resistance type winding temperature detectors per phase.

7.03.02 11000V and 3300V motor bearing shall be provided with one (1) duplex or two (2) simplex type temperature detectors.

7.03.03 The temperature detector mentioned above shall be resistance type, 3 wire, platinum wound, 100 Ohms at 0 deg.C.

Leads of all duplex or simplex type motor winding RTDs and motor bearing RTDs shall be wired up to respective switchgear metering & protection compartment. From which one set of RTDs shall be connected to numerical protection relay and another set shall be kept free for DDCMIS connectivity.

7.04.00 **Indicator/Switch**

7.04.01 Dial type local indicator with alarm contacts shall be provided for the following:

a) 11000V and 3300V motor bearing temperature.

b) Hot and cold air temperature of the closed air circuit for CACA and CACW motor.

7.04.02 Flow switches shall be provided for monitoring cooling water flow of CACW motor and oil flow of forced lubrication bearing, if used.

7.04.03 Alarm switch contact rating shall be minimum 0.5A at 220V D.C. and 5A at 240V A.C.

7.05.00 **Current Transformer for Differential Protection**

7.05.01 Motor above and including 1000KW shall be provided with three differential current transformers (PS class) mounted over the neutral leads within the enclosure. Loose three (3) numbers matching PS class CT shall be supplied for mounting on switchgear.

7.05.02 The arrangement shall be such as to permit easy access for C.T. testing and replacement. Current transformer characteristics shall match with the requirements of differential protection relay.

7.06.00 **Accessory Terminal Box**

7.06.01 All accessory equipment such as space heater, temperature detector, current transformers etc., shall be wired to and terminated in terminal boxes, separate from and independent of motor (power) terminal box.

7.06.02 Accessory terminal box shall be complete with double compression brass glands and pressure type terminals to suit required cable connections.

7.07.00 **Drain Plug**

Motor shall have drain plugs so located that they shall drain the water, resulting from the condensation or other causes from all pockets of the motor casing.

7.08.00 **Lifting Provisions**

Motor weighing 25 Kg. or more shall be provided with eyebolt or other adequate provision of lifting.

7.09.00 **Dowel Pins**

The motor shall be designed to permit easy access for drilling holes through motor feet or mounting flange for installation of dowel pins after assembling the motor and driven equipment.

7.10.00 **Painting**

Motor including fan shall be painted with corrosion proof paints.

8.00.00 TESTS

8.01.00 Upon completion, each motor shall be subject to standard routine tests as per IS. In addition, any special test called for in the driven equipment specification shall be performed.

8.02.00 Unless and otherwise stated, Six (6) copies of routine test certificates shall be submitted for approval prior to the dispatch of the motors from works.

8.03.00 The following type test reports shall be submitted for each type and rating of 11 kV & 3.3 kV motor:

a) Degree of protection test for the enclosure followed by IR, HV and no load run test.

b) Fault level withstand test for each type of terminal box.

c) Lightning impulse withstand test on the sample coil as per IEC 60034, part-15.

d) Surge withstand test on inter-turn insulation as per clause no. 5.1.2 of IEC 60034, part-15.

SPARES

Recommended spares for three (3) years operation shall be quoted along with the bid clearly identifying the part numbers with recommended quantities.

09.00.00 DRAWINGS, DATA & MANUALS

Drawings, data & manuals for the motors shall be submitted as indicated below:

09.01.00 **Along with the bid**

a) List of the motors

b) Individual motor data sheet as per format of the proposal data sheets.

c) Scheme & write up on forced lubrication system, if any

d) Type test report

09.02.00 **After Award of the Contract**

a) Dimensional General Arrangement drawing

b) Foundation Plan & Loading

c) Cable end box details

d) Space requirement for rotor removal

e) Thermal withstand curves hot & cold

f) Starting and speed torque characteristics at 80% & 100% voltage

g) Complete motor data

h) Erection & Maintenance Manual

i) Efficiency curves.

j) List of motors.

k) Test reports

DESIGN DATA

1.0 SERVICE CONDITIONS

Refer Vol-IIA of Specification for FGD package.

2.0 AUXILIARY POWER SUPPLY

Supply	Description	Consumer
H.T. Supply	11000V, 3Ø, 3W, 50 Hz, non-effectively earthed. Fault level 40kA symm. for 3sec	Motors above 750kW
	3.3kV, 3Ø, 3W, 50 Hz, non-effectively earthed. Fault level 40kA symm for 3sec	Motors above 160kW up to & including 750kW
L.T. Supply	415V, 3Ø, 3W, 50 Hz, effectively earthed. Fault level 50kA symm for 1sec	Motors above 200W upto 160 kW
	240V, 1Ø, 2W, 50 Hz, effectively earthed.	Motors less than 200W, Lighting, space heating, A.C. control & protective devices
D.C. Supply	220V, 2W, unearthed. Fault level 25*kA for 1sec	D.C. alarm, control & protective devices

* Indicative only; actual value shall be decided by the Bidder, after substantiating the same by calculation.

3.0 RANGE OF VARIATION

A.C. Supply

Voltage: ± 10% Frequency: ± 5%

Combined Volt & frequency: 10%(absolute sum)

D.C. Supply

Voltage: (+10% to -15%)

SCHEDULE OF PRE-COMMISSIONING TESTS OF ~~TRANSFORMER &~~ ELECTRICAL EQUIPMENT

1.	**Power Transformer**	
	Pre-commissioning Tests	
a.	The following test shall be carried out a site as minimum requirements before energizing of a transformer. All tests which may not have been specifically mentioned here but necessary for commissioning and any tests, which have been specifically asked for by the purchaser shall be done by Bidder at no extra cost:	
b.	IR test on each winding to ground and between windings	
c.	Turns ratio test on each tap	
d.	Polarity and vector group test	
e.	Measurement of winding resistance of HV & LV windings for all taps by Kelvin bridge	
f.	IR, wiring and operational tests on all control devices in control cabinet, oil level indicator, winding and oil temp. indicators, cooling fan etc.	
g.	Checking of earthing with respect to transformer tank (flexible from top cover to tank) other parts, neutral and tank to electrodes of Las (for Las located near to transformer)	
h.	Testing of buchholz relay for alarm and trip conditions	
i.	For bushing CTs, tests applicable shall be as for current transformers.	
j.	Setting of oil/winding temperature indicators, level gauge and checking of alarm/trip circuits.	

9.	**AC Motors (including slip rings motor)**	
a	IR test of stator and rotor windings.	
b	Heating of both windings upto the permissible temp. limit from heating curve (only for HT motors).	
c	Ensure that checking / testing of associated switchboard, cables, relays / meter interlockings as mentioned in relevant chapters are completed.	
d	Check tightness of cable connection.	
e	Winding resistance measurement of stator and rotor.	
f	Checking continuity of winding.	
g	Check tightness of earth connections.	
h	Check space heaters and carryout heating of winding (if required).	
i.	Check direction of rotation in decoupled condition during kick start.	
j	Measure no load current for all phases.	
k	Measurement of temperature of body during No-load and load conditions.	
l	Check for tripping of motor from local / remote switches and from electrical / technological protection including differential protection.	
m	Checking of vibration (if required)	
n	Checking of noise level (if required).	
o	During load running, measurement of stator and bearing temperatures (if applicable) for every half an hour interval till saturation comes.	
p	Checking tightness of foundation bolts.	

q	Check operation of speed switch (if there).	
r	Check continuity of temp. detectors.	
s	Check alignment, paralleling of shafts, level of lubricating oil etc. as per manufacturer's manual.	
t	Check contact of slip ring brush and measure brush pressure (150-200 gm/sq.cm).	
u	For CACW drive check cooling water and system / piping, availability of pressure cleaning and pressure testing of pipelines etc.	
v	Check for polarisation index of stator windings R10 / R1 by motorised megger. (The value should not be less than 2.0). R60/R10 absorption co-efficient shall not be less than 1.5	
w	Dielectric test (only for HT motors).	
X	Measurement of open circuit rotor winding voltage for slip ring motor.	
10	**Motors (DC) If required**	
a	IR measurement and heating the winding as per heating curve.	
b	Check for earth connection.	
c	Winding resistance for field and armature.	
d.	Check running of drive at minimum and maximum specified voltage.	
e	Check auto start of drive on failure of AC supply (if applicable).	
f	Check operation of overload relay.	

g	Measure vibration.	
h	Check temperature rise on body of drive after required period of continuous running.	
i	Measure load currents and no load currents (if possible).	
j.	Check direction of rotation.	
k.	Check continuity of winding.	
l	Measurement of RPM.	
11	**For actuator drives following shall be checked / tested.**	
a	Visual and dimensional	
b	Hydraulic pressure for valves	
c	IR and operation of limit switches	
d	Winding resistance	
12	**CRANE/HOIST**	
a	Check IR of all drives, panels and other equipment	
b	Check & clean surface of shop leads(if there)	
C	Check earthing system and earthing of all metallic part	
d	Measurement of no load and load currents for all drives	
e	Observations on speed of hoisting/lowering for main and aux.hoists & brake.	
f	Measurement of deflection at full load and as per mechanical requirement at overload for main hoist.	
g	Checking for operations of all limit switches	

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO.: PE-SS-999-506-E101 Rev 00

1.0 INTENT OF SPECIFIATION

The specification covers the design, materials, constructional features, manufacture, inspection and testing at manufacturer's work, and packing of Low voltage (LV) squirrel cage induction motors along with all accessories for driving auxiliaries in thermal power station.

Motors having a voltage rating of below 1000V are referred to as low voltage (LV) motors.

2.0 CODES AND STANDARDS

Motors shall fully comply with latest edition, including all amendments and revision, of following codes and standards:

IS:325	Three phase Induction motors
IS : 900	Code of practice for installation and maintenance of induction motors
IS: 996	Single phase small AC and universal motors
IS: 4722	Rotating Electrical machines
IS: 4691	Degree of Protection provided by enclosures for rotating electrical machines
IS: 4728	Terminal marking and direction of rotation rotating electrical machines
IS: 1231	Dimensions of three phase foot mounted induction motors
IS: 8789	Values of performance characteristics for three phase induction motors
IS: 13555	Guide for selection and application of 3-phase A.C. induction motors for different types of driven equipment
IS: 2148	Flame proof enclosures for electrical appliance
IS: 5571	Guide for selection of electrical equipment for hazardous areas
IS: 12824	Type of duty and classes of rating assigned
IS: 12802	Temperature rise measurement for rotating electrical machnines
IS: 12065	Permissible limits of noise level for rotating electrical machines
IS: 12075	Mechanical vibration of rotating electrical machines

In case of imported motors, motors as per IEC-34 shall also be acceptable.

3.0 DESIGN REQUIREMENTS

3.1 Motors and accessories shall be designed to operate satisfactorily under conditions specified in data sheet-A and Project Information, including voltage & frequency variation of supply system as defined in Data sheet-A

3.2 Motors shall be continuously rated at the design ambient temperature specified in Data Sheet-A and other site conditions specified under Project Information
Motor ratings shall have at least a 15% margin over the continuous maximum demand of the driven equipment, under entire operating range including voltage & frequency variation specified above.

3.3 Starting Requirements

3.3.1 Motor characteristics such as speed, starting torque, break away torque and starting time shall be properly co-ordinated with the requirements of driven equipment. The accelerating torque at any speed with the minimum starting voltage shall be at least 10% higher than that of the driven equipment.

3.3.2 Motors shall be capable of starting and accelerating the load with direct on line starting without exceeding acceptable winding temperature.

The limiting value of voltage at rated frequency under which a motor will successfully start and accelerate to rated speed with load shall be taken to be a constant value as per Data Sheet - A during the starting period of motors.

3.3.3 The following frequency of starts shall apply

i) Two starts in succession with the motor being initially at a temperature not exceeding the rated load temperature.

ii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature. (not to be repeated in the second successive hour)

iii) Motors for coal conveyor and coal crusher application shall be suitable for three consecutive hot starts followed by one hour interval with maximum twenty starts per day and shall be suitable for mimimum 20,000 starts during the life time of the motor

3.4 **Running Requirements**

3.4.1 Motors shall run satisfactorily at a supply voltage of 75% of rated voltage for 5 minutes with full load without injurious heating to the motor.

3.4.2 Motor shall not stall due to voltage dip in the system causing momentary drop in voltage upto 70% of the rated voltage for duration of 2 secs.

3.5 **Stress During bus Transfer**

3.5.1 Motors shall withstand the voltage, heavy inrush transient current, mechanical and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.

3.5.2 Motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.

3.6 Maximum noise level measured at distance of 1.0 metres from the outline of motor shall not exceed the values specified in IS 12065.

3.7 The max. vibration velocity or double amplitude of motors vibration as measured at motor bearings shall be within the limits specified in IS: 12075.

4.0 **CONSTRUCTIONAL FEATURES**

4.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor or semi-indoor motors shall conform to degree of protection IP: 55 as per IS: 4691and shall be of weather-proof construction. Outdoor motors shall be installed under a suitable canopy

4.2 Motors upto 160KW shall have Totally Enclosed Fan Cooled (TEFC) enclosures, the method of cooling conforming to IC-0141 or IC-0151 of IS: 6362.

Motors rated above 160 KW shall be Closed Air Circuit Air (CACA) cooled

4.3 Motors shall be designed with cooling fans suitable for both directions of rotation.

4.4. Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.

4.5 Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.

4.6 In case Class 'F' insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class 'B' insulation.
In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10°C.

4.7 **Terminals and Terminal Boxes**

4.7.1 Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet-A.

Unless otherwise stated in Data Sheet-A, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current mentioned in data sheet "A".

4.7.2 unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.

4.7.3 Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or U W & V respectively.

4.7.4 Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.

4.7.5 Motor terminals and terminal leads shall be fully insulated with no bar live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A.

4.7.6 Degree of protection for terminal boxes shall be IP 55 as per IS 4691.

4.7.7 Separate terminal boxes shall be provided for space heaters.. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes.

4.7.8. Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.

4.7.9 Cable glands and cable lugs as per cable sizes specified in Data Sheet-A shall be included. Cable lugs shall be of tinned Copper, crimping type.

4.8 Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size given in Data Sheet-A shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.

4.9 **General**

4.9.1 Motors provided for similar drives shall be interchangeable.

4.9.2 Suitable foundation bolts are to be supplied alongwith the motors.

4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above.

4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956.

4.9.5 All motors rated above 30 kW shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Unless otherwise specified, space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz.

4.9.6 Name plate with all particulars as per IS: 325 shall be provided

4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions.

5.0 INSPECTION AND TESTING

5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied.

5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser.

5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan.

5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A.

6.0 DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT

a) OGA drawing showing the position of terminal boxes, earthing connections etc.
b) Arrangement drawing of terminal boxes.
c) Characteristic curves:
(*To be given for motor above 55 kW unless otherwise specified in Data Sheet*).

i) Current vs. time at rated voltage and minimum starting voltage.
ii) Speed vs. time at rated voltage and minimum starting voltage.
iii) Torque vs. speed at rated voltage and minimum voltage.
For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling.
iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.

CABLING, GROUNDING AND LIGHTNING PROTECTION SYSTEM

CABLING, GROUNDING AND LIGHTNING PROTECTION SYSTEM

1.00.00 SCOPE OF WORK

1.01.00 The Scope of Work covers complete and efficient design, engineering, testing at manufacturers works, supply, transportation erection, testing and commissioning of lightning protection system, all cabling and electrical grounding works. The scope shall broadly cover, but not be limited to:

1. Limestone Handling Area

2. Gypsum Handling Area

3. Absorber Area

3. All auxiliary buildings (including electrical rooms of respective buildings) and structures within the FGD package like Limestone preparation building, Absorber pump house, Gypsum De-watering building, FGD Control building, etc. as detailed in the Lead Specification & Plot Plan.

4. Overhead cable trestle and pipe cum cable trestle, if any.

5. All electrical equipment as described in Volumes II-F.

The scope of work shall also include all civil and structural works necessary for successful installation and commercial operation of all electrical equipment to be erected under this specification.

2.00.00 SCOPE OF SUPPLY

2.01.00 The scope of supply shall include but not be limited to the followings:

2.01.01 Timely procurement and transportation to site in properly packed condition of all materials and miscellaneous items required to complete the erection work under this specification.

These materials and miscellaneous items shall include but not be limited to the following:

a) Galvanized steel pre-fabricated cable trays, coupler plates, nuts, bolts & washers, reducers, covers, wall brackets, hanger clamps, straight run, elbows, bends, etc.

b) Galvanised steel rigid/flexible conduits and accessories, ferrules, lugs, glands, terminal blocks, galvanised sheet steel junction boxes, cable fixing clamps, nuts & bolts etc. as required.

c) Cable termination and jointing kits as necessary.

d) All necessary erection materials, consumables and sundry items including arc welding rods to complete the installation for satisfactory and trouble free operation.

e) Mild steel rods for grounding conductor, grounding electrode, column & structure grounding, risers etc.,

Mild steel rod for vertical air terminals,

Materials for electronic grounding,

Galvanized steel flats for horizontal air terminals, for down conductors and for large equipment grounding

Galvanized wire (8SWG) for small equipment grounding.

f) Any item of works or erection materials which have not been specifically mentioned but are necessary to complete the work involved shall be deemed to be included in the scope of this specification and shall be furnished by the Bidder without any extra charge to the Purchaser.

Scope of Services

2.02.00 The scope of Cabling, Grounding and Lightning Protection Systems includes but is not limited to the following:

2.02.01 Furnishing of all erection tools and tackles, testing equipment, implements, supplies, hardware and transport for timely and efficient execution of the erection work. Hydraulic jacks or motorized jacks necessary for lifting of heavy equipment shall be provided by the contractor.

2.02.02 Transport vehicles necessary for efficient transportation of equipment from stores to site of erection and excess materials back to stores.

2.02.03 A general list of the outdoor and indoor Electrical Equipment with accessories for complete assembly, erection and connection, testing and commissioning, putting into successful and satisfactory commercial operations by the contractor and as applicable in a FGD plant is given below. Since plant configuration varies from project to project, actual equipment and accessories shall also be guided by other specification documents.

a) 220/11.5/11.5kV Station Transformer

b) HT Aux. Transformers for FGD system

c) L.T. Transformers (dry)

d) Lighting Transformers

e) Neutral Grounding Resistor Cubicles

f) 3.3Kv & 11kV Busducts

g) 415 V Busduct

h) 11kV & 3.3kV Switchgears

i) 415 V Switchgears, Switchgear cum MCCs.

j) Motor Control Centres, A.C./D.C. Distribution boards, Main lighting distribution boards and miscellaneous items.

k) Battery and Battery Chargers, Uninterrupted Power Supply Panels

l) Electrical Control Desks/Panels, Relay Panels, Data logger Panels etc.

m) Miscellaneous Local Panels.

n) All electrical equipment and systems integral with mechanical equipment, systems and subsystems.

o) Any other equipment, not mentioned herein but required for the completing the Plant shall be deemed included in the scope.

2.02.06 Erection work of equipment shall be carried out in a neat and efficient way so as not to impair their normal functioning in any way.

2.02.07 Pre-commissioning checks as well as commissioning of different equipment shall be carried out as per guidance of actual manufacturer's supervisor and or as per written instructions in Erection Manuals. In case of any site related problem in commissioning activities, contractor shall seek advice of the OE.

2.02.08 All erection work under this specification shall be carried out strictly in accordance with the approved drawings.

2.02.09 Erection work shall also be performed with respect to the following items:

a) Cable trays and accessories

a) Power cables

b) Cables laid directly buried in ground

c) Control, instrument and special cables

2.03.00 All materials and accessories to be supplied by the Bidder shall be brand new ones of reputed make.

2.04.00 Necessary drawings, data sheets and Technical leaflets on each piece of material.

3.00.00 GENERAL REQUIREMENTS

3.01.00 **Codes and Standards**

3.01.01 All cable and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) and IEC except where modified and/or supplemented by this specification.

3.01.02 Cable and material conforming to any other standard, which ensures equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.

3.01.03 The electrical installation shall meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

3.02.00 **Erection Schedule**

3.02.01 The entire erection work shall be carried out in a phased manner. A schedule of the work showing the sequence of erection shall be submitted by the tenderer for this purpose.

3.02.02 The erection schedule, as approved by the Owner's Engineer shall be strictly followed by the Bidder. If, for any reason beyond the control of the Bidder, the work is held-up then the Bidder shall bring it to the notice of the Owner's Engineer without any delay.

4.00.00 DESIGN CRITERIA

4.01.00 **Grounding System**

4.01.01 The main objectives of grounding system are to:

a) Provide safety to personnel from contact of dangerous potential caused by ground fault.

b) Ensure sufficient grounding current for effective relaying.

c) Stabilize circuit potential with respect to ground.

d) The grounding system shall be designed in compliance with the IEEE-80/ IEEE- 665 considering fault current of 50kA for 1 sec. and shall be subject to approval of the Owner.

e) Major items of equipment, such as switchgear, transformer, motor, relay panels and control panels etc shall have integral ground buses or connection points which shall be connected to the underground grid.

f) Electronic panels and equipment, where required, shall be grounded utilizing an insulated ground wire connected in accordance with the manufacturer's recommendations. Where practical, electronics ground loops shall be avoided. Where this is not practical, isolation

4.02.04 For metal structures which are electrically continuous down to the ground level, no lightning protection is required except adequate grounding connections.

4.02.05 **System Design**

a) Air termination network with down conductors and earthing electrodes shall be provided on the basis of IS Code of Practice.

b) Horizontal air termination shall be so laid out that no part of the roof shall be more than 9 meters from the nearest conductor.

c) Shielding angle for one vertical air termination shall be 45 degrees. For more than one rod, shielding angle between the rods shall be taken as 60 Degrees.

d) Down conductors shall run along the outer surfaces of the building and shall have a test joint about 1500 mm above ground.

e) An earth electrode shall be provided at the connection point of the down conductor with the station ground.

f) Galvanised steel rods and flats shall be generally used for air termination and connections. All connections shall be welded type.

g) All other ancillary items in connection with the work described above shall be furnished to complete the work irrespective of whether such items may have been specifically mentioned or not.

4.02.06 All materials and accessories to be supplied by the Bidder shall be brand new ones of reputed make.

4.03.00 **Cabling System**

4.03.01 Erection of cabling work shall be carried out in such a way as to provide a reliable and assured electric power supply system to all FGD auxiliaries.

4.03.02 Cable routing shall be done on unit basis as far as possible.

4.03.03 Cables shall generally be laid on cable trays overhead supported from building steel/structures. Cables shall be run in concrete trenches in those electrical rooms at ground level, which are without any spreader room below.

4.03.04 For inter plant connections, the cables shall be routed through an overhead cable bridge pipe cum cable bridge. For isolated but long outdoor cable route with very few cables of 3/4 nos., the cables may be directly buried subject to Owner's approval.

4.03.05 For underground crossing of railways, road etc. additional protection shall be provided in form of hume pipe or concrete encased rigid steel conduits (duct bank).

4.03.06 A.C. and D.C. circuit shall not be run in same cable. Further, separately fused circuit shall run in separate cables.

4.03.07 Cables for redundant equipment system shall be run in separate trays, as far as possible.

4.03.08 Erection of cabling work shall be executed keeping in view all necessities and requirements.

4.03.09 Suitable embedded steel inserts shall be provided on wall/floor/ ceiling surfaces for welding of cable tray bracket in order to make the cable tray system withstand horizontal/vertical accelerations due to seismic forces for indoor trays and also wind load for outdoor trays in addition to normal tray cable loadings.

4.03.10 All erection work to be carried out under this specification shall conform to the notes and details given in Annexure-A to this specification.

5.00.00 SPECIFIC REQUIREMENTS - SUPPLY

5.01.00 Equipment and Material

5.01.01 Equipment and material shall comply with description, rating, type and size as detailed in this specification, drawings and annexures.

5.01.02 Equipment and materials furnished shall be complete and operative in all details.

5.01.03 All accessories, fittings, supports, hangers, anchor bolts etc. which form part of the equipment or which are necessary for safe and satisfactory installation and operation of the equipment shall be furnished.

5.01.04 All parts shall be made accurately to standard gauges so as to facilitate replacement and repair. All corresponding parts of similar equipment shall be interchangeable.

5.03.00 Conduits and Accessories

5.03.01 The contractor shall provide and install all conduits, mild steel pipes, flexible conduits, rigid PVC pipes, etc. complete with accessories like tees, bends, adopters, locknuts, pull boxes, conduit plugs, caps, etc as required for the cabling work. Conduits shall be furnished in standard length of 5 metres, threaded at both ends.

5.03.02 Conduits diameter upto and including 25mm size shall be of 16 SWG and conduits above 25 mm diameter shall be of 14 SWG. Minimum diameter of conduits shall be 20 mm.

5.02.03 Conduits shall be made of hot-dip galvanized steel with an organic corrosion resistant ID coating. In chemical handling areas, battery room, etc., the

exterior surface shall be further coated with chromate and polymer for better resistance to corrosion. Conduits, fittings & accessories shall have ISI mark.

5.02.04 For sizes above 63 mm, hot dip galvanized - both on inside and outside - steel pipes with necessary fittings & accessories shall be provided and installed by the contractor. The pipes and fittings shall be of heavy duty class with relevant ISI mark.

5.02.05 Flexible conduits complying to relevant IS and made with bright, cold-rolled, annealed and electro-galvanized mild steel strips shall be used between embedded conduits/pipes and the motor terminals. It shall also be used between fixed conduit and any equipment with vibration or equipment requiring regular removal.

5.02.06 Non-metalic conduits made of HDPE outer jacket with friction-reducing permanent internal lining shall generally be used for control & instrumentation cables in some areas where cable trays do not exist and where the runs are straight ones Necessary fittings & accessories as may be required for the installation shall also be provided.

5.03.00 **Junction Boxes**

5.03.01 Technical requirement for both non-metallic type and galvanized steel Junction Boxes are given below. Unless the choice is specifically mentioned in the General / Lead Electrical Specification or elsewhere in the tender document, galvanized steel Junction Boxes shall be offered.

5.03.02 Non-metallic Junction Boxes

a) Material of the Junction Boxes shall be halogen-free and silicon-free, glass fibre-reinforced polycarbonate for outdoor use and/or for cable sizes more than 50 sq.mm. Material shall be ABS/ polycarbonate for indoor use and/or for cable sizes upto 50 sq. mm. Junction boxes for use with fire-survival cables shall be of Duro-plast / powder-coated metal.

b) Material of all non-metallic junction boxes shall be fire retardant and self-extinguishing in accordance with UL 94 V0. It should be tested at Glow Wire test for 960º C.

c) Boxes shall be suitable for continuous operation at an ambient temperature range of -10º C to +80º C.

d) The impact strength of polycarbonate enclosures/boards i.e. the degree of protection against mechanical shock load shall be in accordance with EN 50298-98 for IK 08 (5 Joule).

e) Degree of protection shall be IP 66 to EN 60529. Junction boxes shall have integrally embedded gaskets made of Polyurethane.

f) Allowing a minimum of 20% spare terminals after complete termination, the terminal board for control and instrumentation JBs shall have 6 /12 / 24 / 36 / 48 ways.

g) Doors shall have stainless steel quick fastening screws.

h) The boxes shall be complete with all brackets/fasteners as required for installation on walls, columns and structure.

5.03.03 Steel Junction Boxes

a. Junction boxes with IP 55 degree of protection, shall comprise of a rectangular parallelepiped case constructed from cold rolled sheet steel of minimum thickness 2mm. Top of the box shall be arranged to slope towards the rear of the box. Gland plate shall be 3mm thick sheet steel with neoprene/synthetic rubber gaskets. All junction boxes shall be of adequate strength and rigidity, hot dip galvanized as per relevant IS, and suitable for mounting on wall, column, structures etc. The boxes shall be complete with M8 earthing stud and all brackets/fasteners as required for installation.

b) No. of Ways:6 / 12 / 24 / 36 / 48 with 20% spare terminals after termination.

c) Outdoor JBs shall be similar but with a canopy at the top.

d) Doors shall be hinged and lockable and shall be made of the same material as the case. The doors shall have industrial heavy-duty hinges. The doors shall be easily but firmly lockable with quick release fastener.

5.03.04 **The junction boxes shall have the following indelible markings:**

- Circuit nos. on top by white-stenciled paint at site.
- Circuit nos. with ferrules (inside) as per approved drawing.
- Danger sign in case of 415 V circuit.

5.04.00 **Terminals**

5.04.01 Multiway terminal blocks of approved type, complete with screws, nuts; washers and marking strips shall be furnished for connection of incoming/outgoing wires.

5.04.02 Each control cable terminal shall be suitable for connection of 2 nos. 2.5 sq.mm. stranded copper conductors without any damage to the conductor or looseness of conductors.

5.05.00 **Cable Termination & Straight Through Joints**

5.05.01 Bidder shall supply cable termination and jointing kits in requisite quantity for H.T. Power Cables, L.T. Power, Control Cables, Instrumentation Cables, etc. along with all accessories & consumables required for making termination and joints complete. Those shall be of proven design and make which have already been extensively used and type tested.

5.05.02 Components shall be pre-moulded type, taped type or heat-shrinkable type. 11kV, 6.6kV and 3.3kV grade joints and terminations shall be type tested as per IS: 13573.

5.05.03 Kits shall be complete with the alumunium solderless crimping type cable lugs and ferrule as per DIN standard.

5.06.00 **Cable Glands**

Cable shall be terminated using double compression type cable glands. Cable glands shall conform to BS 6121 or to EN 50262. Ingress Protection rating for cable glands with seal, when offered conforming to EN 50262, shall be minimum IP 66 in line with BS. Cable glands shall be made of tinned brass gland, double compression type complete with necessary armour clamp and tapered washer, etc. Rubber components shall be of neoprene or better synthetic material and of tested quality. Cable glands shall match with the sizes of different H.V./L.V./Control cables supplied/erected.

5.07.00 **Cable Lugs**

All cable lugs shall be Cd plated copper. Cable lugs shall be suitable for termination of different cross-sections of H.V./L.V./Control/Instrumentation cables and shall be of following types :

i) Aluminium tubular terminal end for solderless crimping to aluminium conductors.

ii) Copper tubular terminal end for solderless crimping to copper conductors.

Solderless crimping of terminals shall be done by using corrosion inhibiting compound. The cable lugs shall suit the type of terminals provided on the equipment. Lugs for control/instrumentation cables shall be PVC insulated/sleeved type.

iii) Cable lugs for control cable termination shall be insulated. These lugs shall be pin type/flat type/ring type/U type to suit the terminals provided in the panels.

5.08.00 **Cable Clamps and Straps**

5.08.01 Trefoil clamps for single core cables shall be pressure die-cast aluminium or fibre glass or nylon with necessary G I fasteners. Trefoil clamps shall have adequate mechanical strength to forces generated by peak value of maximum system short circuit current.

5.08.02 Cable clamps required for multicore cables on vertical run shall be made up of 25x3mm size aluminium strip. For clamping the multicore cables, self-

locking, de-interlocking type fire-resistant nylon clamps/straps of sufficient strength shall be used.

5.09.00 **Consumables and Hardware**

5.09.01 The Bidder shall furnish all erection materials, hardware and consumables required to complete the installation.

5.09.02 The materials shall include but not be limited to the following :

Consumables : Welding rods & gas, oil and grease, cleaning fluids, paints, electrical tape, soldering materials etc.

Hardware : Bolts, nuts, washers, screws, brackets, supports, clamps, hangers, saddles, cleats, sills, shims etc.

5.09.03 Supply of cement, sand, stone etc. required for the execution of the contract shall be the responsibility of the Bidder.

5.10.00 **Testing Equipment**

5.10.01 The major testing equipment that are required to be arranged by the Bidder for site testing are listed below:

a) **Insulation Tests**
   i) Power operated Meggar - 1 KV and 10 KV grade
   ii) Hand operated Meggar - 1 KV grade

b) Hand driven earth Resistance Meggar, range 0-1/3/30 ohms.

c) High potential testing set - roller mounted type

d) Tong testers of suitable ranges.

e) Contact resistance measuring set for micro-ohms.

f) Torque wrench of various sizes.

g) Multi meters, test lamp, field telephone with buzzer set, different gauges etc.

5.10.02 The list of equipment is indicative only. Any other test equipments required shall be arranged by the Bidder.

6.00.00 METHODS AND WORKMANSHIP

6.01.00 All work shall be installed in a first class, neat workmanlike manner by mechanics/electricians skilled in the trade involved.

6.02.00 The erection work shall be supervised by competent supervisors holding relevant supervisory license from the Government.

6.03.00 All details on installation shall be electrically and mechanically correct.

6.04.00 The installation shall be carried out in such a manner as to preserve access to other equipment installed.

7.00.00 INSTALLATION

7.01.01 Installation work shall be carried out in accordance with good engineering practices and also as per manufacturer's instructions/ recommendations where the same are available.

7.01.02 Equipment shall be installed in a neat workmanlike manner so that it is level, plumb, square and properly aligned and oriented.

7.01.03 Cable installation work shall mean erection of cable trays/racks, supports, hangers, junction boxes, conduits, laying of cables either in ground or on trays inside trenches tunnels/overhead trays in conduits etc. dressing and clamping, jointing and termination inclusive of supply of necessary jointing/termination kits, lugs, glands, ferrules, tapes etc. and other accessories, grounding of cable armour. In case of direct laying in ground, all excavation work, necessary back-filling, supply of bricks and protective concrete slabs, removal of excess earth shall be part of the installation work.

7.01.04 Grounding installation work shall mean erection, jointing/brazing/welding, connection and painting, testing of ground conductors including supply of necessary steel/copper.

7.01.05 Lightning protection system installation work shall mean erection, jointing, welding, connection and painting, testing of air termination network, down conductors, shielding masts, connection to ground grid, electrodes, risers, horizontal conductors etc. of lightning protection system.

7.02.00 **Cable Trays**

7.02.01 Pre-fabricated cable trays and accessories shall be assembled & erected at site. Adequate spaces shall be provided to facilitate installation of cable system and to allow routine inspection and modification after installation.

7.02.02 Cable trays either inside concrete trenches or inside buildings and racks inside cable shafts shall be aligned and leveled properly. All tray runs shall be installed parallel to the trench/building walls and floors except otherwise noted in the approved drawings.

7.02.03 As far as practicable, cable trays shall be supported from one side only in order to facilitate installation and maintenance of cables from the other side.

7.02.04 The cable trays shall be supported in general at a span of not exceeding 1.5 metres horizontally and 1.0 metre vertically.

7.02.05 Sufficient spacing not less than 250 mm shall be provided between trays and maintained to permit adequate access, for installing & maintaining the cables..

7.02.06 Complete cable tray support structure after installation shall be inspected/ tested for welding strength, straightness, accuracy, use of proper sizes and compliance to drawings.

7.02.07 Complete cable tray and accessory installation work shall be inspected/tested for proper alignment, leveling, use of proper accessories, high quality workmanship etc.

7.02.08 The Bidder shall remove the RCC/steel trench covers whenever required and shall again place the same in their positions after the erection work in the particular area is completed or when further work is not likely to be taken up for some time.

7.02.09 Whenever any pipe/conduit/cable tray emerges out or enters into a building care should be taken to ensure that no water enters into the building.

7.02.10 Cable trays in areas subject to excessive coal dust, oil spillage, mechanical damage or accessible to personal contact shall be provided with raised sheet metal tray covers, installed on upper tray in horizontal run and front in vertical run.

7.02.11 Cable trays/racks shall be so arranged that they do not obstruct or impair clearances of passage way.

7.02.12 Cable tray/conduit system shall be so designed as to accommodate maximum pulling tension and minimum bending radius of cable.

7.02.13 Cable tray/conduit system shall be constructed to prevent drainage of water into equipment or building.

7.02.14 Cable tray/conduit system shall be electrically continuous and grounded.

7.02.15 Different voltage grade cables shall be laid in separate trays when trays are run in tier formation. Power cables shall normally be on top trays and control/instrumentation cable on bottom trays.

7.02.16 Trenches

i) PCC flooring of built up trenches shall be sloped for effective drainage with sump pits and sump pumps.

ii) No subzero level cable vault/trenches shall be provided below control building/switchgear rooms in FGD areas.

7.03.00 **Cable and Conduits**

7.03.01 The Bidder shall install, terminate and connect up all cable and conduits as per drawings and cable schedules.

7.03.02 The drawings shall be strictly followed except where obvious interference occurs. In such cases, the routing shall be changed as directed and/or approved by the Engineer.

7.03.03 Approximate lengths of cable and conduit runs shall be shown by the Bidder in the cable schedule for guidance only. Before commencement of work the Bidder shall take actual measurements and prepare his own cable-cutting schedule to reduce wastage to a minimum.

7.03.04 The Bidder shall also maintain and submit when requested, a record of cable insulation value when drawn from store, after laying, before and after termination/jointing.

7.03.05 Where direct heat radiation exists, heat isolating barriers, shall be adopted for cabling system.

7.03.06 Cabling/wiring in offices, laboratories, control rooms etc. shall be taken through concealed G.I. or rigid PVC pipes as directed by the Owner's Engineer.

7.03.07 At certain places where hazardous fumes/gasses may cause fire to the cables, cable trenches after installation of cables shall be sand filled.

7.04.00 **Conduit and Accessories**

7.04.01 Conduit/pipes shall be used only in short lengths in certain areas where required and/or as directed by the Engineer.

7.04.02 The Bidder shall furnish all conduits complete with accessories as required.

7.04.03 Conduits shall be flexible type in general. However, rigid type steel conduit if required shall also be supplied by the Bidder.

7.04.04 Except for inside an enclosure wherever the cable enters or leaves the conduit, the conduit end shall be sealed by suitable sealing compound, having fire withstand capability.

7.04.05 The entire metallic conduit system, when embedded or exposed shall be electrically continuous and grounded.

7.04.06 Where it is possible for water or other liquids to enter conduits, sloping of conduit runs and drainage of flow points shall be considered.

7.04.07 Pull boxes shall be installed between termination points where required to facilitate cable pulling, but at a maximum interval of 30 meters.

7.04.08 Conduits shall be firmly fastened within 900 mm of each junction box/pull box/cabinet/fitting etc. Conduits shall be supported at least every 2000 mm.

7.05.00 **Cables: Storage and Handling**

7.05.01 Cable drums shall be stored on hard and well-drained surface so that they may not sink. In no case shall the drum be stored on the flat, i.e., with flange horizontal.

7.05.02 Rolling of drums shall be avoided as far as practicable, for short distance, the drums may be rolled provided they are rolled slowly and in proper direction as marked on the drum.

7.05.03 In absence of any indication, the drums may be rolled in the same direction as it was rolled during taking up the cable.

7.05.04 For unreeling the cable, the drum shall be mounted on jacks or on cable wheel. The spindle shall be strong enough to carry the weight without bending.

7.05.05 The drum shall be rolled on the spindle slowly so that the cable should come out over the drum and not below the drum.

7.05.06 While laying cable, cable rollers shall be used at an interval of 2000 mm. The cables shall be pushed over the roller by a gang of people positioned in between rollers over a suitable distance. Care shall be taken so that kinks and twists or any mechanical damage does not occur in cables. Only approved cable pulling grips or other devices shall be used. Cables shall not be dragged on ground or along structure while laying out from cable drums.

7.05.07 Cable shall not be pulled from the end without having intermediate pushing arrangement. Bending radius of the cable during installation shall not be less than what is specified by the manufacturer.

7.05.08 Empty cable drums shall be returned to the Owner.

7.06.00 **Cable Laying**

7.06.01 Cable shall generally be installed in ladder type prefabricated trays except for some short run in rigid/flexible conduit for protection or crossings.

7.06.02 Cables laid on trays and risers shall be neatly dressed and clamped with self-locking type fire resistant nylon ties at an interval of 750 mm for horizontal and vertical runs, in case of both power, control and instrumentation cables.

7.06.03 All single core power cables for 3 Ph. AC circuits shall be laid in trefoil formation and suitably clamped with self-locking type fire resistant nylon ties at an interval of 750mm.

7.06.04 L.T. multicore power cables with cross-sectional area of 95 sq.mm and above and all H.T. multicore power cables and shall be clamped individually by self-locking type fire resistant nylon ties.

7.06.05 L.T. power cables of cross sectional area less than 95 sq.mm and all control and Instrumentation cables shall be clamped in bunches with self-locking type fire resistant nylon ties. The number of cable in one bunch shall not exceed eight (8).

7.06.05 Prior to laying of cables inside the indoor and outdoor trenches, the Bidder shall properly clean the trenches.

7.06.06 In outdoor areas, buried cables shall be laid and covered with sand/riddled earth and protected from damage by bricks at sides and precast slab at top.

7.06.07 When buried cables cross road/railway track, adequate protection shall be provided in the form of hume/ galvanised iron pipes laid at a minimum depth of 1 meter below ground.

7.06.08 After completion of installation and prior to connection, all power cables shall be subjected to a high potential test.

7.07.00 **Cable Fire Sealing**

7.07.01 Cable/cable tray openings in walls and floors or through pipe sleeves from one area to another or from one elevation to another within the unit shall be seated by a fire proof sealing system (FPSS) of minimum 2 Hrs rating. The FPSS shall effectively prevent the spread of fire from the flaming to non-flaming side of a fire.

7.07.02 Wherever the cables/cable trays pass through walls/floors, fire proof cable penetration seals rated for two hour shall be provided. This shall be by suitable block system using individual blocks with suitable framework or by silicon RTV foaming system. In case foaming system is offered, damming board, if used, shall not be considered for fire rating criteria. Any of the system offered shall be of proven type as per BS: 476 (Part-20) or equivalent standard.

In order to prevent fire propagation through cable penetrations, after laying, dressing & clamping of cables, all the openings shall be properly sealed by using Fire Stop Mortar Seal and Fire Retardant Cable coating compound. Also the cable runs both before and after the fire scale shall be suitably sprayed with anti-fire propagation liquid.

7.08.00 **Cable Laying in Trenches**

7.08.01 RCC cable trenches with removable covers shall be provided by the Contractor. Cables shall be laid in 3 or 4 tires in these trenches RCC covers of trenches in process area shall be effectively sealed to avoid ingress of chemicals etc. Removal of concrete covers for purposes of cable laying and reinstating them in their proper positions after the cables are laid shall be done by the Contractor at no extra cost.

7.08.02 For cable trays are laid in trench in more than two tiers a space of minimum 600 mm shall be available for maintenance. In case two or more tiers of cable trays are running parallel along both sides of trench walls there shall be space of minimum 600 mm between them.

7.08.03 Cables shall be handled carefully during installation to prevent mechanical injury to the cables. Ends of cable leaving trenches shall be coiled and provided with a protective pipe or cover tilt such times the final termination to the equipment is completed.

7.08.04 Prior to laying of cables inside both indoor and outdoor trenches, the Contractor shall properly clean inside of those trenches.

7.08.05 When cables are laid in multiple tiers, spacing between individual tiers shall be as approved by Site Engineer.

7.08.06 As each row of cables is laid in place every cable shall be given on insulation test in the presence of Site Engineer. Any cable, which proves defective, shall be replaced before the next groups of cables are laid.

7.08.07 All wall openings/pipe sleeves shall be effectively sealed after installation of cables to avoid seepage of water inside building/lined trench.

7.08.08 Where cables rise from trenches to motor, control station, lighting panels etc., they shall be taken in G.I. Pipes for mechanical protection up to a minimum of 150mm above grade.

7.08.09 Cable ends shall be carefully pulled through the conduit, to prevent damage to these cables. Where required, approved cable lubricant shall be used for this purpose. Where cable enters conduit the cable should be bent in large radius. Radius shall not be less than the recommended bending radius of the cables specified by the manufacturer.

7.08.10 Following guide of the pipe fill shall be used for sizing the pipe size:-

a) 1 cable in pipe - 53% full
b) 2 cables in pipe - 51% full

c) 3 or more cables - 40% full

7.08.11 After the cables are installed and all testing is complete, conduit ends above grade shall be plugged with a suitable weatherproof plastic compound/'PUTTI' for sealing purpose. Alternatively G.I. Lids or PVC bushes shall be employed for sealing purposes. The cost for the same shall be deemed to have been included in the installation of G.I. pipe and no separate payment shall be allowed.

7.08.12 Where cables pass through foundation walls or other underground structures, the necessary ducts or openings shall be provided in advance for the same. However, should it become necessary to cut holes in existing foundations or structures, the electrical Contractor shall determine their location and obtain approval of the Site Engineer before cutting is done.

7.09.00 **Cable Tags & Markers**

7.09.01 Each cable and conduit run shall be tagged with numbers that appear in the cable and conduit schedules. Cables and conduits shall be tagged at their entrance, bends, every 30.0M and exit from any equipment, junction box. When a cable/conduit passes through a wall, tags shall be fitted on both sides of the wall.

7.09.02 The tags shall be of aluminium with the number punched on it and securely attached to the cable by not less than two turns of 16 SWG G.I. wire. For single core cable the wire shall be of non-magnetic material.

7.09.03 Location of cable joints, if any, shall be clearly indicated with cable marker with an additional inscription 'cable-joint'.

7.09.04 Contractor shall furnish and install all tags and markers stated above.

7.09.05 For buried cable, the marker shall project 150 mm above ground and shall be spaced at an interval of 30 meters and at every change of direction.

7.10.00 Cable Termination and Connection

7.10.01 Termination and connection of cables shall be done strictly in accordance with manufacturer's instruction, drawings and/or as directed by the Engineer.

7.10.02 Work shall include all clamping, fitting, fixing, soldering, tapping, compound filling, cable jointing, crimping, shorting and grounding as required for the complete job. All equipment required for all such operations shall be of Contractor's procurement. Furnishing of all consumable materials such as soldering material, electrical tape, sealing material as well as cable jointing kits shall be included in the offer.

7.10.03 Cable joint kits for all cables shall be supplied by Contractor under this specification. Responsibility for proper termination shall lie on the contractor. Guarantee for termination shall also have to be given by Contractor.

7.10.04 The equipment will be generally provided with blank bottom plates for cable/conduit entry and cable end box for power cables.

7.10.05 The bidder shall perform all drilling, cutting on the blank plate and any minor modification work required to complete the job.

7.10.06 If the cable end box or terminal enclosure provided on the equipment is found unsuitable and requires major modification, the same shall be carried out by the contractor.

7.10.07 Control/instrumentation cable cores entering control panel/ switchgear/ MCC, etc. shall be neatly bunched and served with PVC perforated tape to keep it in position at the terminal block.

7.10.08 The bidder shall put ferrules on all control cable cores in all junction boxes and at all terminations. The ferrules shall carry terminal numbers as per drawings. All ferrules shall be coloured, plastic & interlocked type.

7.10.09 Spare cores shall be similarly ferruled, crimped with lug and taped on the ends. Spare cores shall be ferruled with individual cable number.

7.10.10 Termination and connection shall be carried out in such a manner as to avoid strain on the terminals.

7.10.11 All cable entry points shall be properly sealed and made vermin and dust proof. Unusual opening, if any, shall be effectively closed. Sealing work shall be carried out with approved sealing compound having fire withstand capability for at least three hours.

7.10.12 Strips and special tools like manually or pneumatically driven gun/pistol for termi point/equivalent connection shall be supplied by the Contractor.

7.11.00 **Cable Joints**

7.11.01 Cable shall be installed without joints as far as practicable.

7.11.02 If however jointing becomes necessary, it shall be made only by qualified cable jointer and strictly in accordance with manufacturer's recommendation.

7.12.00 **Grounding**

7.12.01 The Bidder shall carryout the interconnection among various peripheral earthing grids/mats, steel structures, lightning protection system as well as grounding of all electrical equipment, etc. The grounding work shall be carried out as per provisions of I.E. rules Indian standards and enclosed grounding and lightning protection notes and details.

7.12.02 Grounding shall be done by conductors of adequate sizes (size shall be selected by the bidder with supporting calculation, if not specified) and the same shall be connected to the risers of main ground mat.

7.12.03 For fabricated cable trays, a separate ground conductor (50x6 mm G.S. flat) shall run along the entire length of each route of cable tray being suitably clamped on the cable tray. Individual cable trays of each section shall be connected to above ground conductor through 50x6 mm G.S. flat to maintain continuity of ground path.

7.11204 All ground conductor connections shall be made by electric arc welding/ brazing unless otherwise specified. Ground connections shall be made from nearest available station ground grid risers. The rods/connection shall be coated with cold galvanizing /weather resistance anti corrosive paints.

7.12.05 All ground conductors shall be painted black for easy identification.

7.12.06 Equipment ground connections, after being checked and tested by the Engineer, shall be coated with anti-corrosive paint.

7.17.02 Upon completion of work, the Bidder shall remove all rubbish, tools, scaffoldings, temporary structures and surplus materials etc. to leave the premises clean and fit for use.

8.00.00 TESTS

8.01.00 **Shop Tests**

8.01.01 All equipment shall be completely assembled, wired, adjusted and routine tested as per relevant Indian Standards at manufacturer's works.

8.01.02 Tests on panels/junction boxes shall include:

a) Wiring continuity tests.

b) High voltage and insulation tests.

c) Operational tests.

8.02.00 **Site Tests**

8.02.01 Bidder shall thoroughly test and meggar all cables, wires and equipment to prove the same are free from ground and short circuit.

8.02.02 If any ground or short circuit is found, the fault shall be rectified or the cable and/or equipment replaced.

8.02.03 All power cables after installation and prior to connections shall be subjected to High Potential tests. Also the insulation resistance values shall be measured both before and after Hipot test for comparison. The leakage current shall also be measured during the Hipot test at site.

Cable cores shall be tested for:

a) Physical damage

b) Continuity

c) Correctness of connections as per relevant wiring diagram

d) Insulation resistance to earth

e) Insulation resistance between conductors

f) Proper earth connections of cable glands, cable boxes, cable armour, screens etc.

8.02.04 All equipment shall be demonstrated to operate in accordance with the requirements of this specification.

8.03.00 **Test Certificates**

8.03.01 Type test certificate on any equipment, if so desired by the Owner, shall be furnished. Otherwise the equipment shall have to be type tested, free of charge, to prove the design.

9.00.00 DRAWINGS, DATA & MANUALS

9.01.00 **To be submitted with the Bid**

9.01.01 Make, type and catalogue number of different electrical items and accessories along with technical leaflets, data sheets etc.

9.01.02 Typical General arrangement drawings showing constructional features, fixing arrangement of pre-fabricated cable trays.

9.01.03 Bill of Materials for cable trays and accessories, conduits & accessories.

9.01.04 Layout of Grounding system and lightning protection system showing connection and other details along with backup design calculations and detailed write up.

9.01.05 Bill of materials for grounding and lightning protection system.

9.01.06 Drawing showing details of equipment grounding.

9.02.00 **To be submitted after Award of Contract**

9.02.01 Make, type and catalogue number of cable termination kits, joints and accessories.

9.02.02 Detail dimensional drawings showing constructional features, grounding, fixing arrangement etc.

9.02.03 Bill of Materials for Pre-fabricated cable tray and accessories, Conduits & accessories.

9.02.04 Dimensional G.A. drawings and data sheets for different equipment and items supplied under this specification.

9.02.05 Layout drawing of Grounding system and Lightning protection system showing connection details along with backup design calculation and detailed write up.

9.02.06 Bill of material for grounding system and lightning protection system.

9.02.07 Drawing showing details of equipment grounding system.

NOTES AND DETAILS
FOR
CABLING SYSTEM

1.00.00 GENERAL

1.01.00 These notes and details shall be read and construed in conjunction with Specification and the drawings meant for cable tray details and supporting arrangements in Trench, Racks etc., enclosed elsewhere. In case of conflict between these notes and drawings, the latter shall prevail.

1.02.00 The Cabling System installation work shall conform to the requirements of the latest revisions of the following standards/codes

a) Indian Electricity Rules, 1956, with up to date amendment.

b) I.S. Code of Practice

2.00.00 CABLE ROUTING/LAYING

2.01.01 Cables shall generally be laid on ladder type cable trays either in trenches or overhead supported from building steel/structures except in some cases cables may have to be laid underground and for short runs in conduits for protection or crossing.

2.01.02 For interplant connections, the cables may be routed through an overhead cable bridge or cable trenches/tunnels selection being dependent on site constraints. Directly buried cable shall be avoided as far as possible. Owner's prior approval shall be taken for exceptional cases, where buried cables cannot be avoided.

2.01.03 For underground crossing of railways, roads etc. hume pipes shall be used and shall be laid at a depth of minimum 1000 mm such that cables shall not be damaged.

2.01.04 The cable racks in dust prone areas shall be supported from available structure in vertical configuration with suitable cover to avoid deposition of lignite dust as far as practicable.

2.01.05 Different voltage grade cables shall be laid in separate trays when trays are arranged in tiers. Power cables shall be on top trays and Control/Instrumentation cables on bottom trays, and it is recommended that trays for cables of different voltage levels be stacked in descending order with higher voltage level above.

2.01.06 Cables for redundant equipment/system shall be run in separate trays in separate route.

2.01.07 Cables from two different services viz. supply from station board and supply from unit board shall be fully segregated to prevent simultaneous damage due to fire in one of the services.

2.01.08 Low level signal cables and other special Instrumentation and Control cables shall run in separate trays. In general, a minimum of 1500 mm clearance shall be maintained between these cables and noise generating equipment (large motors, generators, transformers etc.).

2.01.09 The cable spreaders of each unit shall be compartmentalized by provision of fire proof partition wall.

2.01.10 The floor of the cable spreader rooms shall have to be made water proof so that water does not percolate to lower levels in the event of fire fighting operations. Adequate arrangement for efficient drainage of water shall be provided. The cable raceways should also be suitably curved to avoid water entry through this place.

2.02.00 **Cable Trays/Supports**

2.02.01 Cable trays and covers shall be pre-fabricated type, constructed from minimum 14 SWG sheet steel for trays and 16 SWG for covers and hot-dip galvanized after fabrication.

2.02.02 Cable tray supports shall be cantilever type for each installation. All supports and hardware shall be hot-dip galvanized. Support shall be fixed with bolts and no welding shall be done on the galvanized parts.

2.02.03 Standard cable tray width shall be 600 mm. However, trays with 450, and 300, 150 mm width may be used in some places considering the requirement and space restrictions. For instrumentation and control purpose, some perforated type cable trays of width 150 and/or 100mm may be used particularly in low space area and 600, 450, 300 mm perforated trays may be used depending on site requirement.

2.02.04 Cable trays shall be ladder type with 250 mm rung spacing, 100 mm depth and rung width not less than 50 mm.

2.02.05 All weld for cable tray supports shall have a minimum throat thickness of 6 mm.

2.02.06 Cable trays in areas subjected to excessive lignite dust, or mechanical damage shall have hot-dip galvanised sheet metal tray cover installed on front tray in vertical run and inverted `V' type on upper tray in horizontal run.

Where covers are used on trays containing power cables, consideration should be given to ventilation requirements. Areas where corrosive chemicals are likely to be handled, cable tray and covers shall be epoxy painted.

2.03.00 **Conduits**

2.03.01 Conduits shall be rigid steel coated type; minimum size of conduit shall be limited to 19mm.

2.03.02 Steel conduits with interior coating of silicon epoxy ester for ease of wire pulling shall be seamed by welding and flo-coat metal conduit/hot-dip galvanized. These shall be supplied in standard length of 5M with minimum wall thickness as specified in IS: 9537 Part-II. In chemical handling areas, Battery room etc., the exterior surface shall be further coated with chromate and polymer for better resistance to corrosion.

2.03.03 Conduit runs shall be supported at an interval of 750 mm for vertical run and 1000 mm for horizontal run.

2.03.04 Conduits shall be sized so that conduit fill (ratio of total cable area to conduit area) shall not exceed the following:

One Cable	:	53%
Two Cable	:	31%
Three Cables & Up	:	40%

2.03.05 Conduit runs shall be provided with necessary bends as required.

2.04.00 **Installation**

2.04.01 The Bidder shall install, terminate and connect up all cables and conduits with supporting arrangements as per drawings, cable schedules and interconnection chart/drawings.

2.04.02 The HV power cables of 11 KV/3.3 KV shall be laid in trays or racks as follows:

a) In single layer only.

b) 3 core cables to be laid giving one diameter gap of the largest diameter adjacent cable.

c) Single core cables to be laid in trefoil formation with a spacing equal to diameter of the trefoils.

2.04.03 1100V grade power cables shall be laid in single layer in trays.

2.04.04 1100V grade power cable shall be laid giving one diameter gap of the largest diameter adjacent cable.

2.04.05 Control and Instrumentation cables can be laid up to a maximum of three layers in each tray.

2.04.06 The trays shall be run with a vertical spacing of 300 mm for overhead cable trays as well as inside cable trenches. A minimum of 225 mm clearance shall be provided between the top of tray and beams, cold piping, 500 mm clearance for hot piping/object to facilitate installation of cables in tray.

2.04.07 Adequate pull boxes shall be provided in conduit run to facilitate cable pulling in long runs and also to ensure that there shall be no more than 270 Deg. bends between pull points.

2.04.08 Cable tray/conduit system shall be installed to accommodate cable manufacturer's recommended maximum pulling tension and minimum bending radius.

2.04.09 All openings in the floor and wall for cable access shall be sealed after installation of the cable system with non-inflammable materials, as follows:

i) Fire stop/Penetration seal shall be installed in the cable spreaders and cable raceways.

ii) Similarly in the trenches fire stop/penetration seals shall be provided at suitable interval to avoid spread of fire.

iii) For all H.V., L.V., Relay and Control panels, Control desk, instrumentation panels, battery charger, D.C. Dist. boards and other miscellaneous panels, fire-stops should be provided below base plate.

2.04.10 All floor/wall openings for cable entry to the electrical equipment and accessories shall be sealed with non-inflammable materials, after completion of cable installation. Thickness of such materials shall be equal to the thickness of floor/wall unless specified otherwise.

2.04.11 The portion of galvanized steel, which, if required, undergoes any welding at site shall be coated with two (2) coats of cold galvanizing anti-corrosive paint after welding.

2.04.12 The cables shall be coated with fire protection coating as specified elsewhere.

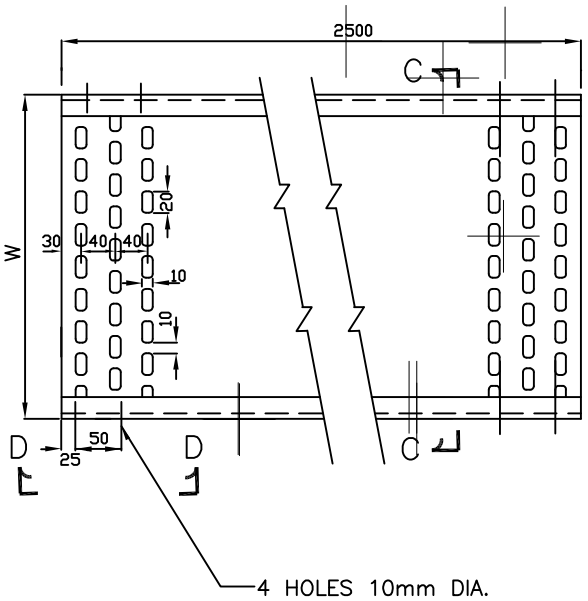
2.05.00 **Identification**

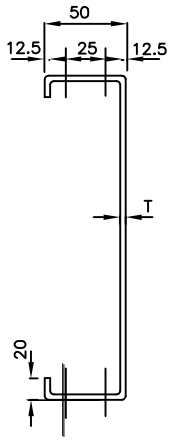
2.05.01 The complete cabling system shall be properly identified. Methods for identification of cabling system shall be furnished to the successful tenderer and the Bidder shall strictly adhere to the said methods.

2.05.02 Each cable and conduit run shall be tagged with numbers that appear in the cable and conduit schedule.

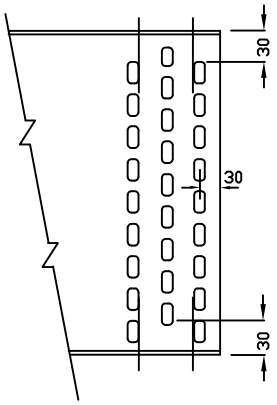
2.05.03 Location of cables laid directly underground shall be clearly indicated with cable marker made of galvanized iron plate, projected above ground level.

2.05.04 Cable tags shall be provided on all cables at each end (just before entering the equipment enclosure), on both sides of a wall or floor crossing, on each duct/conduit entry, at each bend and at every thirty (30) metres in cable tray/trench runs. Cable tags shall also be provided inside the switchgear, MCC, control & relay panels etc. wherever required for cable identification, such as where a number of cables enter together through a gland plate.

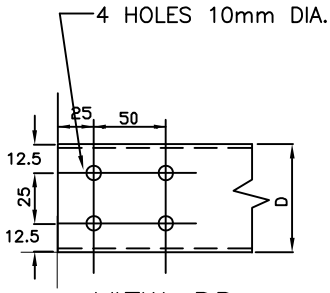




SECTION–CC
(100/50 TRAYS)



ARRANGEMENT OF PERFORATIONS

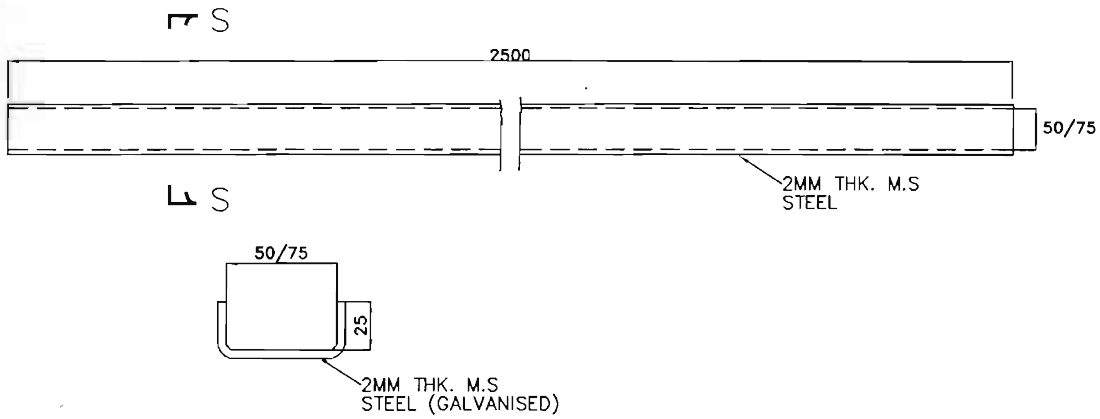


VIEW–DD
(100,50W TRAYS)

TRAY WIDTH W (mm)	100	50
TRAY DEPTH D (mm)	50	50
T (mm)	2	2

PERFORATED TYPE TRAY

TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES	DWG. NO.



SECTION S–S

CABLE TROUGHS

SEE GENERAL NOTES IN SHEET 11.

भेल BHEL	TYPICAL DETAILS OF CABLE TRAY AND ACCESSORIES	BHEL DRAWING NO. PE–DG–427–507–E005
		SH 10 OF 11 | REV 00

SUBSECTION-II C

GENERAL TECHNICAL REQUIREMENT (CONTROL AND INSTRUMENTATION)

8.00.00 **GENERAL REQUIREMENTS**

8.01.00 Integrated DCS based closed loop control, open loop control and sequential control and bulk data acquisition system for FGD System in hierarchical levels has been envisaged for the plant. (BHEL scope)

8.02.00 Suggestive Control System Architecture for the FGD control system is schematically shown in Drawing No. 17A14-DWG-I-001. Bidder shall develop detail drawing based on this technical specification.

8.03.00 All field process transmitters shall be smart (HART based) type.

8.04.00 Final control device for regulating duty control shall have pneumatic actuator with HART based smart pneumatic positioners. Actuators for isolating and inching duty valves shall be, in general, electrical motor operated. Solenoid operated pneumatic actuator will be used for on-off duty control valves All the position limit switches employed in the pneumatic on-off valves shall be non-contact type.

8.05.00 Process switch (Pressure / Level switch) function shall generally be derived from analog process transmitters.

8.06.00 Process transmitter and valve positioner shall communicate with the DCS in the form of analog signal 4-20 mA DC along with superimposed digital signal through HART protocol. Separate handheld smart configurator shall be furnished for local and manual configuration / adjustment of all HART instrument / devices.

8.07.00 Power supply for Transmitters, contact interrogation, relay and solenoid shall be generally 24V DC. Power supplies for interrogation, relay and solenoid shall be provided from Bulk power supply modules separate from control system rack power supply. In all cases redundancy in power supplies & modules shall be considered.

8.08.00 Temperature measurement shall have upscale / down scale protection features to protect from process upset in case of sensor failure. Both the elements of duplex temperature sensors shall be brought to junction boxes.

8.09.00 Temperature transmitters shall be provided for all control applications. Transmitter shall be two wire type and current output of 4-20 mA DC with superimposed digital signal in HART protocol. For temperature monitoring functions, temperature elements (TC / RTD) shall be connected to their respective input module of PLC through instrumentation signal / Triad cable in case of RTD type element, extension / compensating cable for K type TC.

8.10.00 All alarm and trip signal shall be configured in NC mode of configuration so that any breakage in the wire can be identified with alarm.

8.11.00 Bidder shall be fully responsible for safe and efficient operation of the control

loops and interlock / protection logic even under all plant disturbances, disabilities, emergencies and component failures.

8.12.00 Critical maintenance purpose manual isolation valves of equipment, suction valves of critical pumps shall have open & close end position status indication at ~~PLC.~~ DCS

8.13.00 All regulating duty control valves shall have mechanical position indicator and contact less position transmitter (4-20mA DC output) for monitoring the position from local and control room respectively. Air lock relays shall be provided with all regulating duty pneumatic drives to achieve stay put / fail safe condition on air failure. Hand wheel shall be provided for local operation. Pneumatic tubing for the control valve hook up including integral tubing of valve shall be of stainless steel material.

8.14.00 Motor winding temperature of HT motors and bearing temperature of HT motors & driven equipment shall be measured in all cases. In general bearing & winding temperature shall be measured with Duplex Resistance temperature detector (RTD).

8.15.00 Bearing temperatures of any equipment driven by H.T. motors shall be provided with direct mounted dial Temperature gauge at each bearing of driven equipment and motor.

8.16.00 All temperature-measuring elements (RTD / TC) shall be of duplex ungrounded type and both the elements shall be terminated at junction box. Extension / Compensating cable for TC and Triad cable for RTD shall be used for interfacing with PLC. Temperature elements shall be supplied with thermowell.

8.17.00 Flow Elements with Flow Transmitters & Flowmeter (Electro-magnetic type, Coriolis mass flow) for flow measurement of process medium like water, air, flue gas, slurry etc. shall be provided by Bidder based on application and as approved by Owner. Wherever DP type transmitter is used for flow measurement, square root extraction is to be performed in the DCS based system.

8.18.00 Pressure gauges, pressure switches and pressure / differential pressure transmitters shall be provided with diaphragm seal in case of dirty, corrosive & viscous fluid application. Diaphragm material shall be suitable for process fluid. Similarly the wetted part material for level transmitter / switches / gauges / analyzers in corrosive application shall have suitable grade material compatible with the corrosive fluid in contact. In all other cases material grade of the wetted part shall in no case be lower than stainless steel unless the process fluid calls for some other material.

8.19.00 Ergonomically & aesthetically designed furniture viz. control desks & chairs shall be provided at the local control room for various workstations. Similarly, furniture shall be provided for equipment like programming stations, PCs and various peripherals. Control desk and Video wall shall be from reputed

manufacturer/s. Local control room interior shall be designed with latest state of the art design prevailing in the modern power plant.

8.20.00 KKS identification system shall be adopted for the tagging. Bidder shall follow the KKS Tag numbering philosophy while preparing all instrumentation & control related documents.

8.21.00 The SI / MKS system of units shall be used for design, drawings, diagrams, instruments etc.

8.22.00 **Vibration Monitoring System**

Microprocessors based standalone online Vibration Monitoring System (VMS) shall be provided for rotating machine condition monitoring & diagnostic. On-line Vibration Monitoring System shall be provided for all HT drives (160 KW & above).

Each HT drive (160 KW & above) shall be provided with vibration sensors on the DE and NDE bearings of motors and fans / pumps. On each bearing there shall be two vibration sensors, one in X direction and other in Y direction along with key phasor for on line vibration monitoring and analysis.

Each vibration monitoring panel shall have local LCD display mounted on the panel.

8.23.00 **Process Connection & Instrument Hook Up (as applicable)**

Instruments	**EQUIPMENT / PIPE SIDE**	**INSTRUMENT SIDE**
Level Instruments		
Internal Displacer	4" – Flanged	4" - Flanged
External Displacer	2" – Flanged	2" - Flanged
Level gauge	¾" –Flanged	¾" - Flanged
DP Type	½" (min.)-welded 1" – welded for vessel like HP heaters, LP heaters, De-aerator etc. application	½"- NPT
External cage Level switch	1"- welded	1"- welded
Flow Instruments		

Instruments	EQUIPMENT / PIPE SIDE	INSTRUMENT SIDE
DP Type	½" - welded in general 1" – welded for high pressure / temperature main steam, feed water, PRDS etc. application	½" - NPT
Pressure Instruments		
Conventional	½" (min.)-welded 1"- welded for high pressure/ temperature. application	½" - NPT
Diaphragm type-HFO application	3"- Flanged	3"- Flanged
Temperature Instruments		
Thermowell	Generally - M 33 X 2 (M) 1½" Flanged- For air/FG path application	½" NPT
Analyzer		
Liquid analyzer	½"- 1" – welded	½"

8.24.00 **Electrical Power Supply Systems**

240V AC Redundant Package UPS system with 60 minutes back-up to cater various C&I system loads in FGD control room including PLC, HMIs, field instruments / analyzers, Relay based Local Control Panel etc. and PLC / Proprietary control and monitoring system for package systems (if any), Vibration Monitoring System shall be provided by the bidder.

UPS Power supply (max. 1 kVA) required for the FGD C&I loads, located in main plant CCR, shall be made available to the bidder at purchasers ACDB terminals as single redundant feeder. Cabling from the purchaser ACDB to FGD load points/ ACDB is under the scope of the bidder.

DC power distribution for PLC and loop-powered field instruments shall be derived from the UPS supply and the required DC distribution boards will be located within PLC cabinets. Any other DC power supply required for the plant will also be suitably derived and distributed. (UPS specification shall be covered

in Electrical Volume)

8.25.00 **Instrumentation & Control Cabling**

8.25.01 Instrumentation cables shall be copper, overall screened for binary signals and individual & overall screened for analog signals. All cables shall be FRLS type (inner & outer sheath) and armoured. Inter panel cables inside Control Rooms may be unarmoured. All the unarmoured cables shall run through conduits.

8.25.02 Fiber Optic cables in the field shall be laid through HDPE conduits for buried section and through dedicated encased perforated GI trays for over-ground section.

8.25.03 Bidder to follow the the following philosophy

1) DI & DO signal cannot be routed through the same cable.
2) Single pair or single triad cable is not acceptable. Minimum of 2 pairs or 2 triad cable shall be used.
3) Each multi-pair or multi-triad cable shall have 20% or minimum 1 pair / 1 triad cable whichever is maximum as spare.

8.25.04 Cable size & type shall be as below for different type of signals and control system shall be followed in general.

1) Cables for analog signals will be instrumentation paired cable of 0.5 sq. mm copper conductor size, with individual pair shielding & overall shielding.
2) Cables for binary signals will be instrumentation paired cable of 0.5 sq. mm copper conductor size with overall shielding only.
3) Conductor cross section for triad signal cables will not have individual conductor cross section below 1.5 sq. mm.
4) For interposing relay drive connection individual conductor cross section will not be below 1.5 sq. mm.
5) Cables for power supply to each solenoid valves will be control cable of 3C x 2.5 sq. mm copper conductor size for all voltage level.

9.00.00 **TYPE TEST**

9.01.00 **General Requirements**

a) The Bidder shall furnish the type test reports of all type tests as per relevant standards and codes as well as other specific tests indicated in this specification. List of major tests are furnished below for solid state equipment. For the balance systems & instruments, which are not indicated here, type tests may be conducted as per manufactures

standard or if required by relevant standard.

b) The Bidder / sub-vendor / manufacturer is required to conduct certain type tests specifically for this project as specified in respective sections and to be witnessed by Owner / Consultant or their authorized representative, even if the same had been conducted earlier. Incase Owner / Consultant decides to waive any of the Type tests for any item based on tests conducted by Bidder in the last five years, Test certificates for same shall be provided for review / acceptance and the final decision rests with Owner / Consultant.

c) Submission of type test results and certificate shall be acceptable provided:

i) The same has been carried out by the Bidder / sub-vendor on exactly the same model / rating of equipment.

ii) There has been no change in the components of offered equipment from tested equipment.

iii) The test has been carried out as per the latest standards along with amendments.

d) In case the approved equipment is different from the one on which the type test had been conducted earlier or any of the above grounds, then the tests have to be repeated and the cost of such tests shall be borne by the Bidder within the quoted price and no extra cost shall be payable by the Owner on this account.

e) The schedule of conduction of type tests / submission of reports indicating the test standard shall be submitted and finalized during pre-award discussion for Owner / Consultant's review & approval.

f) For the type tests to be conducted, Bidder shall submit detailed test procedure for approval by Owner / Consultant. This shall clearly specify test setup, instruments to be used, procedure, acceptance norms (wherever applicable), recording of different parameters, interval of recording, precautions to be taken etc. for the tests to be carried out.

9.02.00 **Special requirements for Solid State Equipments& Systems**

The type tests reports, as a minimum, over and above the requirements of above clause which are to be submitted for each of the major C&I system shall be as indicated below:

9.02.01 **Electromagnetic Immunity as per EN 61000-6-22**

a) Equipment furnished by Bidder shall incorporate necessary techniques to eliminate measurement and control problems caused by electromagnetic interferences especially encountered in power plant

environment. Equipment, which is vulnerable to such interference, shall be suitably immunized to eliminate possible problems.

b) Required shielding, input balancing, ripple amplitude and grounding for field signals and for the control systems to achieve an installation with minimum noise coupling from all sources.

c) Any additional equipment, deliverables required for effectively eliminating the noise problems shall be identified and included.

d) Electromagnetic emission as per EN 61000-6-43

9.02.02 Surge-Protection For Solid State Equipment

All solid state systems / equipment shall be immuned and able to withstand the electrical noise and surges as encountered in actual service conditions inherent in a power plant. All the solid state systems/ equipments shall be provided with all required protections that needs the surge withstand capability as defined in ANSI 37.90a-1989. Hence, all front end cards which receive external signals like analog input & output modules, binary input & output modules etc. including power supply, data highway, data links shall be provided with protections that meet the surge withstand capability as defined in ANSI 37.90a. Complete details of the features incorporated in electronics systems to meet this requirement, the relevant tests carried out, the test certificates etc. shall be submitted along with the proposal. As an alternative to above, IEC / EN 61000-4-4 & IEC / EN 61000-4-5 for Electrical fast transient / burst and Surge immunity may also be adopted for SWC test.

9.02.03 Type Test Requirement for C&I Systems

Sl. No.	Item	Test Requirement	Standard	Test to be specifically conducted	Approval required on Test Certificate	Remarks
1.	Transducers	As per Standard	IEC-688, IS-12784	NO	YES	
2.	Thermocouples	Degree of Protection Test	IS-2147	NO	NO	
3.	RTD	As per Standard	IEC-751	NO	NO	
4.	C.J.C. Box	Degree of Protection Test Ambient Temp. effect	IS-2147 Approved Procedure	NO NO	YES YES	
5.	Electronic Transmitter	As per Standard	BS-6447 / IEC-770	NO	YES	

Sl. No.	Item	Test Requirement	Standard	Test to be specifically conducted	Approval required on Test Certificate	Remarks
6.	E/P Converter	As per Standard	Mfr. Standard	NO	YES	
7.	Dust Emission Monitor	Degree of Protection Test	IS-2147	NO	YES	
8.	Instrumentation Cables Twisted & Shielded			YES	YES	
	a) Conductor	• Resistance Test	VDE-0815			
		• Diameter Test	IS-10810			
		• Tin Coating Test (drain wire)				
	b) Insulation	• Loss of mass	VDE-0472			
		• Aging in air ovens	0472 **			** As per VDE 0207 for Teflon insulated cables
		• Tensile Strength and Elongation	VDE 0472 **			
		• Heat Shock	VDE 0472 **			
		• Hot Deformation	VDE 0472			
		• Shrinkage	VDE 0472			
		• Bleeding & Blooming	IS-5831			
	c) Inner Sheath	• Loss of mass	VDE-0472			
		• Heat Shock	VDE 0472 **			
		• Cold Bend / Cold Impact Test	IS-5831			
		• Hot Deformation	VDE 0472			
		• Shrinkage	VDE 0472			

Sl. No.	Item	Test Requirement	Standard	Test to be specifically conducted	Approval required on Test Certificate	Remarks
	d) Outer Sheath	• Loss of mass	VDE-0472			
		• Aging in air ovens	VDE 0472 **			
		• Tensile Strength and Elongation Test before and after ageing	VDE 0472 **			
		• Heat Shock	VDE 0472 **			
		• Hot Deformation	VDE 0472			
		• Shrinkage	VDE 0472			
		• Bleeding & Blooming	IS-5831			
		• Colour Fastness to Water	IS-5831			
		• Cold Bend / Cold Impact Test	IS-5831			
		• Oxygen Index Test	ASTMD-2863			
		• Smoke Density Test	ASTMD-2843			
		• Acid Gas Generation Test	IEC-754-I			
	e) Fillers	• Oxygen Index Test	ASTMD-2863			
		• Smoke Density Test	ASTMD-2843			
		• Acid Gas Generation Test	IEC-754-I			
	f) AL-MYLAR Shield	• Continuity Test				
		• Shield Thickness				
		• Overlap Test				
		• Noise	IEEE			

Sl. No.	Item	Test Requirement	Standard	Test to be specifically conducted	Approval required on Test Certificate	Remarks
		Interference	Transactions			
	g) Overall Cable	• Flammability	IEEE 383			
		• Noise Interference				
		• Dimensional Checks	IS 10810			
		• Cross talk				
		• Mutual Capacitance	VDE 0472			
		• HV Test	VDE 0472			
		• Drain Wire Continuity				
9.	Pressure Gauge	• Degree of Protection Test	IS-2147	NO	NO	
		• Temperature Interference Test	IS-3624	NO	NO	
10	Temperature Gauge	Degree of Protection Test	IS-2147	NO	NO	
11	Pressure & Differential Pressure Switch	• Degree of Protection Test	IS-2147	NO	NO	
		• As per Standard	BS 6134	NO	NO	
12	Level Switch	Degree of Protection Test	IS-2147	NO	NO	
13	Conductivity Level Switch	Degree of Protection Test	IS-2147	NO	YES	
14	Control Valves	CV Test	ISA 75.02	YES	NO	
15	Flow Nozzles & Orifice Plate	Calibration	ASME PTC, BS-1042	YES	NO	
16	PLCs	All tests as per IEC-1131	IEC-1131			
17	LIE / LIR / Junction Box	Degree of Protection Test	IS-2147	YES	YES	
18	Flue Gas O_2	Degree of	IS-2147	NO	YES	

Sl. No.	Item	Test Requirement	Standard	Test to be specifically conducted	Approval required on Test Certificate	Remarks
	Analyzer	Protection Test				
19	Flue Gas SO_2 Analyzer	Degree of Protection Test	IS-2147	NO	YES	

10.00.00 **TRAINING**

10.01.00 Bidder's experienced personnel / engineers shall provide training courses on offered PLC, VMS or any other special instrument, to Owner's engineers in the following areas:

a) Operator training

b) Hardware maintenance training

c) Software training

d) Any other specialized training as required for system operation and maintenance

10.02.00 The maintenance training shall include lectures and hands on experience on a similar type of equipment / system at manufacturer's works and / or training simulator. The details of hardware and software training shall be finalized during detailed engineering and shall be subject to Owner's acceptance.

GENEREAL REQUIIREMENTS (INSTRUMENTS)

6.06.00 Instrument Accuracy, Standard Scales and Ranges

6.06.01 Instrument Accuracy

a) Accuracy of linear instruments shall meet the specified accuracy over its span.

b) Flow meter shall meet the specified accuracy criteria when operating between 25 and 100 percent of full-scale flow value. The accuracy guarantee shall include the effect of errors in the differential head measuring device, square root converter and signal generator.

c) Level measurement shall be linear with respect to the measured level based on a specific gravity of 1.00.

d) Wherever the measured parameter like flow is influenced by process pressure & temperature, required correction against pressure and temperature shall be introduced for such measurement.

e) Temperature compensation shall produce corrections over a flow range from 10 percent to 100 percent of maximum flow subject to a plus or minus tolerance of one-half of one percent of the maximum flow.

6.06.02 Instrument Scale Displays

a) All displays shall be in engineering units. Instrument scales displayed on screen shall have graduations with scale divisions based on multiples of 10. The smallest division shall preferably be a whole number approximately 1% of the scale range if not otherwise impracticable.

b) Pressure instrument shall have the unit suffixed with ‘a’ or ‘g’ to indicate absolute or gauge pressure, respectively.

c) Scales and charts of all instruments shall have linear graduations

6.06.03 **Instrument Ranges**

Unless otherwise impractical, Instrument range shall be selected in such a way so that the normal reading lies within 50% to 70% of full scale for linear parameters and within 70% to 90% of full scale for flow measurements. Deviation indicators shall have the null position at mid-scale. The normal operating parameter shall be identified with a clear green mark.

6.07.00 **Environmental Conditions**

6.07.01 Control & Instrumentation system shall be suitable for continuous operation in the environmental condition as per the project metrological data provided elsewhere in the specification and shall meet the minimum design requirement of 50°C and 95% RH.

Equipment which cannot meet the stipulated environmental condition shall be installed in air conditioned environment..

6.07.02 Particulate contamination from fly ash and coal dust and gaseous contaminants such as SO_2 and other flue gas constituents in the plant can have deleterious effect on printed circuit board, connectors and components. This hazard shall be taken into design considerations.

6.07.03 Instruments, devices and equipment for location in outdoors/ indoor/ air-conditioned areas shall be designed to suit the environmental conditions indicated below and shall be suitable for continuous operation in the operating environment and also during periods of air conditioning failure without any loss of function, or departure from the specification.

SL. NO.	LOCATION	ENCLOSURE TYPE
1.	Indoor type non- ventilated enclosure in non-hazardous area	IP-54
2.	Indoor type ventilated enclosure in non-hazardous area	IP -42
3.	Enclosure in Air conditioned area	IP-32 with suitable canopy at top to prevent ingress of dripping water.
4.	Outdoor type in non-hazardous areas	IP-65 with anticorrosion coating.
5.	Outdoor in hazardous areas	As per requirements of the NEC Code for the location

6.08.00 **Name plate**

6.08.01 Each instrument / item of plant shall have nameplate, permanently attached to it in a prominent position, made of non-hygroscopic & non-corrosive material (generally stainless steel) upon which is to be engraved as per the existing philosophy.

6.08.02 Stainless steel tag plate shall be wired to the instrument. Inscription on equipment (labels) shall be in English.

6.08.03 Caution / Danger & Hazardous name plates shall be in English, Tamil & Hindi.

7.00.00 **CODES AND STANDARDS**

7.01.00 The design, construction and testing of all equipment, facilities, components and systems shall be in accordance with standards/ codes issued by Bureau of Indian Standards (BIS) and/or equivalent international standards/ codes. A non-exhaustive list of reputed international standards is given below:

a) American National Standards Institute (ANSI)

b) American Petroleum Institute (API)

c) American Society of Mechanical Engineers (ASME)

d) American Society of Testing and Materials (ASTM)

e) American Water Works Association (AWWA)

f) American Welding Society (AWS)

g) British Standards (BS)

h) Deutsches Institut fur Normung (DIN), Germany

i) Heat Exchange Institute (HEI), USA

j) Hydraulic Institute Standards (HIS), USA

k) International Electro-technical Commission (IEC)

l) Institute of Electrical and Electronics Engineers (IEEE)

m) International Organisation for Standardization (ISO)

n) National Electric Code (NEC), USA

o) National Electrical Manufacturers Association (NEMA), USA

p) National Fire Protection Association (NFPA), USA

q) Tubular Exchanger Manufacturers Association (TEMA), USA

r) VDE association for Electrical, Electronic and Information Technologies (VDE), Germany

Other International Standards, equivalent or superior to the above Standards can also be adopted. However, in the event of any conflict between the requirements of the International standards / codes and the requirements of the BIS standards / codes, the latter shall prevail.

7.02.00 The following latest edition of codes and standards prevailing at the time of award of contract shall generally be applicable.

1) **Temperature Measurement**

a) Instrument and apparatus for temperature measurement - ASME PTC 19.3 (1974).

b) Temperature Measurement - Thermocouples - ANSI - MC 96.1 - 1982.

c) Temperature Measurement by electrical resistance thermometers - IS: 2806

d) Thermometer-element-Platinum resistance - IS: 2848 / DIN 43760.

2) **Pressure Measurement**

a) Instrument and apparatus for pressure measurement - ASME PTC 19.2 (1964).

b) Bourdon tube pressure and vacuum gauges - IS: 3624/1996.

3) **Flow Measurement**

a) Instruments and apparatus for flow measurement - ASME PTC 19.5 (1972) Interim supplement, Part-II.

b) Measurements of fluid flow in closed conduit - BS 1042.

4) **Electronic Measuring Instruments and Control Hardware**

a) Automatic null balancing electrical measuring instruments -ANSI C 39.4 (Rev. 1973), IS 9319

b) Safety requirements for electrical and electronic measuring and controlling instrumentation - ANSI C 39.5 / 1974.

c) Compatibility of analog signals for electronic industrial process instruments - ISA-S 50.1: ANSI MC 12.1 / 1975.

d) Dynamic response testing of process control instrumentation - ANSI MC 4.1 (1975) - ISA -S26 (1968).

e) Surge withstand capability (SWC) tests - ANSI C 37.90A (1989), IEC / EN 61000-4-4 & IEC / EN 61000-4-5.

f) Printed circuit boards – IPC-TM-650, IEC 326-2 & IEC 326-4.

g) General requirements and method of tests for printed wiring boards - IS-7405 (Part-I) /1994, IEC 326-2.

h) Edge socket connectors - IEC 130-11.

i) Requirements and methods of testing of wire wrap terminations-- DIN 41611 Part-2.

j) Dimensions of attachment plugs and receptacles- ANSI C73-1973.(Supplement ANSI C73a – 1980)

5) **Instrument Switches and Contacts**

a) Contact Rating - AC services NEMA ICS Part-2 125, A-600

b) Contact Rating - DC services NEMA ICS Part-2 125, N-600

6) **Enclosures**

a) Enclosures for Industrial Controls and Systems–NEMA ICS-6-110.15 through 110.22

b) Racks, panels and associated equipment -EIA: RS-310-B-1983 (ANSI C83.9 - 1972)

7) **Apparatus, Enclosures and Installation Practices in Hazardous Area**

a) Classification of hazardous area - NEMA Article 500, Volume-6, 1978.

b) Electrical Instruments in hazardous dust locations - ISA-RP 12.11.

c) Intrinsically safe apparatus - NFPA Article 493 Volume-4 1978.

d) Purged and pressurized enclosure for electrical equipment in hazardous location - NFPA Article 496 Volume-4, 1978.

8) **Annunciators**

a) Specifications and guides for the use of general-purpose annunciators - ISA 18.1- (1979) (R2004).

b) Surge withstands capability tests - ANSI C37.90 -1989 / IEC /EN 61000-4-4 & IEC /EN 61000-4-5.

9) **Interlocks, Protections**

a) Relays and relay system associated with electric power apparatus - IEEE Standards 3.13.

b) Surge withstands capability tests - ANSI C37.90 a - 1971 and IEEE Standard 472-1974.

c) General requirements and tests for switching devices for control and auxiliary circuits including contactor relays - IS-6875 (Part-I)/1973.

10) **UPS System**

a) Practice and requirements for semi-conductor power rectifiers - ANSI C34.2.
b) Relays and relay systems associated with electrical power apparatus IEEE Standard - 3.13.

c) Surge withstands capability tests - ANSI C 70.90 A/1971, IEC-255.4.

d) Recommended practice for sizing large lead storage batteries for generating stations and sub-stations -IEEE-485.

11) **Control Valves**

a) Control valve sizing (Incompressible fluids) - ISA-S39.1 / 1972.

b) Control valve capacity test (Incompressible fluids) -ISA-S39.2 / 1972.

c) Control valve sizing (Compressible fluids) - ISA-S39.3 / 1972.

d) Control valve capacity test (Incompressible fluids) -ISA-S39.4 / 1972.

e) Control Valve seat leakage – ANSI / FCI 70.2

f) Face to face dimensions of Control Valves - ANSI B16.10

g) Control Valve Capacity Test Procedure – ISA – 575.02

12) **Instrument Tubing**

i) Seamless Carbon Steel Pipe - ASTM-A-106.

ii) Forged carbon steel fittings - ASTM-A-105.

iii) Dimensions of fittings - ANSI-B16.11.

iv) Code for pressure piping, welding, hydrostatic testing - ANSI-B 31.1.

v) Nomenclature for instrument tube fittings - ISA-RP 42.1 / 1982.

vi) Seamless Stainless Steel Tube ASTM A-213 TP 316 / ASTM A-269 TP 316

vii) Seamless Alloy Steel Pipe ASTM A 335 P22

viii) Seamless Stainless Steel Pipe ASTM A-312 TP 316

13) **Cables**

a) Thermocouple extension wires / cables - ANSI MC96.1.

b) Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy-IPCEA S-61-402

c) Guide for design and installation of cable system in power generating station (insulation, jacket materials)-IEEE Standard 422.

d) Requirements of vertical tray flame test - IEEE 383

e) Standard specification for tinned soft or annealed copper wire for electrical purpose - ASTM B33.

f) Specification for PVC insulated (heavy duty) electric cables or (Latest revision) equivalent - IS-1554 Part-1

g) Conductors for insulated electric cables and flexible cords or equivalent - IS-8130, 1984

h) PVC insulation and sheath of electric cables or equivalent - IS-5831

i) PVC insulated cables for working voltage upto and including 1100 volts or equivalent - IS-694 (Latest)

j) Mild steel wires, formed wired and tapes for armouring of cable or equivalent - IS-3975

k) Test on single vertical insulated wire or cable - IEC 332 (Part-1)

l) Swedish Chimney Flame Test - SS 424-1475

m) Test methods for insulations and sheaths of electric cables and cords - IEC 540

n) Colour coding of instrumentation cables - VDE 0815

o) Minimum oxygen concentration to support candle-like combustion of plastics - ASTM D2863

p) Density of smoke from the burning of decomposition of plastics - ASTM D2843

q) Test on gases evolved during combustion of materials from cables - IEC 754

r) Determination of the amount of halogen acid gas - IEC 754 (Part-1)

s) Methods of test for cables - IS 10810

t) Drums for electric cables - IS: 10418

14) **Electronic Cards, Subassemblies and Components**

a) **Unpackaged**

i)	Vibration	:	IEC-68.2.6
ii)	Shock	:	IEC-68.2.27
iii)	Drop & Topple	:	IEC-68.2.31

b) **Packaged**

Vibration, Drop & Static Compression - NSTA.

c) **Electromagnetic Compatibility / Immunity**

i)	Electrical Fast Transient immunity	:	IEC / EN 61000-4-4
ii)	Surge Immunity	:	IEC /EN 61000-4-5
iii)	Radiated Electromagnetic Field	:	EN 61000-4-3
iv)	Electrostatic Discharge immunity	:	EN 61000-4-2
v)	Electromagnetic Emissions	:	VDE 0871, Class-B

15) **Cable Trays, Conduits**

a) Guide for the design and installation of cable system in power generating station (cable trays, support systems, conduits)- IEEE Standard 422, NEMA VE-1, NEC-1981. Test Standards NEMA VE-1-1979.

b) Galvanizing of carbon steel cable trays - ASTM A-386.

VOLUME : II-E

SECTION-III

INSTRUMENTATION AND CONTROL SYSTEM

1.00.00 FIELD INSTRUMENTS

This section provides general guidelines for field instruments, systems and equipment to be supplied under this specification, **as applicable for the Bidder's Scope of Work** for completeness of C&I system. All measuring instruments / equipment and systems / sub-systems offered by Bidder shall be from reputed experienced manufacturer of specified type and range of equipment, whose guaranteed and trouble free operation has been established. All instruments / equipment shall be of proven reliability, accuracy, repeatability requiring a minimum of maintenance and comply with the acceptable international standards. All instruments / equipment and accessories shall be supplied as per technical specifications, ranges, make as approved by Owner / Consultant.

All local gauges as well as transmitters, sensors, and switches for parameters like pressure, temperature, level, flow etc. and vibration transmitters as required shall be provided. In general, transmitters shall be provided for remote monitoring, alarm, interlock and control. Use of process actuated switches shall be avoided as far as possible unless the same is required as per manufacturer's standard & proven practice.

All field instruments shall be weatherproof, drip tight, dust tight and splash proof suitable for use under outdoor ambient conditions prevalent in the subject plant. All field-mounted instruments shall be mounted in suitable locations where maximum accessibility for maintenance is achieved. The enclosures of all electronic instruments shall conform to IP-65 unless otherwise specified.

For all instruments envisaged for corrosive liquid applications, they shall be provided with wetted parts made of Monel / Hastelloy C or any other material (if provenness experience of the proposed material for such applications is established by Contractor).

All instruments shall be provided with durable epoxy coating for housings and all exposed surfaces of the instruments. Anti-corrosive paint shall be applied to the field mounted enclosures / instruments.

1.01.00 **Pressure, Differential Pressure, Flow and Level Transmitter**

01.	Working Principle		:	Smart
02.	Type		:	2-Wire
03.	Output signal		:	Simultaneous transmission of digital and 4-20 mA DC signal. HART protocol.
04.	Signal Processing Unit		:	Silicon solid-state electronic circuitry
05.	Measuring element		:	Capsule/Diaphragm
06.	Element material		:	AISI-316 (Stainless Steel) or better
07.	Over Pressure		:	150% of maximum pressure
08.	Turn-down ratio		:	10:1 for vacuum / very low pressure application. 30:1 for other application
09.	Span and Zero		:	Continuous non-interacting tamper proof, remote as well as manual adjustable from instrument with zero suppression and elevation facility.
10.	Enclosure		:	Epoxy coated Die cast aluminium. IP-65 (Explosion proof for NEC Class-1, Division 1 area) with ½" NPT (F) cable entry.
11.	Output Indicator		:	LCD type
12.	Body		:	Forged Carbon Steel (SS for DM Water)
13.	Operating Voltage		:	24 V DC ± 10%
14.	Load		:	600 Ohms (min.) at 24 Volts DC
15.	Performance :-			
	a)	Accuracy	:	±0.1 % of span or better
	b)	Repeatability	:	± 0.05 % of span or better
	c)	Response time	:	250 msec or better

d) Zero & Span drift : 0.015% per Deg.C at max span

0.11% per Deg.C at min span

e) Stability : 0.1% of calibrated span for six months for ranges upto and including 70 Kg/ sq.cm.

0.25% of calibrated span for six months for ranges more than 70 Kg/ sq.cm (g).

16. Process connection : ½" NPT (F)

17. Sealing / Isolation : Extended diaphragm with 5 meters SS armoured capillary for corrosive, viscous and dirty fluid applications. Material for separator diaphragm, depending on application.

18. Nameplate : Tag number and Service engraved in stainless steel tag plate

19. Accessories :

a) Installation accessories such as mounting bracket, high tensile carbon steel U-bolts suitable for pipe mounting.

b) ½" NPT 2-valve stainless steel manifold, constructed from SS316 bar stock for pressure transmitter.

c) ½" NPT 5-valve stainless steel manifold, constructed from SS316 bar stock for DP transmitter. 3 valve manifold for DP application in flue gas and air.

d) Companion flange with nuts, bolts and gaskets.

e) ½" NPT cable gland

1.02.00 **Ultrasonic Level Transmitter**

01. Principle of operation : Detection of reflected ultrasonic pulse

02.	Signal processing	:	Microprocessor Controlled Signal Processing
03.	Type	:	Smart
04.	Display	:	Large alpha-numeric back lit LCD/LED
05.	Calibration & configuration:		Accessible from front of panel
06.	Diagnostic	:	On-line
07.	Status	:	For power, Hi / Lo / V. Hi / V. Lo-level indication, fault etc.
08.	Construction	:	Plug-on board
09.	Power supply	:	240 V AC 50 Hz / 24V DC
10.	Signal Output	:	4-20 mA DC (isolated) - 600 Ohm load with HART protocol.
11.	Hysteresis	:	Fully adjustable preferred
12.	Output contacts	:	2SPDT Potential free changeover contacts @ 5A 230V AC.
13.	Accuracy & Repeatability	:	0.25% of span or better
14.	Resolution	:	0.1% of span
15.	Operating temp.	:	Transmitter-55 o C and Sensor – 80 o C
16.	MOC Sensor	:	SS 316 in general / PTFE, PP for corrosive application.
17.	Humidity	:	1% to 95% non condensing.
18.	Enclosure	:	IP-65 powder coated die cast aluminium
19.	Cable connection	:	½” NPT with cable gland
20.	Mounting	:	2” flanged for sensor and Transmitter on panel / surface.
21.	Accessories	:	Cable gland, prefab cable, mounting accessories.

Note : Sensors and transmitter shall be separately mounted.

1.03.00 **Radar type Level Measurement**

01.	Type	:	Radar based on Time Domain Reflectometry / Pulse / FMCW as per application	
02.	Antenna	:	Co axial / single rod type guided wave or Horn type as required for the application	
03.	Communication	:	Two wire 4-20mA DC, HART protocol	
04.	Enclosure	:	Explosion proof /IP 65 as per application	
05.	Cable Entry	:	½" NPT	
06.	Calibration	:	a)	Self calibration with internal reference
			b)	Zero & Span calibration
07.	Programming	:	Handheld programmer & Local keypad	
08.	Process Connection	:	Flanged /screwed	
09.	Electronic Housing	:	Epoxy painted Die-Cast aluminium alloy	
10.	Antenna / Flange assembly:		316 SS or Hestalloy (as required)	
11.	Output Indicator	:	Digital Integral Display	
12.	Accuracy	:	5 mm or 0.1% of probe length	
13.	Accessories	:	a)	Programming tool kit, if required
			b)	Gasket

1.04.00 **Pressure Gauge and Differential Pressure Gauge**

01.	Type	:	Bourdon/Bellows/Diaphragm
02.	MOC Sensing & Socket	:	AISI-316 SS
03.	Movement Material	:	AISI-304 SS
04.	Case Material	:	Stainless steel. Enclosure IP-65.
05.	Dial Size	:	Generally 150 mm (100 mm for SWAS gauges)
06.	Scale	:	Black lettering on white background in 270 Deg. arc.

07.	Window	:	Shatterproof glass
08.	Range Selection	:	Normal process pressure – 50 ~ 70% of range (approximately).
09.	Over-range Protection	:	125% of maximum range by internal stop. External stop at zero.
10.	Adjustment	:	Micrometer screw for zero adjustment.
11.	Element Connection	:	Argon welding
12.	Process Connection	:	1/2" NPT (M) Bottom connection for local mounting, back connection for panel mounting.
13.	Performance	:	Accuracy of ± 1.0% of span or better.
14.	Safety Feature	:	Blow out disc /diaphragm at the back
15.	Accessories	:	a) Snubbers and Glycerin filled for pulsating fluid applications. b) Stainless steel Diaphragm seals for corrosive, viscous and solid-bearing or slurry type process fluids. c) Gauge saver wherever required d) 3-Way stainless steel Gauge valve for pressure gauges. Process connection ½" NPT. e) 5-valve SS316 manifold constructed from barstock for differential pressure gauge. Process connection ½" NPT. f) Union, nut & tail piece and other Installation accessories as required.
16.	Applicable standard	:	IS-3624 / 1996
17.	Electrical Contact rating	:	Not applicable
18.	Nameplate	:	Tag number, service engraved in stainless steel tag plate

1.05.00 **Pressure Switch and Differential Pressure Switch**

01.	Type	:	a)	Piston for high pressure application
			b)	Bellow / Diaphragm for low pressure application
02.	Sensing element material	:	AISI SS-316. All other wetted part SS316.	
03.	Case Material	:	Epoxy coated Die-cast aluminum alloy with neoprene gasket.	
04.	Setter Scale	:	Required.	
05.	Over range	:	150% of maximum pressure	
06.	Adjustments	:	Internal Set Point adjustable over span	
07.	Process Connection	:	1/2" NPT (M) bottom connected	
08.	Switch configuration	:	One DPDT (Two SPDT)	
09.	Switch Rating	:	240V, 5A AC/220V, 0.5A DC	
10.	Switch Type	:	Snap acting, shock & vibration proof	
11.	Terminal Block	:	Suitable for full ring lugs for cable connection.	
12.	Cable connection	:	½" NPT conduit connection or compression gland.	
13.	Enclosure Class	:	IP-65 (Explosion proof for NEC Class-1, Division 1 area).	
14.	Performance	:	Repeat accuracy ±1.0%	
15.	Nameplate	:	Tag number, service engraved in stainless steel tag plate	
16.	Accessories	:	a)	Remote diaphragm seal with SS-316 capillary for viscous &corrosive application. MOC of seal material shall be as per process fluid requirement.
			b)	Retention ring and screws for surface mounting.

c) 1/2" NPT 2 Valve SS-316 manifold constructed from bar stock for pressure switch

d) 1/2" NPT 3-Valve SS-316 manifold constructed from bar stock for DP switch

e) ½" NPT cable gland

1.06.00 **Level Switch**

1.06.01 **Type-1**

a)	Type	:	External cage float operated, magnetically coupled
b)	Float material	:	AISI 316 stainless steel
c)	External cage & other wetted part	:	AISI 316 stainless steel
d)	External cage mounting	:	Side Side, on standpipe
e)	External cage connection	:	1" Flanged
f)	Switch housing	:	Epoxy coated die cast aluminum alloy with neoprene gasket conforming to IP-65.
g)	Enclosure class	:	IP 65
h)	Type of switch	:	Snap acting magnetically operated
i)	Switch configuration	:	1DPDT
j)	Contact rating	:	5A, 240VAC / 0.25A, 220V DC
k)	Accessories	:	Counter flange, nuts & bolts, suitable gasket etc. Globe type Drain Valve. ½"NPT cable gland
l)	Application	:	Clean & non acidic fluid application in over ground tanks

1.06.02 **Type-2**

a)	Type	:	Float operated, magnetically coupled

b)	Float material	:	Polypropylene
c)	Housing	:	Polypropylene
d)	Mounting	:	Side mounted.
e)	Process connection	:	1/2" NPT (F) / Flanged
f)	Switch type	:	1 DPDT
g)	Enclosure class	:	IP 65
h)	Contact rating	:	5A, 240VAC/ 0.25A, 220V DC
i)	Cable meters (minimum)	:	Integral FRLS PVC stranded copper (5
j)	Application	:	Acid application in over ground tank

1.06.03 **Type-3**

01	Type	:	Capacitance type
02	Probe	:	a) Rod or suspended electrode b) Rope type probes may be used only where required probe length is greater than 1.5 meters. c) Reference rod for non grounded tank.
03.	Probe Mounting	:	1-1/2" Flanged
04.	Material of construction	:	316 SS and to suit fluid type
05.	Insulation	:	PTFE / PP / Kynar Part / Full as required
06.	Enclosure	:	Powder coated Die cast aluminium with neoprene gasket conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).
07.	Mounting	:	Probe on tap, switch unit separate on surface
08.	Supply voltage	:	240V AC ±10%, 50Hz / 24V DC±10%,
09.	Relay output	:	2 SPDT
10.	Contact rating	:	5A min. at 240V AC on resistive load

11.	Response time	:	100 msec or better
12.	Cable connection	:	½" NPT with cable gland
13.	Accessories	:	Counter flange, cable gland, prefab cable and stainless steel name plate engraved with alpha-numeric. Diagnostic & status LED on front of enclosure.

1.06.04 **Type-4**

a)	Type	:	Non-contact Ultrasonic type
b)	Signal processing	:	Microprocessor Controlled
c)	Display	:	Large alpha-numeric back lit LCD / LED
d)	Calibration & configuration	:	Accessible from front panel
e)	Diagnostic	:	On-line
f)	Status	:	For power, Hi / Lo / V. Hi / V. Lo-level indication, fault etc.
g)	Construction	:	Plug-on board
h)	Power supply	:	240 V AC 50 Hz / 24V DC (UPS supply)
i)	Hysteresis	:	Fully adjustable
j)	Output contacts	:	Potential free changeover contacts @ 5A 230V AC.
k)	Repeatability	:	0.25% of span or better
l)	Operating temp.	:	Transmitter-55^{o} C and Sensor- 80^{o} C
m)	MOC Sensor	:	SS 316 in general. PTFE, PP for corrosive application.
n)	Humidity	:	95% non-condensing.
o)	Enclosure	:	IP-65 powder coated die cast aluminum
p)	Cable connection	:	½" NPT with cable gland
q)	Mounting	:	2" flanged

r)	Accessories	:	Cable gland, mounting accessories.
s)	Application	:	Sludge pits and overhead tanks containing slurry, viscous and dirty fluid like slaked lime, lime preparation tank etc.

1.07.00 **Gauge Glass**

01.	Type	:	Reflex or transparent. Resistant to mechanical shocks by steel armour.
02.	Glass	:	Toughened borosilicate
03.	Body material	:	forged Carbon steel / stainless steel as per process requirements
04.	End connection	:	As per ASME PTC and drain /vent valve 15NB
05.	Accuracy	:	± 2%
06.	Pressure rating	:	Twice the maximum working pressure
07.	Scale	:	Linear vertical
08.	Range selection	:	Covers 125% of max. of scale
09.	Test Pressure	:	1.5 times to the max. design pressure at 38°C
10.	Housing	:	CS /304SS
11.	Accessories	:	SS Ball check valves, gaskets, companion flange, SS drain and vent valve, nuts & bolts etc.

1.08.00 **Sight Glass**

01.	Type		:	Flap-type
02.	End connection		:	Screwed / Flanged
03.	Material :			
	a)	Body	:	SS-304
	b)	Cover Plate	:	SS-304
	c)	Indicator	:	SS-316
04.	Sight Glass		:	Toughened Borosilicate

	05.	Gasket	:	Neoprene
	06.	Bolts & Nuts	:	High tensile steel
	07.	Hydraulic Test Pressure	:	1.5 times maximum working pressure
	08.	Accessories	:	As required

1.09.00 **Temperature Gauge**

	01.	Type	:	Bimetallic & all angle tiltable
	02.	Sensing Element Material	:	Bimetal strip helix
	03.	Stem Diameter	:	1/4”
	04.	Stem Material	:	AISI 304
	05.	Thermometer connection to well	:	½” NPT / SS 304
	06.	Case Material	:	Sturdy, corrosion resistant series 304 stainless steel case and bezel.
	07.	Dial Size	:	5” in general
	08.	Scale	:	Anti parallax heavy gauge aluminum with white matte finish glare free. Black lettering on white background.
	09.	Pointer	:	Balanced, lightweight aluminum with matte black finish.
	10.	Dampener	:	Dampening pointer oscillation
	11.	Mounting	:	Surface with adjustable angle.
	12.	Over range Protection	:	150% of range or more
	13.	Dial connection	:	Back connection with stem
	14.	Range	:	Normal temperature – 50 ~ 70% of range approximately.
	15.	Zero adjuster	:	Adjustable screw at back.
	16.	Window	:	Shatterproof glass.
	17.	Accuracy	:	±1 % or better (Grade A / ASME B40.3)

18.	Enclosure Class	:	IP-65	
19.	Accessories	:	a)	Forged/bar stock thermowell screwed as per ASME PTC code. Process connection M 33X2 (M).
				Material of construction of Thermowell: - SS 316: In general - Inconel: For flue gas application - Tungsten carbide: For lignite mill application.
				Bidder shall provide Wake frequency calculation for thermowell as per ASME PTC 19.3 (latest edition).
			b)	Installation accessories as required.
20.	Nameplate	:	Tag number, service engraved in stainless steel tag plate	

1.10.00 **Thermocouples**

01.	Type	:	a)	Type-K (Chromel-Alumel)
			b)	Duplex
			c)	Ungrounded
02.	Wire gauge	:	16 AWG for Type-K	
03.	Standard	:	ANSI-MC 96.1 for thermocouple	
04.	Protecting Tube :-			
	a) O.D.	:	8 mm	
	b) Material	:	316-SS Seamless	
	c) Filling	:	Magnesium Oxide (Purity above 99.4%)	

05.	Characteristics	:	Linear with respect to temperature within ± ½% of top range value
06.	Accuracy	:	As per IEC 751 / ANSI MC 96.1 (special class)
07.	Head	:	
a)	Type	:	IP-65 universal screwed type. (Explosion proof for NEC Class-1, Division 1 area)
b)	Material	:	Epoxy coated Die cast aluminum or better
c)	Terminal blocks	:	Nickel plated Brass - screw type/ silver plated
d)	Instrument connection to well	:	½" NPT
e)	Cable connection	:	½" NPT gland and grommet.
f)	Others	:	Terminal head cover with SS chain and suitable gasket
08.	Accessories	:	a) Adjustable nipple-union-nipple [1/2" Sch 80 X ½" NPT (M)] with thermowell connection b) Compression fittings/unions c) Flanges etc. (for flanged connections only) d) Forged/bar stock thermowell as per ASME PTC 19.3 code. Process connection M 33X2 (M) in general or 1½" Flanged for Flue gas/ /Air etc. application. e) Material of construction of Thermowell: - SS 316: In general - Inconel: For flue gas application Bidder shall provide Wake frequency calculation for thermowell as per ASME PTC 19.3 (latest edition).

09.	Nameplate	:	Tag number, service engraved in stainless steel tag plate

Notes:

1. Extension cable exposed to atmosphere in the conventional method melts away due to high temperature, at the top of mill or due to lignite burning. Hence the terminals of temperature sensors shall not be at the top of mills itself. The temperature sensors wires are to be laid up to JB though SS tube of required diameter and the head shall be placed nearer to the JB.

2. Thermocouples provided for steam services like MS temp, HRH, CRH, Turbine metal temp, super heater / de super heater area, where the process pipe is inside the insulation of boiler penthouse, Thermowells are inaccessible and terminal head and connecting cable cannot withstand high temperature, for such services thermocouples shall be provided with flexible extension SS316 Sheath of 10-15 meters.

1.11.00 **Resistance Temperature Detector**

01.	Type	:	Platinum (Duplex), Ungrounded
02.	Resistance	:	100 ohm at 0 degC
03.	Base	:	Wound on ceramic (anti-inductive)
04.	Wiring	:	3 /4 Wire
05.	Protecting Tube	:	
a)	O.D.	:	8 mm
b)	Material	:	SS-316, Seamless
c)	Filling	:	Magnesium oxide (Purity above 99.4%).
06.	Calibration	:	DIN 43760 Class A
07.	Characteristics	:	Linear with respect to temperature within ± ½% of top range value
08.	Head :		
a)	Type	:	IP-65 universal screwed type. (Explosion proof for NEC Class-1, Division 1 area)
b)	Material	:	Epoxy coated Die cast aluminum or better
c)	Terminal blocks	:	Nickel plated Brass-screw type / silver plated

d)	Cable connection	:	½" NPT gland and grommet.	
e)	Instrument connection to well	:	½" NPT	
f)	Others	:	Terminal head cover with SS chain and suitable gasket	
09.	Accessories	:	a)	Adjustable nipple-union-nipple [1/2" Sch 80 X ½" NPT (M)] with thermowell connection
			b)	Compression fittings/unions
			c)	Flanges etc. (for flanged connections only)
			d)	Forged/bar stock thermowell as per ASME PTC 19.3 code. Process connection M33X2 (M).
			e)	Material of construction of Thermowell:
				SS 316: In general
10.	Nameplate	:	Tag number, service engraved in stainless steel tag plate	

Notes: The specifications for RTDs of winding/ bearings of motor/ pump can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However, the type of RTD shall be PT100.

1.12.00 **Field Mounted Temperature Transmitters**

01. Working Principle	:	Smart
02. Type	:	Two wire
03. Input	:	Thermocouple K and RTD (Pt 100)-3/4 wire
04. Isolation	:	500V AC
05. Output Signal	:	Simultaneous transmission of digital and 4-20 mA DC signal. HART protocol.
06. Signal Processing Circuitry	:	Microprocessor based Solid State Electronic

07.	Span and Zero	:	Adjustable in field, Non-interacting facility for elevation and suppression of zero.
08.	Enclosure Class	:	IP-65 (Explosion proof for NEC Class-1, Division 1 area)
09.	Output Indicator	:	LCD type
10.	Span Adjustability	:	Yes
11.	Nameplate	:	Tag number to be engraved on metallic tag plate rigidly fixed to the body.
12.	Body	:	Die Cast aluminum
13.	Operating Voltage	:	16-48 V dc
14.	Load	:	600 Ohms at 24V DC (Min.)
15.	Performance		
	a) Accuracy	:	0.4% of span
	b) Repeatability	:	±0.05% of span
	c) Cold Junction Compensation	:	Built-in
	d) Calibration	:	As per N.I.S.T Monograph 125 for T/C and European Curve Alpha = 0.00385 for RTD
16.	Accessories	:	a) Universal mounting bracket suitable for pipe and surface mounting.
			b) Hi-tensile Carbon Steel U-bolts.
			c) ½" NPT cable gland

1.13.00 **Temperature Switch**

01.	Type	:	Bimetallic / gas filled-in
02.	Stem /Bulb Material	:	AISI SS-316
03.	Capillary	:	SS Capillary & Flexible armour

04.	Case material	:	Epoxy coated die-cast aluminum alloy with neoprene gasket conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).
05.	Over range Protection	:	120%
06.	Instrument connection	:	Bottom
07.	Setter Scale	:	Black graduation on white linear scale. Graduation 0-100% with red pointer for set points.
08.	Switch configuration	:	One DPDT (Two SPDT)
09.	Switch rating	:	240V, 5A AC/220V, 0.5A DC
10.	Switch type	:	Snap acting, shock and vibration-proof.
11.	Adjustability	:	Internal Set point adjustable over span
12.	Cable connection	:	½" NPT conduit connection or compression gland.
13.	Compensation	:	a) Capillary compensation with invar wire throughout the capillary length. b) Case compensation
14.	Performance :		
	a) Repeatability	:	< 1 % of full range
15.	Capillary length	:	3 meters (minimum)
16.	Nameplate	:	Tag number, service engraved in stainless steel tag plate
17.	Accessories	:	a) Forged thermowell, Mounting accessories, b) ½" NPT cable gland. c) Material of construction of Thermowell: SS 316 : In general Standard : ASME PTC 19.3

1.14.00 Not used.

1.15.00 Instrument Air System

The instrument Air Supply System for various pneumatic Control & Instrumentation devices like pneumatic actuators, power cylinders, I/P converters, pneumatically operated valves etc. shall be complete in all respect with necessary Air Filter Regulators, valves, piping/tubing etc. Each pneumatic instrument shall have an individual air shut off valve. The pressure-regulating valve shall be equipped with an internal filter, a 50 mm pressure gauge and a built in filter-housing blow down valve.

Filter shall be of minimum 5-micron size & sintered bronze material.

1.15.01 Air Filter Regulator

01.	Filter Element	:	Sintered Bronze
02.	Filter Size	:	5 microns
03.	Input Air	:	10.0 Kg/Sq. cm (maximum)
04.	Output	:	Adjustable from 0-2.5 Kg / Sq. cm and 0-7.0 Kg / Sq. cm (continuous) as applicable.
05.	Effect of Supply	:	Maximum 0.02 Kg/Sq. cm for a change pressure variation in supply pressure of 4 Kg/Sq. cm
06.	Bowl Material	:	Metallic.
07.	Accessories	:	2" dial size output pressure gauge
08.	Feature	:	No perceptible drop of pressure on opening the drain port.

1.15.02 Power Cylinders (Pneumatic)

01.	Mounting Type	:	a) Fixed position mounting (End mounting). b) True union mounting
02.	Control Signal	:	4-20 mA DC for modulating purposes. 24V DC operated solenoid valve operating on pneumatic line for open & closing purpose of on & off drive.
03.	Supply Air	:	0-7 Kg / Cm^2.

04.	Selection	:	Based upon thrust / torque, stroke length, angular movement, full-scale travel time, repeatability, space factor etc. Provision for air-to-open and air-to-close operation.
05.	Casing	:	IP-55.
06.	Accessories	:	a) Air lock relay b) Hand wheel. c) Air filter regulator with gauge. d) Volume Booster. e) Limit Switches. f) Smart Positioner with Input and Output pressure gauges, local keypad & display. g) Solenoid Valve h) Integral non contact type position Transmitter (4-20 mA DC linear output). i) Junction box with cable gland
07.	Fail-safe operation	:	For regulating duty- stay put / Fail safe position against power & air fail.
08.	Repeatability	:	Better than 0.5% of full travel.
09.	Hysterisis	:	Less than ±1% of full travel
10.	Travel time	:	Better than 20 sec.
11.	Operating Temp. limit	:	80°C (min.)

1.15.03 **Electric to Pneumatic (E/P) Converters**

01.	Air Supply	:	1.5 kg/cm^2
02.	Max. supply Pressure	:	7 kg/cm^2
03.	Input Signal	:	4-20 mA DC (as required by the design of control system).
04.	Output Signal	:	0.2 to 1.0 kg/cm^2

05.	Control Action	:	Air to Close, Air to Open and Fail freeze-field selectable.
06.	Response Time	:	5 seconds for 0 to 90% output pressure
07.	Repeatability	:	+/- 0.1% span typical
08.	Accuracy	:	+/- 0.25% span typical
09.	Linearity	:	0.5% of span or better
10.	Hysteresis	:	0.1% of span or better
11.	Ambient Temp. effect	:	Less than 0.02% of span per ºC between -20 ºC to +60 ºC
12.	Supply pressure effect	:	Less than 1%
13.	Span and zero adjustment:		Screw
14.	Mounting	:	Close to Actuator (but not on the actuator)
15.	Output Capacity	:	To suit the actuator
16.	Protection Class	:	IP 65
17.	Allowable Drift Rate	:	± 2% of set point / hour maximum

On loss of control signal, the last set point pressure shall be maintained so that the associated control valve remains in stay put condition.

1.15.04 **Smart positioner**

01.	Type	:	Universal design (linear or rotary application)
02.	Input Signal	:	4-20mA DC, 2 wire loop with 24V DC.
03.	Output Signal (position F/B)	:	i) 4-20mA with HART Protocol ii) Configurable end position switch
04.	Supply Pressure	:	Single acting 1.2 to 7.0 bar Double acting 1.2 to 10.5 bar
05.	Air Delivery	:	Single acting 10.0 SCFM at 2.1 bar supply

			Double acting7.2 SCFM at 2.1 bar supply
. 06.	Housing	:	IP 65
07.	Repeatability	:	+/- 0.3% of span or better
08.	Accuracy	:	+/- 0.1% of span or better
09.	Communication	:	Hart protocol
10.	Power-up with position control	:	< 150 ms or better
11	Power interruption without Reset	:	<100ms or better
12. Body Material		:	Aluminium
13. Response Time		:	Less than 10 sec
14. Features		:	i) Noncontact position feedback sensor
			ii) Integral Electro-Pneumatic convertor
			iii) Self calibration with tunable response time
			iv) Online diagnostics
			v) Pressure gauges to be provided on positioner (I/P & O/P pressure)

1.15.05 **Solenoid Valve**

01.	Operating Principle	:	Electromagnetic (noiseless)
02.	Coil voltage rating	:	24V DC (in general) other 220V DC /240V AC /110V AC as per manufacturer recommendation.
03.	Ways	:	3 ways in general other depending on requirement
04.	Port size	:	1/4" NPT all ports
05.	Body	:	SS Bar Stock
06.	Trim	:	AISI SS-316

07.	Manual Operator	:	In built
08.	Duty	:	Suitable for continuous energization
09.	Sealing	:	Airtight and leak proof
10.	Fluid Temperature	:	0-150 O C (approx.)
11.	Coil Enclosure	:	Stainless Steel
12.	Insulation	:	Class-H
13.	Coil Casing	:	IP-65 (Explosion proof for NEC Class-1, Division-1 area)
14.	Mounting	:	On pipe or on panel
15.	Cable Connection	:	½" NPT cable gland
16.	Accessories	:	Mounting brackets, nuts and bolts as required.
17.	Special feature	:	a) LED indication b) Double coil type.

1.15.06 **Air Lock Relay**

01.	Type	:	Single acting with actuator (spring return) and double acting with double acting piston cylinder
02.	Max. supply Pressure	:	7 kg/cm^2
03.	Set Pressure	:	1.4 ~ 7 kg/cm^2
04.	Ambient Temperature	:	-5 to 60°C
05.	Port Size	:	¼" NPT(F)

1.15.07 **Position Limit Switch**

01.	Type	:	Proximity type
02.	Temperature Range	:	-25 to 85°C
03.	Protection Class	:	IP-65

	04.	Switch configuration	:	2 SPDT
	05.	Contact rating	:	5A min. at 240V AC on resistive load

1.16.00 **Flow Elements**

1.16.01 **Orifice Plate**

	01.	Application	:	Low fluid velocity flow measurement
	02.	Design Standard	:	Concentric as per ASME PTC 19.5 (part-II), ISA RP-3.2 or BS-1042, Part-I
	03.	Tapings	:	Flanged weld neck. No. as required plus one additional pair of taps
	04.	Diameter Ratio	:	Between 0.4 to 0.7
	05.	Plate material	:	Stainless steel or better
	06.	Thickness	:	3 mm for main pipe diameter upto 250 mm, 6 mm for main pipe diameter above 250 mm and 10 mm for main pipe diameter of 500 mm and above.
	07.	Meter run pipe	:	Same as main pipe material
	08.	Root valve	:	Globe type, Body same as main pipe material, trim ss or better
	09.	Impulse pipe	:	Same material as main pipe upto root valve
	10.	Document	:	Beta ratio calculation, assembly drawing and Flow vs. DP curve.
	11.	Accessories	:	Flanges, gaskets, nuts & bolts, root valves jack screw, meter run pipe, Drain & vent hole as per application etc.

1.16.02 **Flow Nozzle**

	01.	Application	:	High fluid velocity flow measurement
	02.	Design Standard	:	Long radius, welded type as per ASME PTC 19.5 (Part-III) or BS – 1042
	03.	Number of Tapings	:	As required plus one additional pair of taps

13.	Response time	:	Less than 5 sec.
14.	Stability	:	± 1.0 % of full scale / month non-cumulative
15.	Power Supply	:	240 V AC, 50 Hz
16.	Operating Temp.	:	0 -50°C
17.	Accessories	:	a) For cation conductivity analyzer Dual Ion-Exchange column, resin, etc. (minimum 12 months requirements). b) Phenolic Nameplate, cable gland

1.17.02 pH Analyzer

A. **Sensor**

01.	Type of Cell	:	Measuring and reference electrode combination with flow through type (polypropylene flow chambers).
02.	Process Connection	:	Screwed
03.	Type of measurement	:	Combination electrode
04.	Temperature Compensation	:	Automatic (Integral) upto 0-100°C with PT-100 Sensor
05.	Preamplifier	:	Integral or separate
06.	Range	:	0-14 pH
07.	Measuring Electrode	:	Glass
08.	Liquid Junction	:	Ceramic/Kyner or equivalent
09.	Pressure Rating	:	10 kg/cm^2
10.	Accessories	:	Vessel (SS 316) with ½" NPT connection
11.	Cable	:	Upto transmitter in flexible conduct

B. **Transmitter**

01.	Type	:	Microprocessor based, Single stream

			with adjustable range facility
02.	Mounting	:	Flush Panel
03.	Protection Class	:	IP – 55 or better
04.	Output	:	4-20 mA DC (isolated) to a load of 600 ohms (min.)
05.	Display		i) Digital Display of process variable in Engineering Unit, Temperature, Alarm Status. ii) Back lit LCD iii) Character Height 12 mm
06.	Calibration	:	Two-point calibration with standard buffer solutions.
07.	Temperature Compensation	:	Manual or Automatic - selectable through keyboard
08.	Diagnostic	:	Self diagnostic for **"**Calibration required**"/ "**Calibration O.K.**"**, electrode checking etc.
09.	Alarm	:	Dual alarm set point (2 SPDT, high & low), hysterisis and time delay adjustable from membrane keyboard. Switch contact rating of 5 Amp, 240 VAC / 0.2 Amp, 220 VDC
10.	Enclosure	:	Die cast aluminium epoxy coated
11.	Cable Termination	:	Internal (cable entry through conduit)
12.	Accuracy	:	± 0.03 pH or better
13.	Repeatability	:	± 0.02 pH or better
14.	Response Time	:	Less than 2 seconds or better
15.	Stability	:	± 0.001 pH / week
16.	Power Supply	:	240 V AC, 50 Hz
17.	Operating Temp.	:	0 - 50°C
18.	Accessories	:	a) Ultrasonic Electrode Cleaner for

uncleaned water.

b) Phenolic nameplate giving tag number, service, cable gland etc.

c) Pre-amplifier, special cable, ultrasonic cleaner, etc.

d) Buffer tablets.

19. Preferred feature — Self cleaning type sensor

1.17.03 **Turbidity Analyzer**

01.	Type	:	Light reflection principle
02.	Accuracy	:	2 % Low range 5 % High range
03.	Response Time	:	5 Min (max) [90% of Full Scale]
04.	Range	:	0-100, 0-200 NTU programmable
05.	No. of streams	:	Single
06.	Output signal :-		
	a) Analog	:	4-20 mA DC (isolated) into 600 ohms
	b) Binary	:	Field adjustable High and low PF contacts.
07.	Zero & span adjustment	:	Yes
08.	Ambient temperature	:	50ºC
09.	Indication	:	Digital
10.	Enclosure Type/ Material	:	Weather & dust proof (IP 55) Die cast aluminum
11.	Type of electronics	:	Microprocessor based
12.	Calibration	:	Auto & manual
13.	Error / Diagnostic	:	To be provided
14.	Mounting arrangement	:	Panel mounted
15.	Power supply	:	240V AC, 50 Hz, 1 Phase UPS

2.00.00 CONTROL PANEL / DESK MOUNTED INSTRUMENTS AND ELECTRICAL SYSTEM ACCESSORIES (As applicable)

2.01.00 Push Button

01.	Type	:	Shrouded square format
02.	Face Dimension	:	32 x 32 mm (maximum)
03.	Contact Configuration	:	2 NO + 2 NC
04.	Contact Addition	:	Add-on block up to 4 each with 2 pairs of contacts
05.	Contact Material	:	Hard Silver Alloy
06.	Contact Rating	:	500V / 10 A
07.	Utilization Category	:	AC11 / DC11
08.	Insulation Voltage	:	2 KV for 1 minute between terminals and earth
09.	Mechanical Life	:	1 million operations
10.	Construction	:	Aluminum shrouding with plastic lens
11.	Colors	:	Red, Green, Yellow, Black, etc.
12.	Connection	:	Screw terminals
13.	Enclosure Class	:	IP-52
14.	Legend	:	Engraving

2.02.00 Illuminated Push Button

01.	Type	:	Square format
02.	Face Dimension	:	32 x 32 mm (maximum)
03.	Contact Configuration	:	2 NO + 2 NC (minimum)
04.	Contact Addition	:	Add-on-Block up to 4 each with 2 pairs of contacts
05.	Contact Material	:	Hard Silver Alloy
06.	Contact Rating	:	500 V/ 10A

	07.	Utilization Category	:	A C11 / DC11
	08.	Insulation Voltage	:	2 KV for 1 minute between terminals and earth
	09.	Mechanical Life	:	1 Million Operations
	10.	Lamp	:	LED with built-in resistors as required
	11.	Lamp Rating :-		
		a) Voltage	:	240 V AC /24V DC
		b) Watt	:	0.5 Watt (approx)
	12.	Lamp and Lens		
		Replacement	:	From front
	13.	Construction	:	Transparent Plastic Lens
	14.	Color	:	Red, Green, Amber, Yellow etc.
	15.	Connection	:	Screw terminals
	16.	Enclosure Class	:	IP-52
	17.	Legend	:	Engraving
	18.	MTBF lamp	:	100000 hours

2.03.00 **Selector Switch**

	01.	Type	:	2/3/4 position stay put type with rotary lever actuator.
	02.	Face Dimension	:	32 x 32 mm (maximum)
	03.	Contact Configuration	:	4 pair of contacts
	04.	Contact Addition	:	Add-on-Block up to 4 each with 2 pairs of contact
	05.	Contact Material	:	Hard silver Alloy
	06.	Contact Rating	:	500 V/10 A
	07.	Utilization Category	:	AC11 / DC11
	08.	Insulation Voltage	:	2 KV for 1 minute between terminals and earth

09.	Mechanical Life	:	1 million operations
10.	Construction	:	Aluminum shrouding
11.	Connection	:	Screw terminals
12.	Enclosure Class	:	IP-52

2.04.00 **Indicating Lamp**

01.	Type	:	LED with built-in resistor
02.	Face Dimension	:	32 x 32 mm (maximum)
03.	Voltage	:	240 V AC / 24V DC
04.	Watt	:	0.5 Watt (approximate)
05.	Lamp and Lens Replacement	:	From front
06.	Construction	:	Transparent Plastic lens
07.	Color	:	Red, Green, Amber, Yellow etc.
08.	Connection	:	Screw terminals
09.	Legend	:	Engraving
10.	MTBF	:	100000 hours

3.00.00 CONTROL VALVES, ACTUATORS & ACCESSORIES

3.01.00 General Requirements

3.01.01 Control Valves and accessories furnished by the Bidder shall be designed and tested in accordance with the latest applicable requirements of code for pressure piping ANSI B 31.1, ASME Boiler and pressure vessel code, Indian Boiler Regulation (IBR), ISA and other standards as specified elsewhere as well as in accordance with the applicable requirements of the “Federal Occupational Safety and Health Standards, USA” or acceptable equal standards.

All the control valves, their actuators and accessories to be furnished under this section shall be fully suitable and compatible with the services covered under the specification.

3.02.00 Control Valve Sizing and Construction

3.07.00 **Control Valve Accessory Devices**

All pneumatic actuated control valve accessories such as air locks, hand wheels / hand-jacks, Non-contact type limit switches, microprocessor based smart electronic Positioners, diffusers, external volume chambers, position transmitters (capacitance or resistance type only), reversible pilot for Positioner, tubing and air sets, solenoid valves and junction boxes etc. shall be provided as per the requirements. For further details please refer clause no. 1.32.00 of this section of the specification.

3.08.00 **Tests**

All valves shall be tested in accordance with the Quality Assurance Programme (QAP). Bidder shall submit QAP for Owner's approval. The tests shall include but not be limited to the following :

a) Non destructive test as per ANSI B 16.34.

b) Hydrostatic shell test as per ANSI B 16.34 prior to seat leakage test.

c) Valve closure test and seat leakage test as per ANSI B 16.34 and as per the leakage class

d) Functional Tests: The fully assembled valves with actuator and all accessories shall be functionally tested to demonstrate from open to close position and vice versa. Valve lift shall be checked at 5 points at 0, 25, 50, 75 and 100% in both the directions with increasing and decreasing inputs. Performance of the valve with Positioner shall be as follows :

   i) Linearity : +/- 1%
   ii) Hysteresis : +/- 1%
   iii) Sensitivity : +/- 0.5%
   iv) Deadband : +/- 1%
   v) Reproducibility : 0.3% of total stroke
   vi) Overall accuracy : +/- 1%

e) CV test: CV test shall be carried out as type test on each size, type and design of the valves as per ISA 75.02 standard and test report shall be submitted for Owner's approval.

4.00.00 **CONTROL DESK / PANEL / RACK / ENCLOSURE**

4.01.00 **General**

4.14.01 **Workstation Furniture**

Modular work station furniture, suitable for mounting servers & historians, programmer stations, PC based systems, printers (A4/A3 color laserjet) etc. shall be provided.

4.14.02 **PC Rack**

PC Racks shall be provided to mount CPUs of workstations/ PCs of OWS/LVS etc. in control room. For each PC / workstation / monitor at least one chair shall be included.

4.14.03 **Chairs**

Industry standard revolving chairs with wheels and with provision for adjustment of height (hydraulically/gas lift) shall be provided for the operators, unit-in-charge & other personnel in control room area. These shall be designed for sitting for long duration such that these are comfortable for the back.

4.15.00 **Local Instrument Enclosure (**Closed type enclosure shall be provided in all areas)

4.15.01 Transmitters, switches and devices located in the field shall be grouped together and shall be installed in the Enclosure in case of outdoor area such as Boiler area etc. and in Open Type Rack in case of covered area. Racks and enclosure shall be factory prefabricated & painted and complete with internal piping, tubing, manifold valve, isolation valves, blow down valves, integral junction box, wiring, illumination etc. with outside access doors, Racks used for furnace, flue gas and air application shall be provided with intermittent & continuous air purging. No more than six instruments shall be grouped in a single rack /enclosure

4.15.02 The local instrument enclosures shall be constructed from 2.0 mm thick sheet plate and shall be of modular construction with one or more modules and two end assemblies bolted together to form an enclosure. Gaskets shall be used in between all mating sections to achieve protection class of IP-55. Enclosure doors shall have three point lock.

4.15.03 The local instrument racks shall be free standing type constructed from suitable 3 mm thick channel frame of steel and shall be provided with a canopy at top to protect the equipment mounted in racks from falling objects, water etc. The canopy shall not be less than 3 mm thick steel and extended beyond the ends of the rack.

4.15.04 Bulk heads, especially designed to provide isolation from process line vibration shall be provided. Bulkhead plates shall be removable type and thickness of not less than 6 mm shall be employed.

4.15.05 2" NB galvanized pipes shall be laid horizontally and supported at two end channels to mount transmitters/ switches at accessible height. Adequate support for manifold, impulse pipe and cable tray shall be provided and the same shall be adjustable.

4.15.06 All internal wirings and / or data bus connections, if any, between the transmitters and terminal junction box shall run through flexible dust tight conduits connected to the terminal box hub. No exposed wirings within transmitter racks, both open and closed type, is admissible.

4.15.07 All racks shall have a common closed drain trough to connect transmitter drain points to a common header after suitable pressure breaking. Covered funnels shall be used for saturated liquid and steam service, whereas, open funnels may be used for cold liquid services. The trough shall be suitably sloped and shall have one end flanged and extending beyond the rack for connection to plant drain header. Individual Instrument blow down line shall be connected to the common blow down drain header through regulating globe type blow down valves. The common blow down drain header shall be 2" NB ASTM A106, Sch-80 Gr. C installed at a slope of 1:25.

4.15.08 The junction box for enclosure and racks shall conform to IP 65 protection class. Junction box shall be provided as an integral compartment at one side of the enclosure / rack with front opening type door. Junction box shall be complete with DIN rail mounted terminals, MCB, receptacles and earth bar. All wiring shall be laid in PVC cable tray. Cable gland plate shall be provided for cable entry from bottom. Earth bar shall be made of tinned copper continuous and of 25 X 6 MM size.

4.15.09 Each rack shall be provided with receptacle, light fixture with wire guard and lighting switch. Light fixtures shall be installed on the ceilings of rack / enclosure.

4.15.10 Type, size and material grade of the impulse pipes, fittings and valves are listed elsewhere in this specification

4.15.11 Bidder shall furnish the drawing and documents showing detail arrangement of racks and enclosure and hook up along with instrument grouping at detailing stage for Owner / Consultant's approval.

5.00.00 FGD CONTROL SYSTEM & CEMS

5.01.00 General Requirements

5.01.01 FGD system automation shall be realized in a dedicated hot redundant Programmable Logic Control (PLC) based control system.

VOLUME: II-F

SECTION-XVIII

VARIABLE FREQUENCY DRIVE

CONTENTS

CLAUSE NO	DESCRIPTION	PAGE NO.
1.00.00	SPECIFIC REQUIREMENTS	1
2.00.00	TECHNICAL PARTICULARS	1
3.00.00	CODES & STANDARDS	1
4.00.00	PERFORMANCE REQUIREMENTS	1
5.00.00	CONTROL REQUIREMENT	3
6.00.00	PANEL CONSTRUCTION	4
7.00.00	COOLING	6
8.00.00	EQUIPMENT/COMPONENT SPECIFICATION	6
09.00.00	PROTECTION, CONTROL, METERING, INDICATION AND ANNUNCIATION	9
10.00.00	EXTERNAL POWER SUPPLY FOR AUXILIARY AND CONTROL CIRCUIT	13
11.00.00	PAINTING	14
12.00.00	INSPECTION, TESTING AND ACCEPTANCE	14
13.00.00	DATASHEET-A, RATING AND REQUIREMENTS	16

VOLUME: IIF

SECTION-XVIII

VARIABLE FREQUENCY DRIVE

1.00.00 SPECIFIC REQUIREMENTS

Variable frequency drives shall be provided as per technological requirement. The following paragraphs define the requirements of variable speed drives.

1.01.00 One spare VFD panel similar in all respect to other VFD panels to be provided and erected for each unit. In case of major failure in any of the VFD panels, Power & Control Cables shall be removed from the defective VFD panel and connected to the spare VFD panel.

2.00.00 TECHNICAL PARTICULARS

System shall be load commutated invertor type, 12-pulse design, having two channels (each channel with six pulse design) for each motor. The VFD and accessories shall comply with the particulars as per the technical requirements specified in Data Sheet-A

3.00.00 CODES & STANDARDS

3.01.00 All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS), IEC, ANSI & NEMA Standards except when otherwise stated herein or in the driven equipment specification.

3.02.00 Equipment and material conforming to any other standards, which ensure equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.

3.03.00 The electrical installation shall meet the requirements of Indian Electricity Rules as amended up-to-date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed

4.00.00 PERFORMANCE REQUIREMENTS

4.01.00 The system shall be energy efficient, designed as standard product and shall provide very high reliability, high power factor, low harmonic distortion and low vibration/wear/ noise.

4.02.00 The system shall be designed to deliver the motor input current and torque for the complete speed torque characteristics of the drive motor, with input supply variation of ± 10% and frequency variation of ± 5%. It shall be capable of

withstanding the thermal and dynamic stresses and the transient mechanical torque, resulting from short circuit.

4.03.00 The drive system shall be designed to operate in one or more of the following operating modes as to suit characteristics of the driven equipment

i) Variable torque changing as a function of speed i.e. speed squared

ii) Constant torque over a specific speed range

iii) Constant power over a specific speed range where the torque decreases when speed increases

4.04.00 The drive controller shall be equipped with microprocessor based digital regulator with programmable functions. The power control regulator logic shall provide for an acceleration/deceleration current limit curve and shall be capable of field be separately programmable from 0.1 to 20 seconds.

4.05.00 Each channel and motor rating shall be rated to meet driven equipment requirements. The system shall be designed for linear continuous speed control from required range of driven equipment rated speed and shall be of a modern proven design and fully compatible with excitation system offered.

4.06.00 The Total Harmonic Distortion (THD) of the voltage and current at inverter output shall be as per IEC 61800-4 and it shall be considered in the design of the motor.

4.07.00 Harmonics at the supply side of the drive system at primary of the main input transformer shall be restricted within the maximum allowable levels of current and voltage distortion as per recommendations in the latest edition of IEEE-519.

4.08.00 The overload capacity of the controller shall be 150% of rated current of motor for one minute for constant torque applications, and 115% of rated current for one minute for variable torque application at rated voltage. If the motor load exceeds the limit, the drive shall automatically reduce the frequency and voltage to the motor to guard against overload. If the load demand exceeds the current limit for more than one (1) minute, the drive shall shut down to prevent overheating of the motor and damage to the drive.

4.09.00 During operation, the system shall be capable of developing sufficient torque under all load condition to respond to a 20% alteration in speed set point within a time limit up to 60 seconds

4.10.00 The integrator action of the speed set point alteration shall be independently adjustable for both an upward and downward alteration. The minimum time interval between set point adjustments by the distributed control system shall be considered as 10 second.

4.11.00 The drive shall trip in case the speed exceeds 105% of the maximum operational speed or reduces to 95% of the minimum operational speed for more than 10 second.

4.12.00 Maximum noise level from the drive at 1meter distance, under rated load with all normal cooling fans operating shall not exceed 85dBA.

4.13.00 Variable frequency drive shall be arranged so that it can be operated in a circuit mode, disconnected from the motor for startup adjustment and troubleshooting/ maintenance.

4.14.00 Voltage at motor neutral terminal shall be floating and neutral shall be insulated adequately for Load Commuted Inverter (LCI) operation.

4.15.00 The drive system shall ensure following

a) Harmful VFD induced harmonics which can create motor heating are eliminated.

b) VFD induced torque pulsation are limited to maximum 1% (even at low speed) so there is minimal stress to the equipment

c) Motor is protected from dv/dt stresses.

d) No appreciable increase in motor audible noise.

4.16.00 Electrical performance of the system shall comply to IEEE, IEC and equivalent international standard

5.00.00 CONTROL REQUIREMENT

5.01.00 The system shall operate on constant V/f supply with required voltage boost capability in low frequency mode of operation.

5.02.00 Short time voltage dip up to 20% of nominal voltage (e.g. in case of a large motor start up connected to the same bus as VFD) shall not cause the control system to stop functioning and shall not trip the drive system.

5.03.00 The system shall also be equipped with a facility which will restart the system in case of voltage dip over 20% or power interrupter for less than 2 seconds, with recovery of the voltage to its normal value. The drive shall have the facility to block this feature, if required by operator. Upon restart the converter shall be capable of synchronizing onto a rotating motor and develop full acceleration torque within 10 seconds.

5.04.00 The power controller shall be controlled to always start the motor in the forward direction. Logic shall be provided to prevent the motor from being started in the reverse direction.

5.05.00 The drive motor shall be speed controlled corresponding to 4-20mA or 0-10V reference input signal. Unless otherwise specified, upon complete loss of the users speed reference signal, the drive shall automatically run at constant speed as at 8-100% of the last speed reference available prior to the loss of signal.

5.06.00 It shall be possible to vary the speed of the drive in either manual or auto mode. Auto/manual selection shall be from VFD panel unless otherwise specified.

- With the selector switch in “manual” mode, the operator shall be able to set the speed through keypad, mounted on front of the drive panel or from speed increase/decrease push buttons from the field. Motor operated potentiometer shall be provided as a speed set point device.

- With selector switch in “auto” mode, speed of the motor shall be controlled from a 4-20mA signal, from owner’s PLC system. Necessary equipment like protocol converter as required for interfacing with PLC shall also be provided in the drive panel.

5.07.00 The required provision for the interface with remote PLC located at control room shall be either through hardwired connection (with potential free contacts and transducers as described elsewhere in this specification).

5.08.00 Drive system shall have provision for interface with upper level automation such as substation monitoring system or electrical control system.

5.09.00 The closed loop control feedback for the drive system having output transformer shall be tapped from the secondary side of the output transformer.

6.00.00 PANEL CONSTRUCTION

6.01.00 The panel shall include suitable semi conducting power devices (line commuted thyristors/Diodes/IGBT). Modules with protective devices, reactors (if required), filters (if required), control circuit, control accessories, indication and annunciation etc, the construction of the panel shall provide effective protection against electromagnetic emissions and shall meet design requirement of integrated standards

6.02.00 Upstream breaker “ON/OFF/TRIP” indications and remote breaker closing and trip push button shall be provided on the front door.

6.03.00 Safety Interlock shall be provided so that power cabinet can’t be opened unless the upstream breaker is disconnected, safety-grounding switch is closed and DC link capacitor is discharged. Power source breaker can only be closed once the earthing switch is open and panel door is closed with lock defeat facility.

6.04.00 Duplicate control supply with automatic changeover shall be provided. Protection shall be provided against AC/DC transients, voltage surge etc. of power and control device.

6.05.00 The drive shall be housed in sheet steel panels fabricated with 2mm thick cold rolled sheet steel. The panel shall be suitable for indoor installation, if not otherwise specified. The panel shall be free standing with degree of enclosure protection as IP-42. The maximum operating height shall be 1800mm approximately.

6.06.00 Bolted un-drilled gland plate shall be provided at bottom. Clamp type terminals shall be used for connection of all wires up to 10mm^2 and terminal for higher sizes shall be bolted type suitable for cable lugs. Minimum space for power cable termination shall be 600mm clear from bottom of the cable gland plate.

6.07.00 Bus bars shall be of electrolytic copper, color coded separately for AC and DC system. All the live parts shall be sleeved/ shrouded to ensure complete safety to personnel intending to carry out routine inspection by opening the panel doors. All the equipment inside the panel and on the doors shall be provided with suitable nameplate.

6.08.00 All the switches, component and accessories which are essential for normal and emergency operation shall be mounted on the door and shall be operable externally. All the analog instruments, where provided, shall be switchboard type, back connected; 72x72mm. Scale shall have red mark indicating maximum permissible operating rating.

6.09.00 Each panel shall be provided with illuminating lamp/11W CFL with switch and fuse. 6/16A, 240V power socket with switch and fuse shall be provided. Each panel shall have space heater with switch fuse and variable setting thermostat.

6.10.00 Copper earth bus of min. 50x6 mm size shall be provided in the panel with provision for connection to plant earth grid. All the non-metallic components/parts shall be connected to the main earth bus bar. Separate earth bus bar and stud for electronic control system as required shall be provided.

6.11.00 All the metal parts shall be treated so as to ensure efficient anti-corrosive protection. Hard wares shall be zinc passivated or electrogalvanised. Panel enclosure and structure supports shall be thoroughly cleaned and degreased to remove mill scale and rust etc. External surface shall be painted RAL – 5015 with two coats of synthetic enamel paint.

6.12.00 All panels shall be of same height so as to form a uniform line-up, to give good aesthetic appearance.

6.13.00 All the control wiring shall be enclosed in plastic/metal channel. Each wire shall be identified at both ends by self-sticking wire marker tapes of PVC ferrules. Power and control wiring inside the panel shall be done with BIS approved, PVC insulated, fire retardant, copper conductor wire. 1.5mm^2 size wire shall normally be used provided the control fuse rating is 10 Amps or less and 2.5mm^2 size for control fuse rating above 16A for electrical circuits and 0.7 mm^2 for electronic circuits. All wires shall be ferruled and terminals shall be properly numbered, minimum 20% spare terminal shall be provided.

6.14.00 All electronic modules and components shall be accessible from front of panel only. Modular assemblies for both the system control electronic equipment and power electronic equipment shall be used.

6.15.00 All low voltage compartment and cabling shall be electrically and physically separated from the high voltage compartment.

6.16.00 DC link capacitor and pre charging and discharging circuit shall be preferably mounted in the rear of the panel.

6.17.00 Suitable removable type hooks shall be provided for lifting the panel.

6.18.00 Perspex type transparent insulating material shall be used for covering live compartments.

6.19.00 Drive keypad, operator control panel required for control, monitoring and measurements shall be supplied and installed outside the panel on the front door. It shall be accessible for operation without opening the front door and shall be non-removable type.

6.20.00 All the equipment shall be complete with cable glands, lugs etc. and cable glands shall be single or double compression type for indoor and outdoor equipment respectively.

7.00.00 COOLING

7.01.00 The drive panel shall be naturally cooled type as per manufacturer's standards. If unavoidable, forced type cooling system shall be provided. Cooling system shall include well-dimensioned panel, adequate cooling airflow path, module cooling fan and if necessary, panel-cooling fan shall be considered. Vendor shall ensure that the panel dimensions and the flow paths have been designed for continuous running at the specified ambient without overheating. For fan cooled drives, redundant ventilating fans (N+1) shall be provided.

7.02.00 Necessary starters shall be provided within the VFD panels for the ventilation fans, any other auxiliary motor etc. The system provided shall be interfaced with drive starting and shut down such that safety interlocks such as start permit from cooling system to drive and trip signal from cooling system to drive in case of cooling system failure etc., shall be incorporated in the overall sequence logic.

7.03.00 MCB for motor space heater, auxiliary power supply if required for local panel, drive panel space etc. shall be included and mounted in easy accessible location.

8.00.00 EQUIPMENT/COMPONENT SPECIFICATION

8.01.00 **Motor**

i) The motor shall be suitable for operation with a solid-state power supply consisting of an adjustable frequency inverter for speed control.

ii) The motor shall be suitable for the current waveforms produced by the power supply including the harmonics generated by the drive.

iii) The Motor shall be designed to operate continuously at any speed over the range 20-100 % of rated speed.

iv) The permitted voltage variation should take into account the steady state voltage drop across the AC drive and all other system components upstream of the motor.

v) Motors required to be transferred to DOL, by-pass mode shall be rated for specified variations in system line voltage and frequency. Starting current of motor in DOL, bypass mode shall be limited to value in motor specifications.

vi) The motor shall be constructed to withstand torque pulsations resulting from harmonics generated by the solid-state power supply.

vii) The motor insulation shall be designed to accept the applied voltage waveform, within the V_{peak} and dv/dt limits as per IEC-61800-4.

viii) The drive manufacturer shall be solely responsible for proper selection of the motor for the given load application and the output characteristics of the drive.

Other details shall be as given in specification of Electric motors, Volume-IIF, Section-II.

8.02.00 **POWER TRANSFORMER**

Indoor dry type/Outdoor ONAN type, and shall be suitable for rating complying with system details. Other details as given in sub-section of LT Transformer Specification, Volume-IIF.

08.03.00 **POWER CONVERTER**

i) The static power shall consist of a line side power converter for operation as a rectifier and a load side power converter for operation as a fully controlled inverter. Power converter shall be fast switching, most efficient and low loss type.

ii) Adequate short circuit and over voltage protection shall be provided for the converter and inverter system.

iii) All power converter devices shall include protective devices, snubber networks and dv/dt networks as required.

iv) The current rating of the converter's semi-conductor components shall not be less than 120% of the nominal current flowing through the elements at full load of the VFD through the whole speed range.

v) All power diodes shall be of silicon type with minimum V_{bo} rating as 2.5 times the rated operating voltage.

vi) The power converter circuit shall be designed so that motor can be powered at its full nameplate rating continuously without exceeding its

rated temperature rise due to harmonic currents generated by the inverter operation.

vii) The conversion devices and associated heat sinks shall be assembled such that individual devices can be replaced without requiring the use of any special precautions/tools.

viii) The cooling system of the electronic components, if provided, shall be monitored and necessary alarms shall be provided to prevent any consequential damage to the power control devices.

ix) Offered system shall also take in account the distance between drive panel and motor and system shall include all material and accessories to make system suitable for a distance of 350m.

8.04.00 DC LINK REACTOR

i) Smoothing reactors for the DC link shall be designed to sufficiently decouple the rectifier and inverter portion of the converter and to limit fault currents in this circuit.

ii) Reactor shall be air-core type, natural cooling and housed in a separate enclosure in ventilated room

iii) Reactor shall be suitable for withstanding earth fault continuously and for operation with the non-sinusoidal current wave shapes and DC components under all operational conditions of the system without exceeding its temperature limits.

iv) Noise level shall not exceed value specified in NEMA TR-1

8.05.00 OUTPUT FILTER

VFD output current waveform should be inherently sinusoidal at all speeds, with harmonic limits as specified in this specification. Output filter shall be provided if required. Output filter capacitors shall be provided with discharge circuits to ensure that all residual stored charge is reduced to less than 50 V DC within 300 seconds after a loss of AC voltage. All capacitor shall be maintenance free and self-healing type.

The VFD system shall inherently protect motor from high voltage dv/dt stress, independent of cable length to motor. Output filter shall be an integral part of the VFD system and included within the VFD enclosure.

8.06.00 BYPASS FEATURE

i) Bypass breaker / contactor-HRC fuse complete with protection, annunciation and metering shall be provided.

ii) All Variable frequency drives (VFD) having bypass feature shall have motor protection relay along with necessary control and metering etc.

Switching scheme shall be such that in case of drive mal-operation, the motor could be taken on bypass control manually, while the drive could be attended by opening its isolation devices.

iii) Safety interlock between inverter and bypass breaker/contactor shall be provided such that closing of healthy device is inhibited in case of external fault.

8.07.00 **CT/PT/METERS**

As required for the system offered and shall be suitable for variable frequency operation.

8.08.00 **LOCAL MOTOR CONTROL STATION**

i) The local motor control station is to be installed in the field near the motor. Components and accessories that are required in the local motor control station may be mounted on the local field mounted panel envisaged for the driven equipment.

ii) Meters in the local control station shall be suitable for 4-20mA transducer outputs and shall be calibrated for the actual motor current. Further, the drives with bypass facility, the meters shall be capable of reading bypass full load and starting currents, as well as the drive current.

09.00.00 PROTECTION, CONTROL, METERING, INDICATION AND ANNUNCIATION

09.01.00 The system vendor shall provide all the necessary system control, protection; alarm equipment and metering for the entire drive system and its auxiliary equipment.

09.02.00 Automatic sequence control shall include start-up of cooling system, auxiliary system of the motor, interlock checking, automatic start and run-up of drive, planned and emergency shutdown. The same shall be processed through microprocessor-based system.

09.03.00 **OPERATOR CONTROL PANEL**

i) Each drive shall be equipped with a front mounted operator control panel consisting of a backlit alphanumeric display and a keypad with keys for parameterization and adjusting parameter which shall be limited to Start/Stop, Local/Remote, Auto/Manual, Increase/Decrease, menu navigation and protection and measurement parameter selection, etc. Also local operation during maintenance should be possible & the same shall be provided inside the panel.

ii) All parameter names, fault messages, warnings and other information shall be displayed in complete English words or standard English abbreviations to allow the user to understand what is being displayed

without the use of a manual or cross-reference table. This shall also be used for the modification of all electrical values, configuration parameters, drive menu parameters, application and activity function access, faults, local control, adjustment storage, self-test and diagnostics. Keypad shall be operable with password for changing the protection setting, safety interlock etc. However the parameters such as measurements, setting, and mode of drive etc. Shall be allowed to be viewed without any password.

iii) Operator console shall have facility / port to connect external hardware such as Lap-Top etc. Console shall have facility for upload and download of all parameter settings from one drive to another identical drive for startup and operation.

iv) Drive system control also have facility to receive tripping signal from upstream breaker for tripping and also provision for closing upstream breaker after all required process parameters are achieved.

v) User-friendly software for operation and fault diagnostic shall be loaded in the drive system panel before commissioning.

09.04.00 **PROTECTIVE FEATURES**

The system offered shall incorporate adequate features, properly coordinated for the drive control and for motor but not limited to the following:

i) Incoming line surge protection.

ii) Under / Over voltage protection.

iii) Phase loss, phase reversal protection.

iv) Programmable Over current Protection and under load protection.

v) Inverter fault.

vi) Over frequency operation.

vii) Ventilation loss.

viii) Over temperature of equipment.

ix) Over speed of motor.

x) Specific motor protection, including motor winding, bearing temperatures, over current, Overload, negative phase sequence, locked rotor and earth fault protections etc.

xi) System Earth fault protection.

xii) Over and under frequency, rotor earth fault, field failure protection for synchronous motor

xiii) Additional protection for drive system

09.05.00 **CONTROL**

The following controls shall be provided as a part of the operators control Panel or through separate switches.

i) Start/Stop

ii) Speed Control (Raise/lower)

iii) Auto/Manual/Test mode

iv) Local/Remote

v) Emergency Stop

vi) Start/Stop for by pass starter (where specified)

vii) Trip-Remote Breaker

viii) Sequential switching of filters

09.06.00 **INDICATORS**

Vendor shall provide indications as required for normal operation and for easy maintenance, which shall be limited to the following indications:

i) Motor running

ii) Motor stopped

iii) VFD System Fault

iv) System ready to start

v) AC mains ON

vi) Motor over speed

vii) Rectifier output 'ON'

viii) Motor zero speed

ix) Rectifier breaker trip

Above indications may be provided as a part of the operator control panel, i.e., door mounted keypad or through hardwired indicating lamps/LEDS.

Potential free contacts of items i-iv shall be wired separately for remote indications in PLC/DCS system.

09.07.00 **METERING**

Digital display of the following parameters shall be as a part of the Operator Control Panel, selected by the operator.

i) Input AC voltage

ii) Input AC frequency

iii) Input AC current

iv) Output voltage

v) Output current VFD / Bypass

vi) Output frequency

vii) Motor thermal state

viii) Drive thermal state

ix) Motor speed

x) Motor energy meter

xi) DC Link voltage

xii) Hour Run

Necessary transducer shall be provided with 4-20mA output for indicating motor speed and motor current in PLC/DCS unless otherwise specified for other parameters.

09.08.00 **AUDIO-VISUAL ANNUNCIATIONS**

i) The system shall incorporate audio-visual annunciations for protection, for various fault conditions, for the Drive motor, Supply cables, DC Reactor and the Converter, output transformer etc.

ii) Alarms shall also be included for the failure of various auxiliaries together with identifications of the failing unit, loss of cooling system, various protections devices provided for converter transformer etc.

iii) Audio-visual window annunciations shall be provided on the front of the panel. All annunciations as required for normal and satisfactorily operation of the drive system shall be included as per vendor standards. These annunciations can be part of operator console panel or separately mounted type.

iv) Vendor shall include audio-visual alarm as required for normal operations and maintenance of the system but not limited to the following :

1. Rectifier fuse failure
2. Main AC failure
3. Inverter fuse failure
4. Inverter overload
5. Inverter high temperature
6. Cooling system failure
7. Motor failed to start
8. Transformer failure
9. Battery monitoring healthiness
10. Communication and measurement system unhealthy
11. Motor temperature high
12. Harmonic filters monitoring

Common potential free contacts shall be provided for above annunciations and these shall be wired up to terminal block for owner's use for remote alarm and monitoring.

09.09.00 **FAULT DIAGNOSTIC**

Fault diagnostic shall be built into the system to supervise the operation and failure of the system. The information regarding failure of any of the system including shut down of the system shall be available for a period of minimum 4 days (96 hours) after a shut down even though no supply would be available to the system. The system may be totally de-energized for maintenance or otherwise. It shall be possible to retrieve the record of events prior to tripping of the system or de-energisation. Auxiliary supply to the system components or to the electronics (firmware) for the diagnostics / display shall be taken care by the manufacturer for this purpose.

10.00.00 EXTERNAL POWER SUPPLY FOR AUXILIARY AND CONTROL CIRCUIT

Auxiliary power supply for devices external to VFD module, space heater supply for Motor, VFD panel space heater, auxiliary power supply for transformers, cubicle 11W CFL lamps etc. shall operate on 240 volts single phase AC provided by purchaser.

All control circuit shall operate at maximum voltage of 240V AC

Vendor shall include supply of all control transformers, protective devices, required accessories etc. and any other control supply voltage as required for the system shall be derived from the power supply made available by other.

11.00.00 PAINTING

11.01.00 All metal surfaces shall be thoroughly cleaned and de-greased to remove mill scale, rust, grease and dirt. Fabricated structures shall be pickled and then rinsed to remove any trace of acid. The under-surface shall be prepared by applying a coat of phosphate paint and a coat of yellow zinc chromate primer. The under-surface shall be made free from all imperfections before undertaking the finishing coat.

11.02.00 After preparation of the under surface, the panel shall be provided with epoxy based powder coating. Panel finish shall be free from imperfections like pinholes, orange peels, runoff painted.

11.03.00 All unpainted steel parts shall be zinc passivated, cadmium plated or suitably treated to prevent rust and corrosion. If these parts are moving elements, then these shall be greased.

11.04.00 Final paint shade shall be RAL - 5015

12.00.00 INSPECTION, TESTING AND ACCEPTANCE

12.01.00 During fabrication, the drive shall be subject to inspection by owner, or by an agency authorized by the owner, to assess the progress of work, as well as to ascertain that only quality raw material is used. The manufacturer shall furnish all necessary information concerning the supply to owner's inspectors.

12.02.00 All tests shall be carried out at the manufacturer's works under his care and expense. The tests shall be witnessed by an inspector of the owner or an agency authorized by the owner. Prior notice of minimum of 4 weeks shall be given to the inspector for witnessing the test.

12.03.00 The routine test shall be conducted on all the drive system. However type test shall be performed on one system of each rating and type unless otherwise agreed between purchaser and manufacturer. For the purpose of testing, drive system shall include input/output transformer (where applicable), switchgears, converter, filters etc.

12.04.00 The routine and type tests to be performed on the drive system shall be as follows :

Routine Tests

a. **Visual Inspection**

It involves checking of the various equipment/components fault diagnostic unit, wiring, terminals, earthing ratings etc, in line with the approved drawings and visual inspection shall not be limited to the following;

i) Dimensions and door layout Vis-à-vis the approved drawings

ii) Degree of protection of cubicles

iii) Simulation facility of control signals for testing purposes

iv) Memory function of fault diagnostic

v) Voltage/Current rating power semiconductor elements

vi) Cable termination size and number of terminals, cable-supporting etc.

vii) Accessibility of components

viii) External signals and indication/alarm signals on converter

ix) Earthing of cubicles and cubicle doors

b. Insulation Test

c. Light load and functional test

d. Load characteristics test

e. Load duty test

f. Checking of Auxiliary devices

g. Checking the properties of the control equipment

h. Checking the protective devices

i. Checking of control and functional requirements

j. High voltage test

k. Shaft current/bearing insulation

l. Automatic restart/re-acceleration

Type Tests

a. Allowable full load current versus speed

b. Efficiency

c. Temperature rise

d. EM Immunity

e. EM Emission

f. Current sharing

g. Voltage division

h. Line side current distortion content

i. Power factor

j. Audible noise

k. Torque pulsation

l. Motor vibration

m. Dynamic performance

n. Current limit and current loop test

o. Speed loop test capability to ride through voltage less than 80%

p. Test capability to restart the system and resynchronize converter onto running motor after a voltage interruption

Type test certificate (not older than 5 years from date of contract) from independent testing agency for similar equipment can be accepted for d, e, f, j, k and l.

13.00.00 DATA SHEET-A

Sl. No.	Description	Unit	Specification Requirement
1.0	Type of drive		Inverter (IGBT based PWM controlled) AC drives
2.0	Manufacturer		*
3.0	Application		Fans/Pumps
4.0	Type of Motor/Model No. of the VFD		VFD shall be considered as per the technological requirement
5.0	Rating of drive	kW	Squirrel cage induction motor
6.0	Quantity		*
7.0	Rated power factor		*
8.0	Efficiency		*
9.0	Rated output voltage	kV	*
10.0	Full load current	kA	*
11.0	Type of duty		a)100% continuous b) 150% overload for 1 minute in

Sl. No.	Description	Unit	Specification Requirement
			24 hours
12.0	Quadrants of operation		*
13.0	Full wave rectification		12 pulse
15.0	Power supply system		
	a)Input power supply		415V, 3 ph, 50Hz
	b)Variation in voltage		±10%
	c)Variation in freqnecy		±5%
	d)Combined voltage & frequency variations		10%
	e)System faultl level	kA	50 kA 1 sec
	f)Type of earthing		Solidly earthed
15.0	Location		Indoor
16.0	Type of cooling		*
17.0	Input and output cables		
	a)Size & type		*
	b)Entry		Bottom
18.0	Dimensions		*
19.0	Degree of protection		IP42
20.0	Power losss ride through time	Sec.	2
21.0	Control characteristics		
	a) Control Method		Drive level control using digital system.
	b) Output freq. range		*
	c) Frequency accuracy		0.01%
	d) Frequency resolution	Hz	0.001
	e) Speed regulation		0.5% of max. speed
	f) Speed range		*
	g)Accelerate/decelerate time		*
	Harmonic limitations		
22.0	I)Voltage harmonics		
	a)Source side		Maximum 5%
	b)Load side		Maximum 5%
	II)Current Harmonics		
	a)Source side		
23.0	i) 5^{th}		Maximum 30%
	ii) 7^{th}		Maximum 20%
	iii) 11^{th}		Maximum 10%
25.0	Miscellaneous		
	a)Soft-start		Yes
	b)Flying restart		Yes
	c)Auto restart		Yes
25.0	Kinetic buffering		Yes (Preferably for a backup time of 2 sec.)
Note	**'*' indicated above shall be filled by the Contractor**		
	'**' Contractor shall furnish the data after placement of order		

9.00.00 ERECTION HARDWARE

This section provides the general technical guidelines for the erection materials for instruments. All erection materials shall be of good quality and conform to the operating environment of the corresponding instrument.

9.01.00 Electrical Accessories

9.01.01 Electrical conduit and associated materials shall conform to the requirements of the articles which follow:

a) **Rigid Steel Conduit**

i) Conduits up to and including 25 mm shall be of 16 SWG and conduits above 25 mm shall be of 14 SWG. Minimum size of conduits shall be 19 mm.

ii) Each piece of conduit shall be straight, free from blister and other defects and covered with capped bushing at both ends.

iii) All rigid conduit couplings and elbows shall be hot dip galvanized rigid mild steel in accordance with ANSI C 80.1 and UL6. The conduit interior and exterior surfaces shall have a continuous zinc coating with an over coat of transparent enamel or zinc chromate. Conduits shall be furnished in standard length of 3 meters, threaded at both ends.

iv) All conduit fittings shall conform to the requirements of ANSI C 80.4 and UL-514 where these standards apply.

b) **Flexible Conduit**

i) Flexible conduit shall be of three layer construction of very high quality of lead coated steel. Outside and inside layer shall be reinforced with heat resistant material.

ii) Lead coating outside and inside of the conduit steel surface shall provide a non-corrosive characteristic particularly in acidic atmosphere. Besides flexibility, this shall be strong enough to stay at the desired profile without support and shall be durable and strong so as to offer sufficient mechanical protection. It shall also be fully liquid dust and air tight and shall withstand a continuous hydraulic pressure up to 2 Kg/Sq. cm and temperature up to 200 °C.

c) **Special Fittings**

i) Conduit sealing and fittings shall be provided as required and shall be consistent with the area and equipment with which they are installed.

ii) Double locknuts shall be provided on all conduit terminations not provided with threaded lugs and couplings. Locknuts shall be designed to securely bond the conduit to the enclosure when tightened. Locknuts shall not loosen due to vibration.

iii) Conduit supports shall be furnished and installed in accordance with the specifications.

9.01.02 **Junction Box**

01.	Type of Enclosure	:	Dust tight & weatherproof conforming to IP 65
02.	Material	:	3 mm sheet steel/ fiberglass reinforced polyester (UV stabilized)
03.	Type of Cover	:	Solid unhinged with retention chain/ screwed at all four corners
04.	Paint	:	RAL 7032 – Siemens Grey
05.	Mounting	:	Surface/ 2” pipe stanchion (At a dry compartment at one side of the enclosure/ rack with front opening type door)
06.	Cable Entry	:	3 mm (min) Bottom / side Gland plate
07.	Gasket	:	Neoprene
08.	Grounding	:	Brass earth lug with green screw head External-two (2) nos., Internal – one (1) no.
09.	No. of Drain holes	:	Two at bottom capped
10.	Identification	:	Label for JB & tags for cable
11.	Accessories	:	a) Rail mounted cage clamp type screw less terminals (suitable for conductor size up to 2.5 sq. mm of suitable voltage grade) with markers and 20% spare terminals. b) Cable gland (Brass) & raceways

9.01.03 **Cable Gland**

01.	Type	:	Double compression

02.	Entry Thread	:	NPT
03.	Material	:	Brass
04.	Finish	:	Cadmium Plated.
05.	Protection	:	IP 54 or better
06.	Accessories	:	Neoprene gasket, locknuts, reducers etc.

9.01.04 **Cable Tray**

01.	Material	:	Mild steel
02.	Thickness	:	not less than 2.0 mm
03.	Finish	:	Hot dip galvanized
04.	Perforation	:	As per MFR standard.
05.	Cover	:	Suitable for tray

9.02.00 **Process Hook Up Accessories & Specification (as applicable)**

Material and rating of the hook up items shall generally suit the piping and fluid condition. Bidder shall furnish hook up drawings and the drawings for open racks & closed racks for Owner / Consultant's approval. For the design guide line Bidder shall refer to Section-I of this Volume.

9.02.01 **Specification for Process Hook Up Materials**

Sr. No	System	Piping class	Impulse Pipe Material	Sche -dule	Materials for Valve / Fittings	Stem Mate-rial	Rating of Fitting	Pr. Class of valve
1.	Auxiliary steam	G	ASTM-A106 Gr. B	80 (½ inch)	ASTM-A 105	ASTM -A182 Gr. F-6a	3000 lb	800
2.	Air / Flue Gas Outside Furnace	K	ASTM-A106 Gr. B/C	80 (¾ inch)	ASTM-A 105	ASTM -A182 Gr. F-6a	3000 lb	800
3.	Air / Flue Gas Inside Furnace	L	ASTM-A335 Gr. P-22	80 (¾ inch)	ASTM-A 182 Gr. F-22	ASTM -A182 Gr. F-6a	3000 lb	800

Sr. No	System	Piping class	Impulse Pipe Material	Sche -dule	Materials for Valve / Fittings	Stem Mate-rial	Rating of Fitting	Pr. Class of valve
4.	DM Cooling Water	M	ASTM A312 TP 316	40 (1/2 inch)	ASTM A182 F316	SS or better	3000 lb	800
5.	Cooling Water	N	ASTM-A106Gr . C	80 (½ inch)	ASTM-A 105	SS or better	3000 lb	800

Note:

1) Above requirements to be complied by Bidder as applicable for the FGD system. Rating of piping/ fittings / valves etc. is subjected to be approved by Owner as per the final design pressure & temperature finalized during the detail engineering as per ANSI B31.1.

2) Material shall be compatible with that of the impulse pipe material and design parameter.

3) For DM water services, complete erection hardware material shall be SS316 only.

9.02.02 **Seamless Stainless Steel Pipe**

01.	Reference	:	ASTM A-312 TP 316
02.	Material Grade	:	TP 316
03.	Type	:	Seamless /Plain end
04.	Size	:	½" NB
05.	Schedule	:	40
06.	Standard Length	:	5 meter

9.02.03 **Stainless Steel Pipe Fittings**

01.	Reference	:	ASTM A-182 F 316 / ANSI B16.11
02.	Type	:	Forged
03.	Rating	:	3000 lbs / 6000 lbs / 9000 lbs
04.	Size	:	½" NB

	05.	End connection	:	Generally socket weld
	06.	Type of Fittings	:	Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.

9.02.04 **Seamless Stainless Steel Tube**

	01.	Reference	:	ASTM A-213 TP 316
	02.	Material Grade	:	TP 316
	03.	Size	:	½" OD X 2.1 MM Thick
	04.	Type	:	Cold drawn annealed, pickled, passivated, de-scaled, hydraulically cleaned seamless tube.
	05.	Properties	:	The tube shall be free from scratches and suitable for bending and capable of being flared by hardened and tapered steel pin. The expanded tube shall show no crack or rupture. Hardness shall be RB 80.
	06.	Test Pressure	:	400 Kg/Sq. cm (minimum)
	07.	Tolerance	:	± 0.13 mm for outside diameter ± 15 % for wall thickness
	08.	Standard Length	:	5 meter
	09.	Test	:	Flare, Hardness, Ball and Bubble Test

9.02.05 **Stainless Steel Tube Fittings**

	01.	Reference	:	ASTM-A-182
	02.	Type	:	Double ferrule double compression
	03.	Material	:	316 Stainless steel forged
	04.	Ferrule	:	316 Stainless Steel
	05.	Type of Fittings	:	Male / female connector, elbow, cross / equal tee, straight connector, bulkhead union, ferrule etc. as required to suit installation.

	06.	Size	:	To suit SS tubing and NPT end connection

9.02.06 **C.S. Pipe**

	01.	Reference	:	ASTM-A 106 Gr. C
	02.	Material	:	Cold drawn seamless black C.S.
	03.	Type	:	Seamless / Plain ends
	04.	Size	:	½" NB
	05.	Schedule	:	80, 160, XXS as required
	06.	Standard Length	:	5 meter

9.02.07 **C.S. Pipe Fittings**

	01.	Reference	:	ASTM-A 105 / ANSI B16.11
	02.	Type	:	Forged
	03.	Rating	:	3000 lbs / 6000 lbs / 9000 lbs
	04.	Size	:	½" NB
	05.	End connection	:	Generally socket weld
	06.	Type of Fittings	:	Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.

9.02.08 **A.S. Pipe**

	01.	Reference	:	ASTM-A 335 P22 AS PER ANSI B 36.10
	02.	Material	:	Cold drawn seamless A.S.
	03.	Type	:	Seamless / Plain ends
	04.	Size	:	½" NB
	05.	Schedule	:	XXS
	06.	Standard Length	:	5 meter

9.02.09 **A.S. Pipe Fittings**

01.	Reference	:	ASTM-A 182 F22 AS PER ANSI B 16.11
02.	Type	:	Forged
03.	Rating	:	9000 lbs
04.	Size	:	½" NB
05.	End connection	:	Generally socket weld
06.	Type of Fittings	:	Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.

9.02.10 **Carbon Steel Globe Valve**

01.	Reference	:	ASTM A-105
02.	Type	:	Globe
03.	Construction	:	Forged Body Cadmium Plated
04.	End Connection	:	½" Socket Weld
05.	Rating	:	Cl. 800 / CL. 2500
06.	Material	:	Body - Carbon steel Stem - Hardened Steel Plug - AISI 316 SS Seat- Stainless steel stellited
07.	Packing	:	Teflon / Grafoil as required
08.	Yoke	:	ASTM A105
09.	Handwheel	:	Carbon steel
10.	Design standard	:	As per ANSI B 16.34

9.02.11 **Stainless Steel Globe Valve**

01.	Reference	:	ASTM A-182 F316
02.	Type	:	Globe

	03.	Construction	:	Forged Body
	04.	End Connection	:	Socket Weld
	05.	Proof Pressure	:	400 Kg/cm^2
	06.	Material	:	Body - Stainless steel Stem - Hardened Steel Plug - AISI 316 SS Seat- Stainless steel stellited
	07.	Packing	:	Teflon as required
	08.	Yoke	:	ASTM A182 F316
	09.	Handwheel	:	Carbon steel
	10.	Design standard	:	As per ANSI B 16.34

9.02.12 **Alloy Steel Globe Valve**

	01.	Reference	:	ASTM A-182 F22
	02.	Type	:	Globe
	03.	Construction	:	Forged Body
	04.	End Connection	:	½" Socket Weld
	05.	Rating	:	CL. 2500
	06.	Material	:	Body - Alloy steel Stem - Hardened Steel Plug - AISI 316 SS Seat- Stainless steel stellited
	07.	Packing	:	Grafoil as required
	08.	Yoke	:	ASTM A182 F22
	09.	Handwheel	:	Carbon steel
	10.	Design standard	:	As per ANSI B 16.34

9.02.13 **Condensate Pot**

	01.	Reference	:	ASTM A182 F22 / ASTM A105

02.	Material	:	Alloy steel / carbon steel as per application	
03.	Construction	:	Drilled from barstock	
04.	End connection	:	3 nos. ½" socket weld end	
05.	Accessories	:	Vent valves	

9.02.14 **Instrument Valve Manifold**

01.	Type	:	a) Two valve manifold b) Five valve manifold c) Three valve manifold	
02	Mounting	:	Remote 2" Pipe Mounting	
03.	Construction	:	Single block (bar stock)	
04.	Material	:	Forged body and bonnet AISI 316 stainless steel	
05.	Ports	:	1/2 " NPT (F)	
06.	Rating	:	420 Kg/Sq. cm at ambient	
07.	Operating Temperature	:	(-)30 to (+)170°C	
08.	Packing	:	PTFE Wafer	
09.	Seat & Stem	:	AISI 316 SS	
10.	Plug	:	AISI 316 SS free to turn on stem / 17-4 PH	
11.	Handle Bar	:	AISI 316 SS	
12.	Connection	:	Straight	
13.	Accessories	:	a) Plugs for all ports b) Mounting Bracket, bolts, nuts	

9.02.15 **Air Header**

			For Panel	**For Field**
01.	Material of Construction	:	Stainless steel	Stainless steel

	02.	Inlet Connection	:	2" NPT (M)	1" NPT (M)
	03.	Header Take-off	:	Stainless Steel	Stainless Steel
	04.	Take off Connection	:	1 / 2" NPT (M)	1/ 2" NPT (M)
	05.	Take-off Valves	:	Stainless Steel	Stainless Steel
	06.	Tube Take-off	:	Tube adapter on valve	Tube adapter on valve
	07.	Drain	:	SS drain valve at lowest point	SS drain valves at lowest point

9.02.16 **Seamless Stainless Steel Tube**

01.	Reference	:	ASTM A-269 TP 316
02.	Material Grade	:	TP 316
03.	Size	:	¼" OD x 0.049" wall thickness
04.	Type	:	Cold drawn annealed, pickled, passivated, de-scaled, hydraulically cleaned seamless tube.
05.	Properties	:	The tube shall be free from scratches and suitable for bending and capable of being flared by hardened and tapered steel pin. The expanded tube shall show no crack or rupture. Hardness shall be RB 80.
06.	Test Pressure	:	400 Kg/Sq. cm
07.	Tolerance	:	± 0.13 mm for outside diameter ± 15 % for wall thickness
08.	Standard Length	:	5 meter
09.	Test	:	Flare, Hardness, Ball and Bubble Test

10.00.00 **SPECIAL TOOLS & TACKLE AND TEST EQUIPMENT**

10.01.00 Bidder shall supply a complete set of new, unused and reliable type of special tools and tackle and test equipment which are necessary or convenient for erection, commissioning, maintenance and overhaul of the plant and equipment provided under this specification.

10.02.00 The tools & tackle and Test Equipment shall be shipped in separate container, clearly marked with names of the equipment for which they are intended.

10.03.00 Bidder shall furnish list of tools & tackle and test equipment proposed to be supplied along with the bid, if applicable. Minimum two (2) nos. antistatic wrist band in each control panels are mandatory and shall be included in the bid.

TYPICAL DRIVE INTERFACE

FOR TENDER PURPOSE ONLY

REV	DATE	PREPD	CHKD	APPVD	NATURE OF REVISION & DESCRIPTION
0	09.08.2018	AAM	AKP	AT	FIRST ISSUE

REVISION STATUS

OWNER: NLC TAMILNADU POWER LIMITED

PROJECT: 2x500 MW THERMAL POWER PLANT AT TUTICORIN

TITLE: TYPICAL DRIVE INTERFACE

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	AAM	JOB NO.	17A14
CHECKED	AKP	SCALE	NIL
APPROVED	AT	DATE	09.08.2018
DWG. NO.	17A14-DWG-I-0021		REV 0

SHEET 1 OF 8

FILE LOCATION:
PLOT DATE:

S/N	DESCRIPTION	SHEET NO.
1.	COVER SHEET	1 OF 8
2.	INDEX SHEET	2 OF 8
3.	INTERFACE FOR BIDIRECTIONAL DRIVE (WITH INTEGRAL STARTER)	3 OF 8
4.	INTERFACE FOR UNIDIRECTIONAL LT DRIVE (CONTACTOR OPERATED)	4 OF 8
5.	INTERFACE FOR UNIDIRECTIONAL HT/LT DRIVE (BREAKER OPERATED)	5 OF 8
6.	INTERFACE FOR BIDIRECTIONAL DRIVE (WITH NON INTEGRAL STARTER)	6 OF 8
7.	INTERFACE FOR ON/OFF SOLENOID ACTUATED DRIVE	7 OF 8
8.	INTERFACE FOR CONTROL VALVE	8 OF 8

FOR TENDER PURPOSE ONLY

REV	DATE	PREPD	CHKD	APPVD	NATURE OF REVISION & DESCRIPTION
0	09.08.2018	AAM	AKP	AT	FIRST ISSUE

REVISION STATUS

OWNER: NLC TAMILNADU POWER LIMITED

PROJECT: 2x500 MW THERMAL POWER PLANT AT TUTICORIN

TITLE: TYPICAL DRIVE INTERFACE

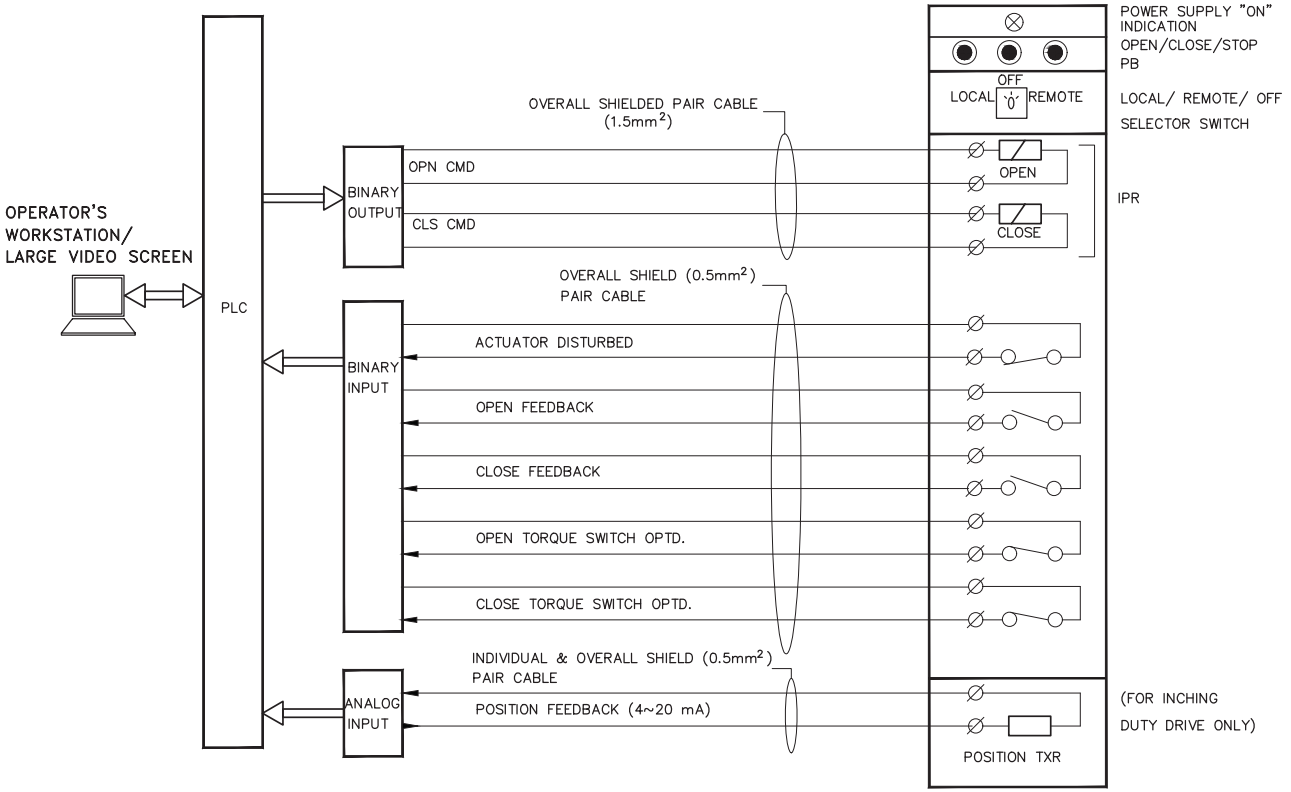
DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	AAM	JOB NO.	17A14
CHECKED	AKP	SCALE	NIL
APPROVED	AT	DATE	09.08.2018
DWG. NO.	17A14-DWG-I-0021		REV 0
			SHEET 2 OF 8

FILE LOCATION:
PLOT DATE:

FILE LOCATION: C:\Users\Administrator\Desktop\AYAN\21-08-2018\17A14-DWG-I-0021-R-0-SHT-3-8.dwg
PLOT DATE: 21 August 2018, 12:08 PM

PLC INTERFACE FOR BIDIRECTIONAL DRIVE (WITH INTEGRAL STARTER)



NOTE:

1. ACTUATOR DISTURBED CONSIST OF FOLLOWING SIGNALS: –
   a) LOSS OF POWER SUPPLY,
   b) LOSS OF CONTROL SUPPLY, MOTOR THERMOSTAT TRIP,
   c) THERMAL OVER LOAD RELAY TRIP,
   d) TORQUE OPEN/CLOSE CUT OFF,
   e) LOCAL/OFF/REMOTE SEL. SWITCH IN LOCAL OR OFF MODE.
   f) VALVE JAMMED.
   g) EMERGENCY STOP PB PRESSED.
2. PLC VENDOR SHALL FURNISH DETAILED INTERFACE SCHEMES BASED ON THIS BASIC DIAGRAM AND SPECIFICATION.
3. IPR – INTERPOSING RELAY (TO BE LOCATED INSIDE THE INTEGRAL STARTER)
4. RELEASE PARTS OF THE SPECIFICATION SHALL BE REFERRED FOR OTHER SPECIFIC REQUIREMENTS (FOR EXAMPLE REDUNDANCY)

FOR TENDER PURPOSE ONLY

REV	DATE	PREPD	CHKD	APPVD	NATURE OF REVISION & DESCRIPTION
0	09.08.2018	AAM	AKP	AT	FIRST ISSUE

REVISION STATUS

OWNER: NLC TAMILNADU POWER LIMITED

PROJECT: 2x500 MW THERMAL POWER PLANT AT TUTICORIN

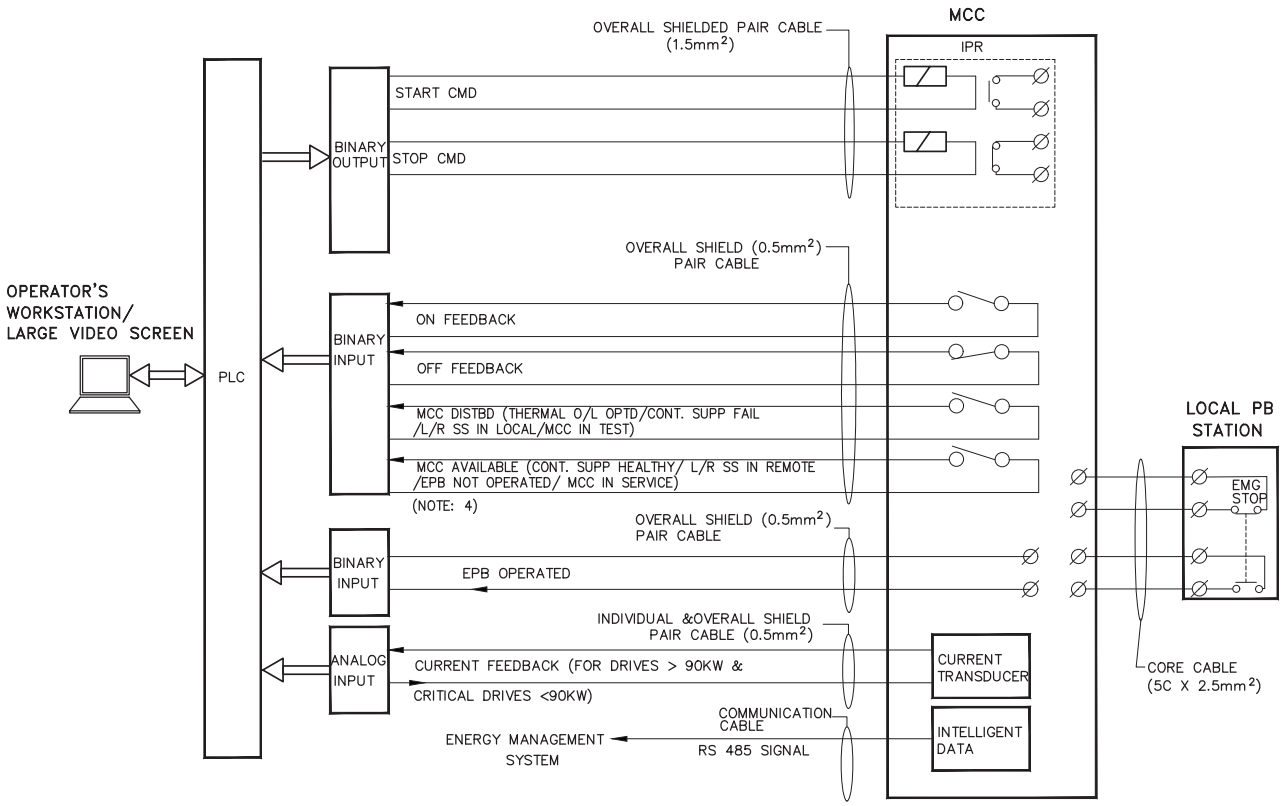
TITLE: TYPICAL DRIVE INTERFACE

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	AAM	JOB NO.	17A14
CHECKED	AKP	SCALE	NIL
APPROVED	AT	DATE	09.08.2018
DWG. NO.	17A14-DWG-I-0021		REV 0

SHEET 3 OF 8

PLC INTERFACE FOR UNIDIRECTIONAL LT DRIVE (CONTACTOR OPERATED)



NOTE:

1. IPR – INTERPOSING RELAY
2. PLC VENDOR SHALL FURNISH DETAILED INTERFACE SCHEMES BASED ON THIS BASIC DIAGRAM AND SPECIFICATION.
3. RELEVANT PARTS OF THE SPECIFICATION SHALL BE REFERRED FOR OTHER SPECIFIC REQUIRMENTS (FOR EXAMPLE REDUNDANCY).

FOR TENDER PURPOSE ONLY

REV	DATE	PREPD	CHKD	APPVD	NATURE OF REVISION & DESCRIPTION
0	09.08.2018	AAM	AKP	AT	FIRST ISSUE

REVISION STATUS

OWNER: NLC TAMILNADU POWER LIMITED

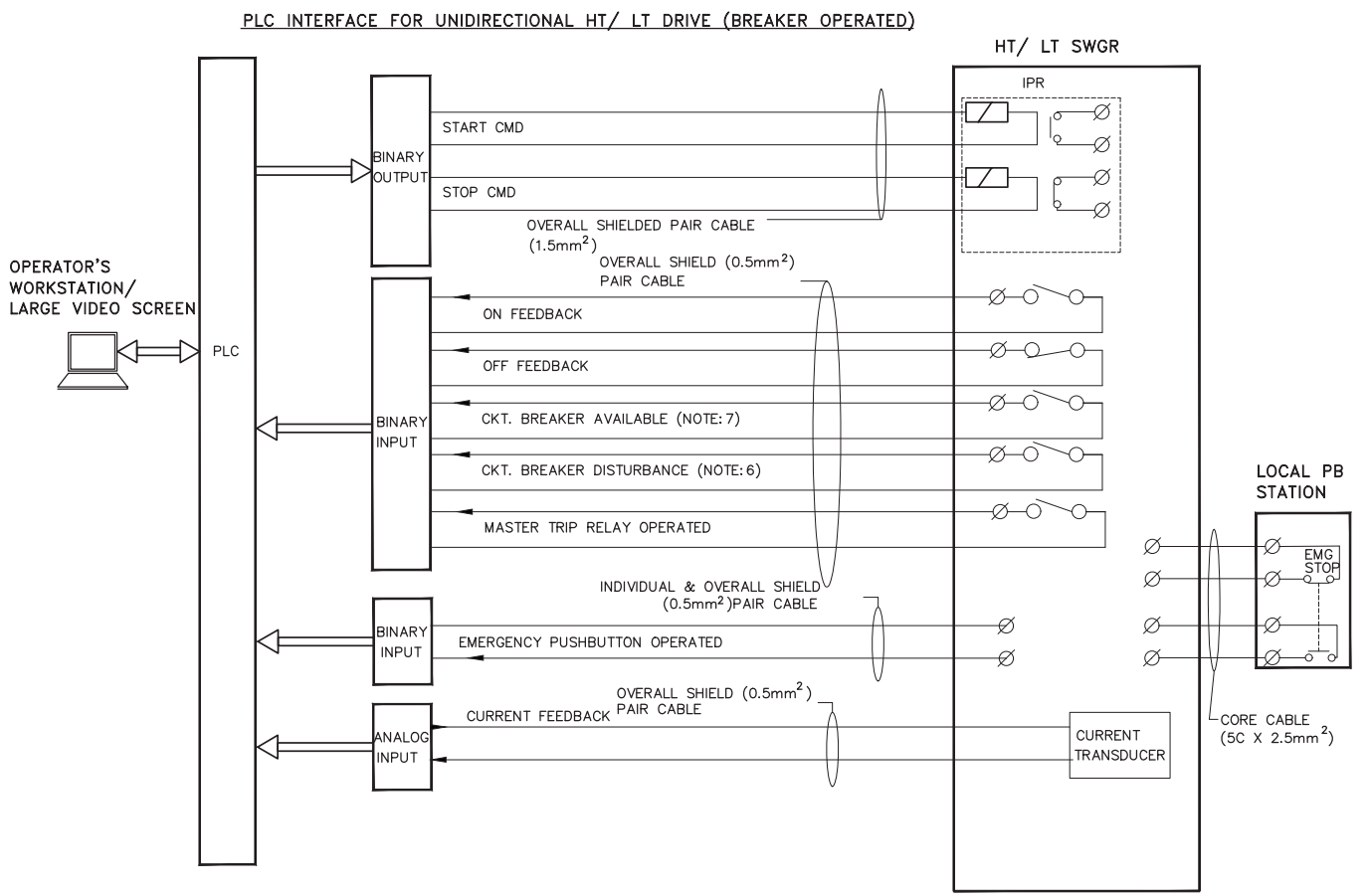
PROJECT: 2x500 MW THERMAL POWER PLANT AT TUTICORIN

TITLE: TYPICAL DRIVE INTERFACE

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	AAM	JOB NO.	17A14
CHECKED	AKP	SCALE	NIL
APPROVED	AT	DATE	09.08.2018
DWG. NO.	17A14–DWG–I–0021		REV 0
			SHEET 4 OF 8

FILE LOCATION: C:\Users\Administrator\Desktop\AYAN\21-08-2018\17A14-DWG-I-0021-R-0-SHT-4-8.dwg
PLOT DATE: 21 August 2018, 12:07 PM



NOTE:

1. IPR – INTERPOSING RELAYS
2. PLC VENDOR SHALL FURNISH DETAILED INTERFACE SCHEMES BASED ON THIS BASIC DIAGRAM AND SPECIFICATION.
3. RELEVANT PARTS OF THE SPECIFICATION SHALL BE REFERRED FOR OTHER SPECIFIC REQUIRMENTS (FOR EXAMPLE REDUNDANCY).
4. MOTOR WDG AND BRG TEMPERATURES SHALL BE CONNECTED TO THE RESPECTIVE PLC RTD I/O CARDS.
5. ALL COMMANDS AND FEEDBACKS SHALL BE REDUNDANT FOR HT DRIVES & CRITICAL LT DRIVES.
6. CKT BREAKER DISTURBANCE CONSISTS OF THE FOLLOWING:–
   - –BREAKER IN TEST POSITION
   - –TRIP COIL UNHEALTHY
   - –CONTROL SUPPLY FAIL
   - –L/R SELECTOR SWITCH IN LOCAL
7. CKT. BREAKER AVAILABLE CONSISTS OF THE FOLLOWING:–
   - –BREAKER IN SERVICE POSITION
   - –CONTROL SUPPLY HEALTHY
   - –BREAKER SPRING CHARGED
   - –BREAKER (L/R SS) IN REMOTE
   - –MTR NOT OPERATED.
   - –EPB NOT OPERATED

FOR TENDER PURPOSE ONLY

REV	DATE	PREPD	CHKD	APPVD	NATURE OF REVISION & DESCRIPTION
0	09.08.2018	AAM	AKP	AT	FIRST ISSUE

REVISION STATUS

OWNER: NLC TAMILNADU POWER LIMITED

PROJECT: 2x500 MW THERMAL POWER PLANT AT TUTICORIN

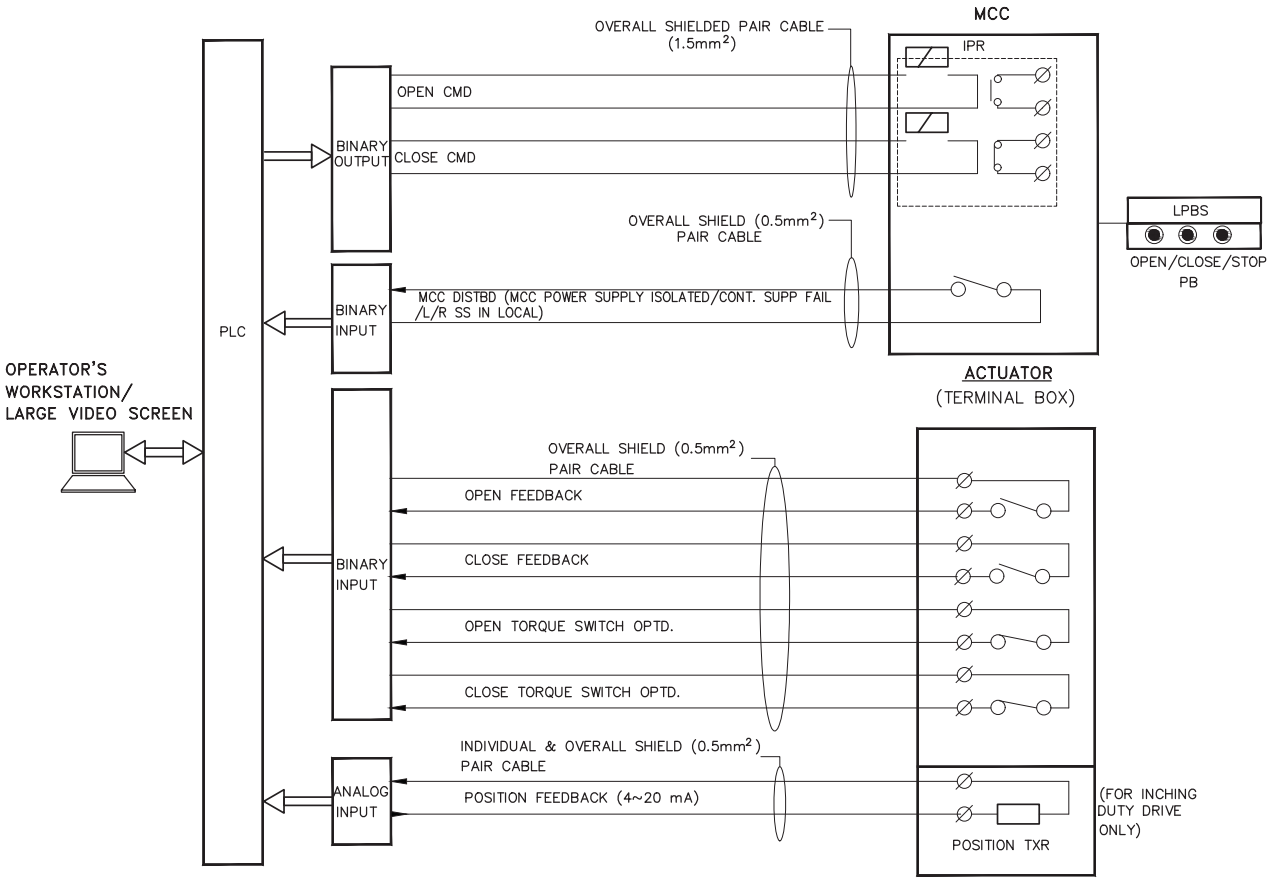
TITLE: TYPICAL DRIVE INTERFACE

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	AAM	JOB NO.	17A14
CHECKED	AKP	SCALE	NIL
APPROVED	AT	DATE	09.08.2018
DWG. NO.	17A14–DWG–I–0021		REV 0
			SHEET 5 OF 8

FILE LOCATION: C:\Users\Administrator\Desktop\AYAN\21-08-2018\17A14-DWG-I-0021-R-0-SHT-5-8.dwg
PLOT DATE: 21 August 2018, 12:09 PM

PLC INTERFACE FOR BIDIRECTIONAL DRIVE (WITH NON INTEGRAL STARTER)



NOTE:

1. IPR – INTERPOSING RELAY
2. PLC VENDOR SHALL FURNISH DETAILED INTERFACE SCHEMES BASED ON THIS BASIC DIAGRAM AND SPECIFICATION.
3. RELEVANT PARTS OF THE SPECIFICATION SHALL BE REFERRED FOR OTHER SPECIFIC REQUIRMENTS (FOR EXAMPLE REDUNDANCY).

FOR TENDER PURPOSE ONLY

REV	DATE	PREPD	CHKD	APPVD	NATURE OF REVISION & DESCRIPTION
0	09.08.2018	AAM	AKP	AT	FIRST ISSUE

REVISION STATUS

OWNER: NLC TAMILNADU POWER LIMITED

PROJECT: 2x500 MW THERMAL POWER PLANT AT TUTICORIN

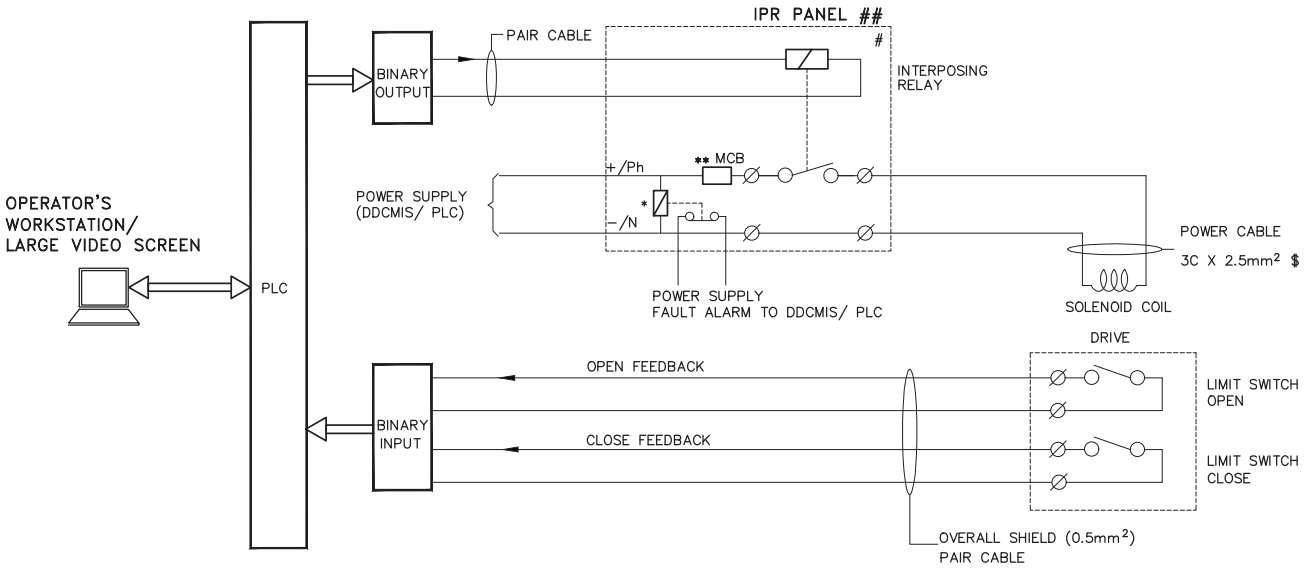
TITLE: TYPICAL DRIVE INTERFACE

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	AAM	JOB NO.	17A14
CHECKED	AKP	SCALE	NIL
APPROVED	AT	DATE	09.08.2018
DWG. NO.	17A14–DWG–I–0021		REV 0
			SHEET 6 OF 8

FILE LOCATION: C:\Users\Administrator\Desktop\AYAN\21-08-2018\17A14-DWG-I-0021-R-0-SHT-6-8.dwg
PLOT DATE: 21 August 2018, 12:10 PM

PLC INTERFACE FOR ON/OFF SOLENOID ACTUATED DRIVE



NOTE:

1. ** MCB SHALL BE PROVIDED FOR EACH SOLENOID.
2. * COMMON FOR ALL SOLENOIDS OF SIMILAR COIL VOLTAGE RATING.
3. PLC VENDOR SHALL FURNISH DETAILED INTERFACE SCHEMES BASED ON THIS BASIC DIAGRAM AND SPECIFICATION.
4. TWO INDEPENDENT OUTPUTS FROM PLC SHALL BE PROVIDED TO PUSH – PULL TYPE VALVES WITH DUAL COIL SOLENOIDS. RELEVANT PARTS OF THE SPECIFICATION SHALL BE REFERRED FOR OTHER SPECIFIC REQUIRMENTS.
5. $ POWER CABLE CROSS SECTION SHALL BE AS PER CABLE SIZING CALCULATION.
6. # FOR DOUBLE SOLENOID VALVES, SAME ARRANGEMENT SHALL BE APPLICABLE FOR SECOND SOLENOID.
7. ## IPR PANEL SHALL BE INTEGRAL FOR THE PLC BASED SYSTEMS.

FOR TENDER PURPOSE ONLY

REV	DATE	PREPD	CHKD	APPVD	NATURE OF REVISION & DESCRIPTION
0	09.08.2018	AAM	AKP	AT	FIRST ISSUE

REVISION STATUS

OWNER: NLC TAMILNADU POWER LIMITED

PROJECT: 2x500 MW THERMAL POWER PLANT AT TUTICORIN

TITLE: TYPICAL DRIVE INTERFACE

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	AAM	JOB NO.	17A14
CHECKED	AKP	SCALE	NIL
APPROVED	AT	DATE	09.08.2018
DWG. NO.	17A14–DWG–I–0021		REV 0

SHEET 7 OF 8

FILE LOCATION: C:\Users\Administrator\Desktop\AYAN\21-08-2018\17A14-DWG-I-0021-R-0-SHT-7-8.dwg
PLOT DATE: 21 August 2018, 12:11 PM

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

FOR TENDER PURPOSE ONLY

REV	DATE	PREPD	CHKD	APPVD	NATURE OF REVISION & DESCRIPTION
0	10.08.2018	AAM	AKP	AT	FIRST ISSUE

REVISION STATUS

FILE LOCATION:
PLOT DATE:

OWNER: NLC TAMILNADU POWER LIMITED

PROJECT: 2x500 MW THERMAL POWER PLANT AT TUTICORIN

TITLE: TYPICAL INSTRUMENT INSTALLATION DIAGRAM

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	AAM	JOB NO.	17A14
CHECKED	AKP	SCALE	NIL
APPROVED	AT	DATE	10.08.2018
DWG. NO.	17A14-DWG-I-0022		REV 0

SHEET 1 OF 16

NOTES :

1..PROVISION OF SINGLE OR DOUBLE ROOT VALVE AND DRAIN VALVE SHALL BE IN ACCORDANCE WITH THE PRESSURE/TEMPERATURE REQUIREMENT. FOR LINE PRESSURE EQUAL TO OR GREATER THAN 40 KG/SQ.CM 2 NOS ROOT VALVE AND 2 NOS DRAIN VALVE SHALL BE REQUIRED.

2..MATERIAL, SIZE AND RATING OF THE PROCESS HOOK UP ITEMS SHOWN IN THE DRAWING ARE INDICATIVE ONLY. ACTUAL REQUIREMENT SHALL BE AS PER PROCESS CONDITION & SPECIFICATION V.IIE/S-III

3..DRAIN PIPE IN RACK AND ENCLOSURE SHALL BE 2" NB ASTM A 106 SCH 80 Gr.C. DRAIN HEADER SHALL BE TO THE NEAREST DRAIN PIT AS PER SITE CONDITION.

4..ALL FITTINGS SHALL BE WITH DOUBLE COMPRESSION FERRULE & NUTS.

5..UNION SHALL BE USED AT EVERY 6M INTERVAL OF IMPULSE LINE OR AS REQUIRED.

6..IMPULSE LINE SHALL BE SUPPORTED WITH U-CLAMPING AT EVERY 2.5M SPAN.

FOR TENDER PURPOSE ONLY

REV	DATE	PREPD	CHKD	APPVD	NATURE OF REVISION & DESCRIPTION
0	10.08.2018	AAM	AKP	AT	FIRST ISSUE

REVISION STATUS

OWNER: NLC TAMILNADU POWER LIMITED

PROJECT: 2x500 MW THERMAL POWER PLANT AT TUTICORIN

TITLE: TYPICAL INSTRUMENT INSTALLATION DIAGRAM

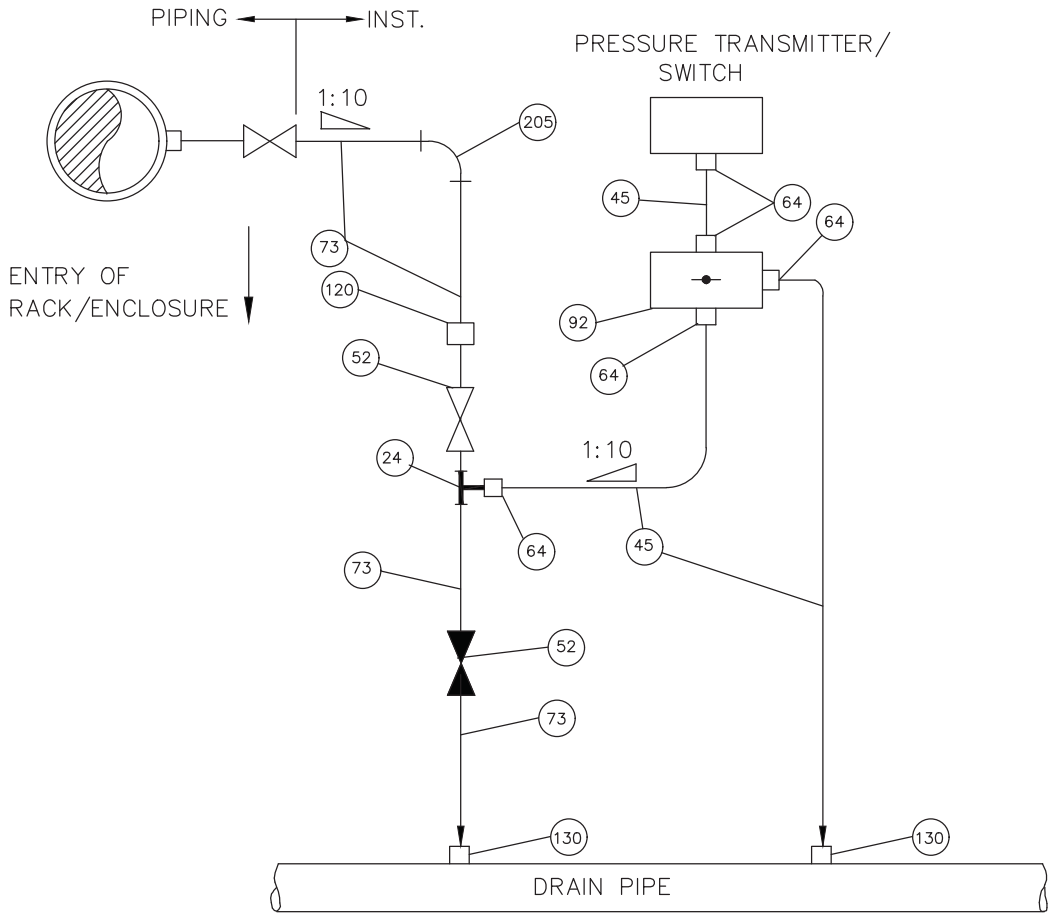
DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	AAM	JOB NO.	17A14
CHECKED	AKP	SCALE	NIL
APPROVED	AT	DATE	10.08.2018
DWG. NO.	17A14-DWG-I-0022		REV 0

SHEET 3 OF 16

FILE LOCATION:
PLOT DATE:

PRESSURE TRANSMITTER/PRESSURE SWITCH MOUNTED BELOW SOURCE POINT



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
24	1	UNEQUAL TEE, 1/2" SW X 1/2" NPT (F)
45	3 M	TUBE, 1/2" OD
52	2	GLOBE VALVES, 1/2" SW
64	8	MALE CONNECTOR, 1/2" NPT (M) X 1/2" OD
73	15 M	IMPULSE PIPE, 15 NB
92	1	2 VALVE MANIFOLD, 1/2" NPT (F)
120	1	BULK-HEAD UNION, 1/2" SW
130	2	HALF COUPLING, 1/2" SW
205	1	90° ELBOW, 1/2" SW

SERVICE : WATER.

FOR TENDER PURPOSE ONLY

REV	DATE	PREPD	CHKD	APPVD	NATURE OF REVISION & DESCRIPTION
0	10.08.2018	AAM	AKP	AT	FIRST ISSUE

REVISION STATUS

OWNER: NLC TAMILNADU POWER LIMITED

PROJECT: 2x500 MW THERMAL POWER PLANT AT TUTICORIN

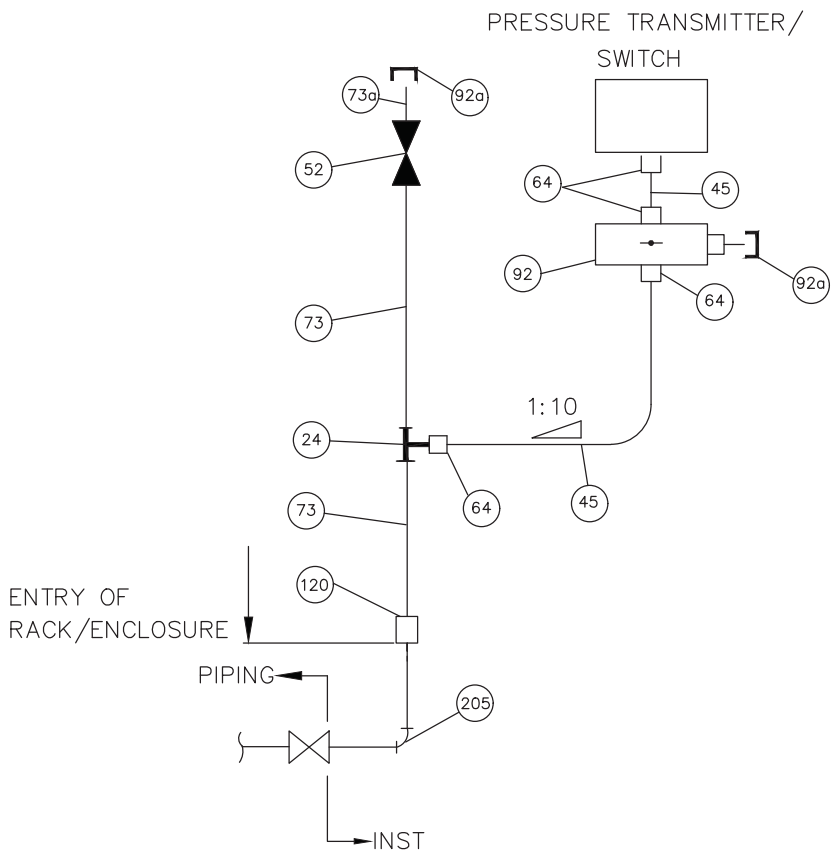
TITLE: TYPICAL INSTRUMENT INSTALLATION DIAGRAM

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	AAM	JOB NO.	17A14
CHECKED	AKP	SCALE	NIL
APPROVED	AT	DATE	10.08.2018
DWG. NO.	17A14-DWG-I-0022		REV 0
			4 SHEET OF 16

FILE LOCATION: C:\Users\Administrator\Desktop\AYAN\INST INSLL\17A14-DWG-I-0022-R-0-SHT-5-20 (PT).dwg
PLOT DATE: 16 August 2018, 12:15 PM

PRESSURE TRANSMITTER/PRESSURE SWITCH MOUNTED ABOVE SOURCE POINT



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
24	1	UNEQUAL TEE, 1/2" SW X 1/2" NPT (F)
45	3 M	TUBE, 1/2" OD
52	1	GLOBE VALVE, 1/2" SW
64	4	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD
73	15 M	IMPULSE PIPE, 15 NB
73a	1	NIPPLE, 1/2" SW X 1/2" NPT (F), 150 MM
92	1	2-VALVE MANIFOLD, 1/2" NPT (F)
92a	2	VENT PLUG, 1/2" NPT (M)
120	1	BULK HEAD UNION/COUPLING, 1/2" SW
205	1	90° ELBOW, 1/2" SW

SERVICE : AIR

FOR TENDER PURPOSE ONLY

REV	DATE	PREPD	CHKD	APPVD	NATURE OF REVISION & DESCRIPTION
0	10.08.2018	AAM	AKP	AT	FIRST ISSUE

REVISION STATUS

OWNER: NLC TAMILNADU POWER LIMITED

PROJECT: 2x500 MW THERMAL POWER PLANT AT TUTICORIN

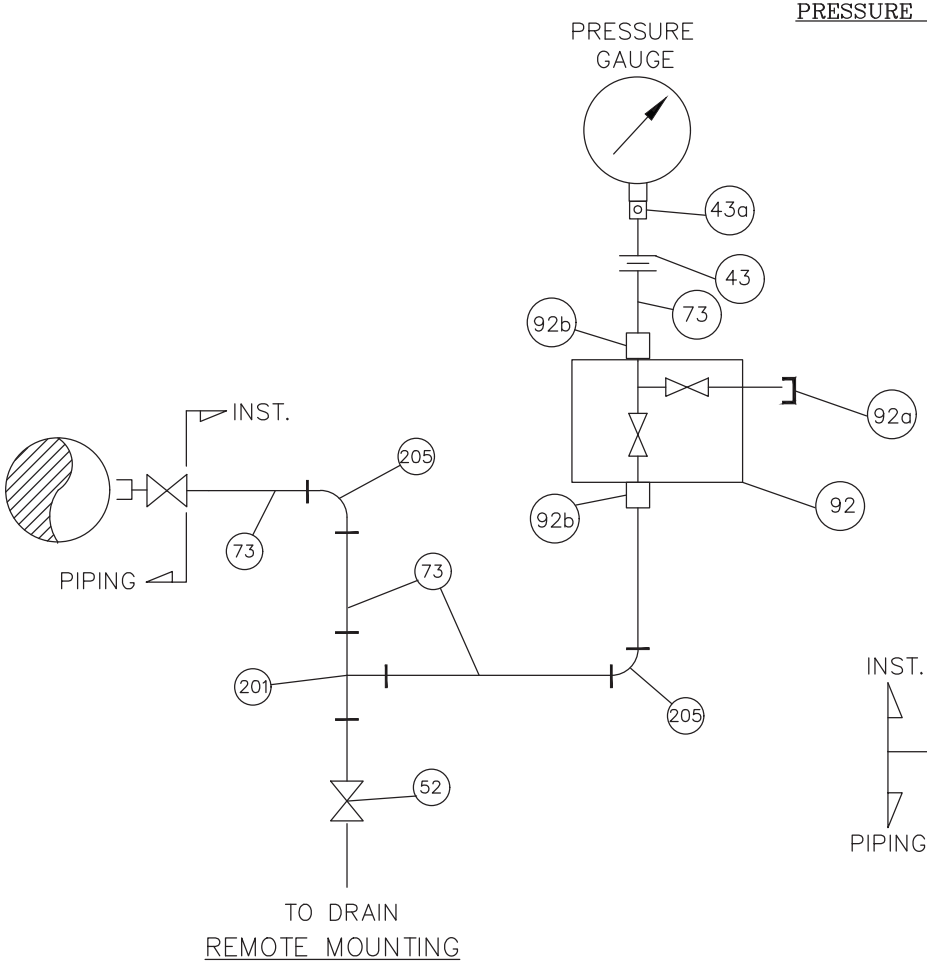
TITLE: TYPICAL INSTRUMENT INSTALLATION DIAGRAM

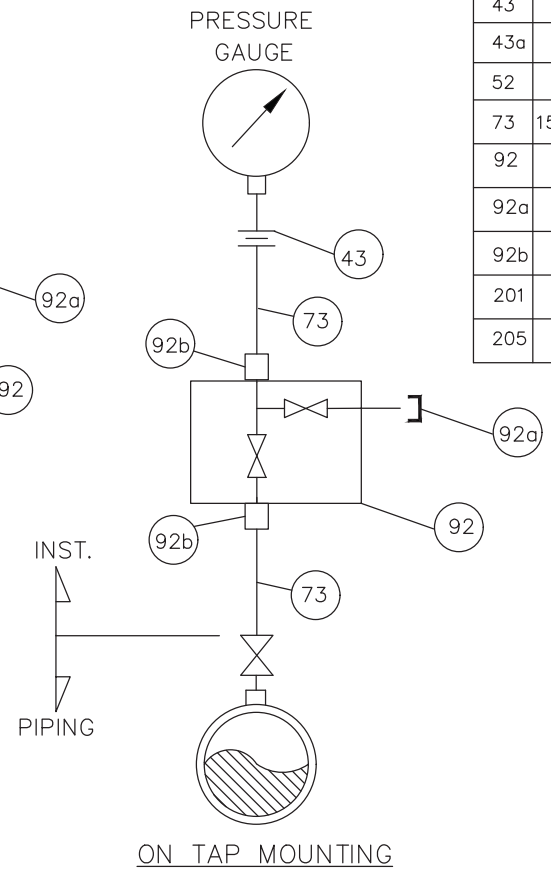
DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	AAM	JOB NO.	17A14
CHECKED	AKP	SCALE	NIL
APPROVED	AT	DATE	10.08.2018
DWG. NO.	17A14-DWG-I-0022		REV 0
			5 SHEET OF 16

FILE LOCATION: C:\Users\Administrator\Desktop\AYAN\INST INSLL\17A14-DWG-I-0022-R-0-SHT-7-20 (PT).dwg
PLOT DATE: 16 August 2018, 12:16 PM

PRESSURE GAUGE





BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
43	1	THREE PIECE UNION, 1/2" SW X 1/2" NPT (F)
43a	1	SNUBBER, 1/2" NPT (M) X 1/2" NPT (F) (AT PUMP DISCHARGE)
52	1	GLOBE VALVE, 1/2" SW
73	15Mtrs	IMPULSE PIPE 15 NB
92	1	2 VALVE MANIFOLD, 1/2" NPT (F)
92a	1	VENT PLUG, 1/2" NPT (M)
92b	1	ADAPTOR, 1/2" SW X 1/2" NPT (M)
201	1	EQUAL TEE 1/2" SW
205	2	90° ELBOW 1/2" SW

SERVICE : WATER

FOR TENDER PURPOSE ONLY

REVISION STATUS					NATURE OF REVISION & DESCRIPTION
REV	DATE	PREPD	CHKD	APPVD	
0	10.08.2018	AAM	AKP	AT	FIRST ISSUE

OWNER: NLC TAMILNADU POWER LIMITED

PROJECT: 2x500 MW THERMAL POWER PLANT AT TUTICORIN

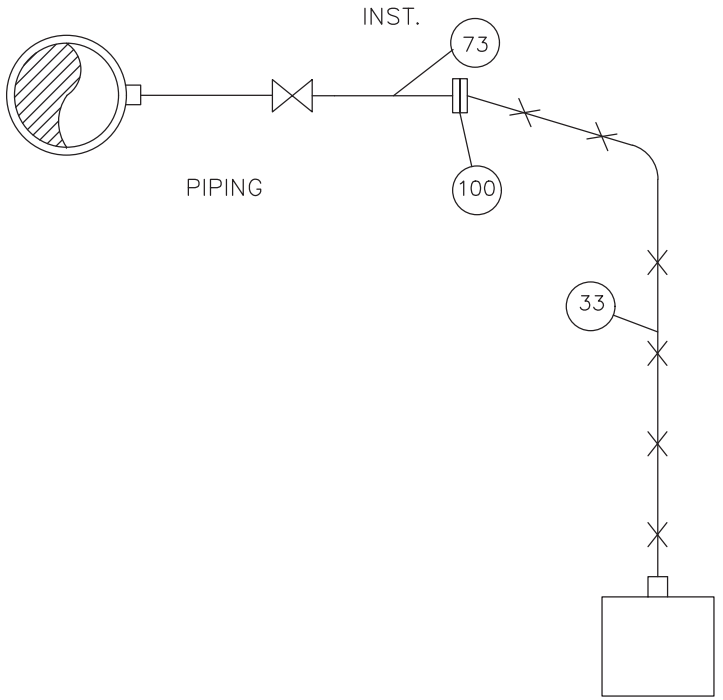
TITLE: TYPICAL INSTRUMENT INSTALLATION DIAGRAM

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	AAM	JOB NO.	17A14
CHECKED	AKP	SCALE	NIL
APPROVED	AT	DATE	10.08.2018
DWG. NO.	17A14-DWG-I-0022		REV 0
			SHEET 10 OF 16

FILE LOCATION: C:\Users\Administrator\Desktop\AYAN\INST INSLL\17A14-DWG-I-0022-R-0-SHT-13-20 (PG).dwg
PLOT DATE: 16 August 2018, 12:21 PM

PRESSURE TRANSMITTER/PRESSURE SWITCH WITH REMOTE DIAPHRAGM SEAL



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
33	A/R	SS ARMOURED CAPILLARY TUBE
73	1 M	IMPULSE PIPE, 15 NB
100	1	FLANGE ASSEMBLY TO SUIT 1/2" PIPE

SERVICE: CORROSIVE/ VISCOUS/SOLID BEARING OR SLURRY SERVICE

FOR TENDER PURPOSE ONLY

REV	DATE	PREPD	CHKD	APPVD	NATURE OF REVISION & DESCRIPTION
0	10.08.2018	AAM	AKP	AT	FIRST ISSUE

REVISION STATUS

OWNER: NLC TAMILNADU POWER LIMITED

PROJECT: 2x500 MW THERMAL POWER PLANT AT TUTICORIN

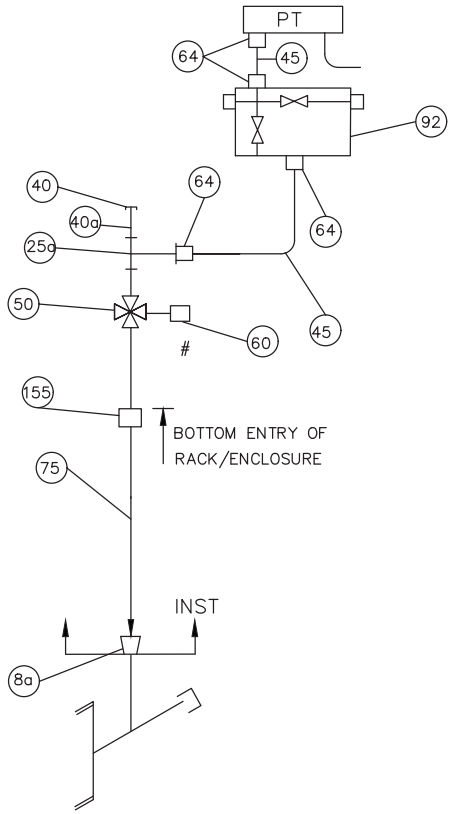
TITLE: TYPICAL INSTRUMENT INSTALLATION DIAGRAM

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	AAM	JOB NO.	17A14
CHECKED	AKP	SCALE	NIL
APPROVED	AT	DATE	10.08.2018
DWG. NO.	17A14-DWG-I-0022		REV 0
			SHEET 11 OF 16

FILE LOCATION: C:\Users\Administrator\Desktop\AYAN\INST INSLL\17A14-DWG-I-0022-R-0-SHT-15-20 (DIA SEAL).dwg
PLOT DATE: 16 August 2018, 12:23 PM

PRESSURE TRANSMITTER
MOUNTED ABOVE SOURCE POINT



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
8a	1	REDUCER 1" NB X 3/4" NB–SW
25	1	EQUAL TEE, 3/4" SW
25a	1	UNEQUAL TEE, 3/4" SW (2) X 1/2" NPT (F)
40	1	PLUG, 3/4" NPT (M)
40a	1	NIPPLE, 3/4" SW X 3/4" NPT (F), 150 MM
45	3 M	TUBE, 1/2" OD
50	1	FOUR WAY VALVE SIZE :(2 X 3/4" NB–SW)X(2 X 1/2"NPTF)
60	1	QUICK DISCONNECTING FITTING SIZE:1/2"NPT(M)
64	4	MALE CONNECTOR, 1/2" NPT (M) X 1/2" OD
75	A/R	IMPULSE PIPE, 15 NB
93	1	3 VALVE MANIFOLD, 1/2" NPT(F)
155	1	BULK HEAD UNION, 3/4" SW

SERVICE : FLUE GAS.

FOR TENDER PURPOSE ONLY

REV	DATE	PREPD	CHKD	APPVD	NATURE OF REVISION & DESCRIPTION
0	10.08.2018	AAM	AKP	AT	FIRST ISSUE

REVISION STATUS

OWNER: NLC TAMILNADU POWER LIMITED

PROJECT: 2x500 MW THERMAL POWER PLANT AT TUTICORIN

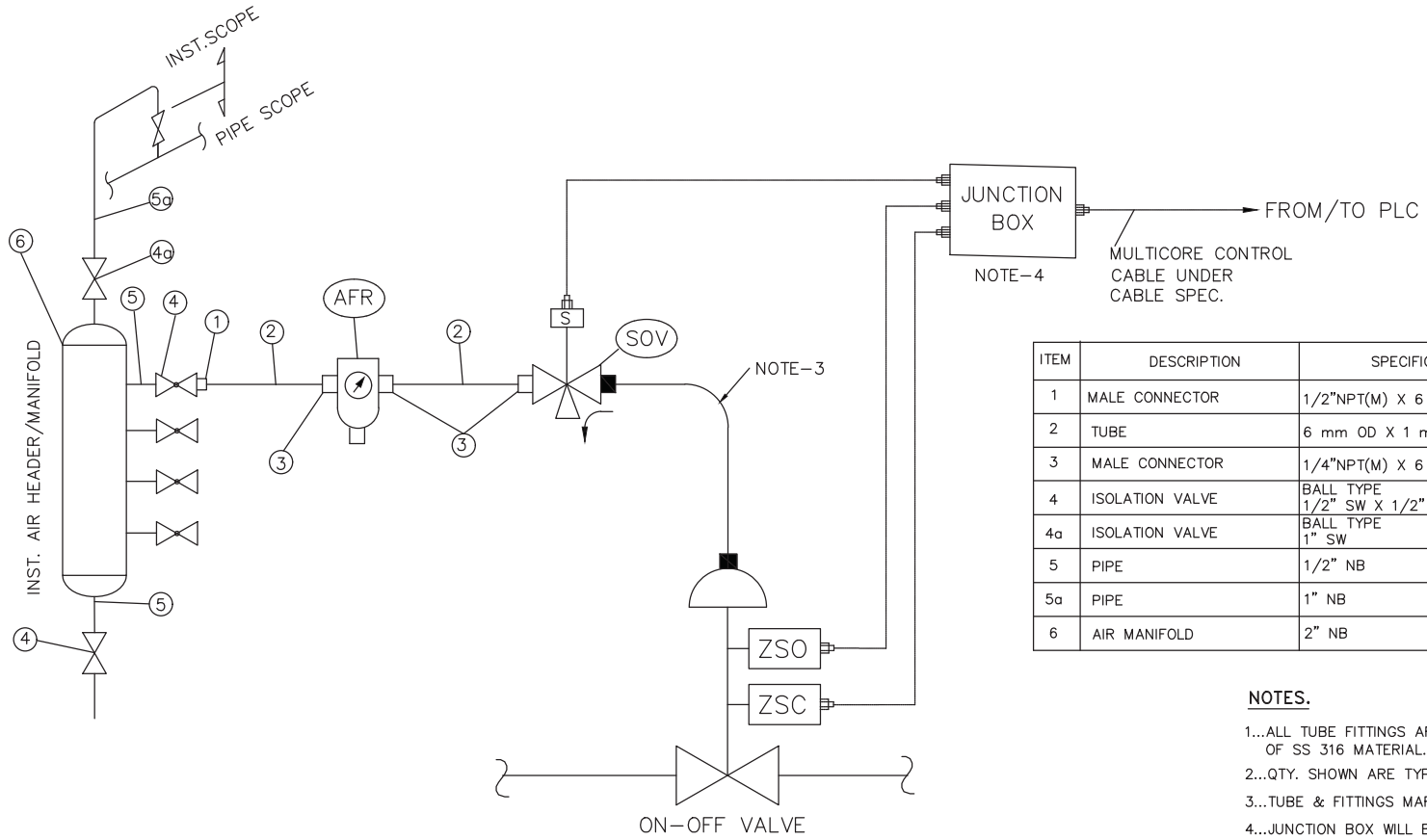
TITLE: TYPICAL INSTRUMENT INSTALLATION DIAGRAM

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	AAM	JOB NO.	17A14
CHECKED	AKP	SCALE	NIL
APPROVED	AT	DATE	10.08.2018
DWG. NO.	17A14–DWG–I–0022		REV 0

SHEET 14 OF 16

FILE LOCATION: C:\Users\Administrator\Desktop\AYAN\INST INSLL\17A14–DWG–I–0022–R–0–SHT–18–20 (PT–FLUE).dwg
PLOT DATE: 16 August 2018, 12:27 PM



PNEUMATIC SOV HOOK UP SCHEME

ITEM	DESCRIPTION	SPECIFICATION	QTY.	REMARKS
1	MALE CONNECTOR	1/2"NPT(M) X 6 mm OD	1	
2	TUBE	6 mm OD X 1 mm THK.	10 MTRS.	
3	MALE CONNECTOR	1/4"NPT(M) X 6 mm OD	3	
4	ISOLATION VALVE	BALL TYPE 1/2" SW X 1/2" NPT(F)	2	
4a	ISOLATION VALVE	BALL TYPE 1" SW	1	
5	PIPE	1/2" NB	A/R	
5a	PIPE	1" NB	A/R	
6	AIR MANIFOLD	2" NB	1	

NOTES.

1...ALL TUBE FITTINGS ARE OF DOUBLE COMPRESSION TYPE AND OF SS 316 MATERIAL.

2...QTY. SHOWN ARE TYPICAL FOR ONE INSTALLATION ONLY.

3...TUBE & FITTINGS MARKED ■ ARE INTEGRAL TO THE VALVE.

4...JUNCTION BOX WILL BE INTEGRAL TO ACTUATOR.

5...ISOLATION VALVE SHALL BE INSTALLED CLOSE TO THE VALVE ASSEMBLY.

FOR TENDER PURPOSE ONLY

REV	DATE	PREPD	CHKD	APPVD	NATURE OF REVISION & DESCRIPTION
0	10.08.2018	AAM	AKP	AT	FIRST ISSUE

REVISION STATUS

OWNER: NLC TAMILNADU POWER LIMITED

PROJECT: 2x500 MW THERMAL POWER PLANT AT TUTICORIN

TITLE: TYPICAL INSTRUMENT INSTALLATION DIAGRAM

DEVELOPMENT CONSULTANTS PVT LTD.
CONSULTING ENGINEERS
KOLKATA • MUMBAI • CHENNAI • NEW DELHI

PREPARED	AAM	JOB NO.	17A14
CHECKED	AKP	SCALE	NIL
APPROVED	AT	DATE	10.08.2018
DWG. NO.	17A14-DWG-I-0022		REV 0
			SHEET 16 OF 16

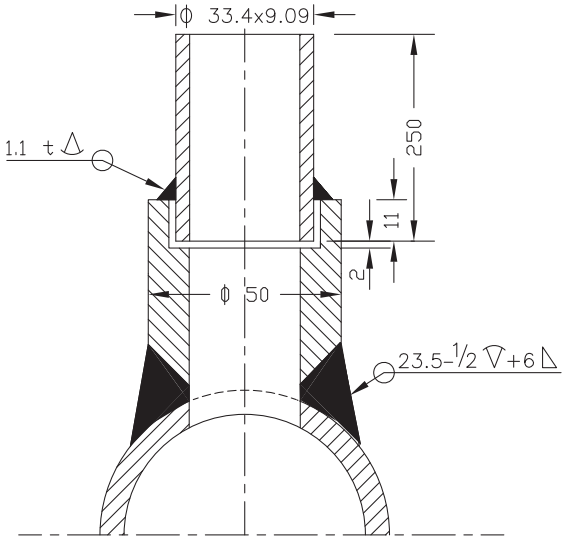
FILE LOCATION: C:\Users\Administrator\Desktop\AYAN\INST INSLL\17A14-DWG-I-0022-R-0-SHT-20-20 (SOV).dwg
PLOT DATE: 16 August 2018, 12:29 PM

INSTRUMENT STUB DETAILS

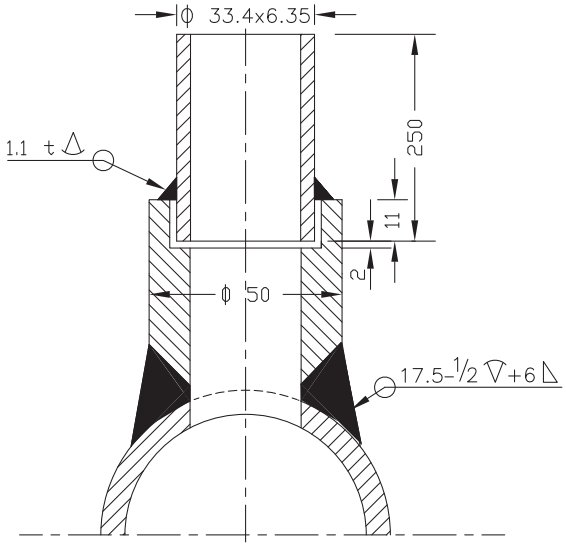
This document is the property of NATIONAL THERMAL POWER CORPORATION LTD.
No part of this document will be reproduced by any means without the written permission.

PRESSURE MEASUREMENT

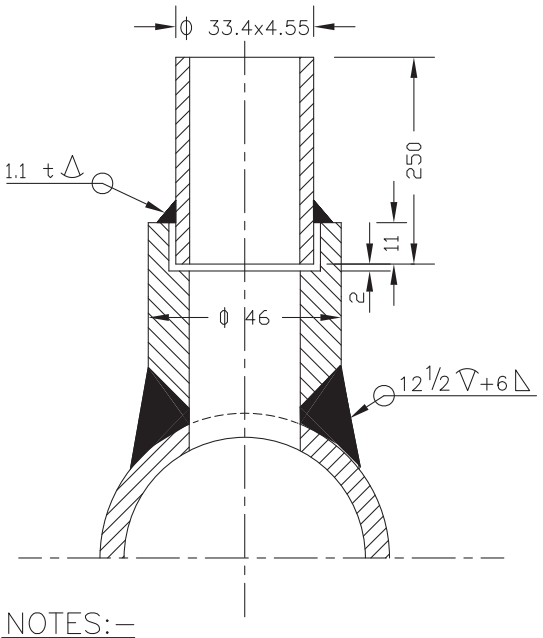
(SYSTEM PR.>40Kg/Sq Cm CL 9000)



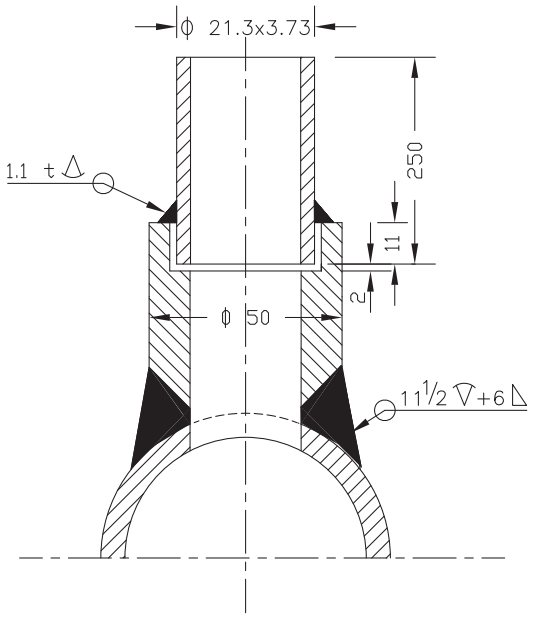
(SYSTEM PR.>40Kg/Sq Cm CL 6000)



(SYSTEM PR. <40Kg/Sq cm Nb 25 CL 3000)



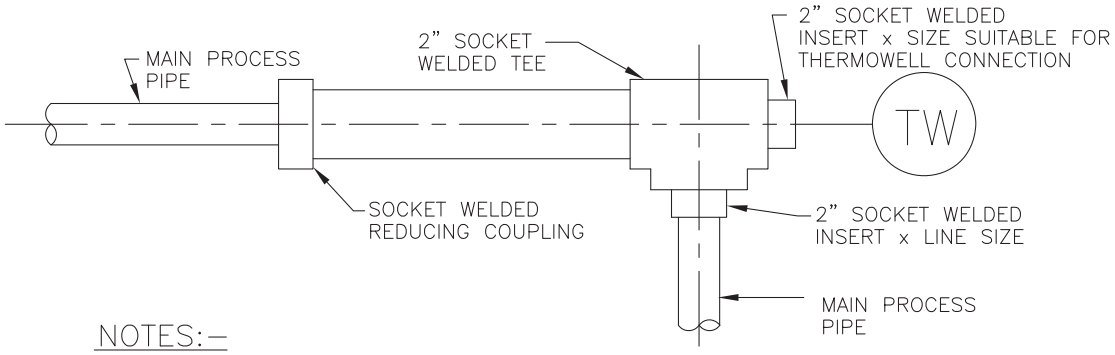
(SYSTEM PR. <40Kg/Sq cm Nb 15 CL 3000)



NOTES:–

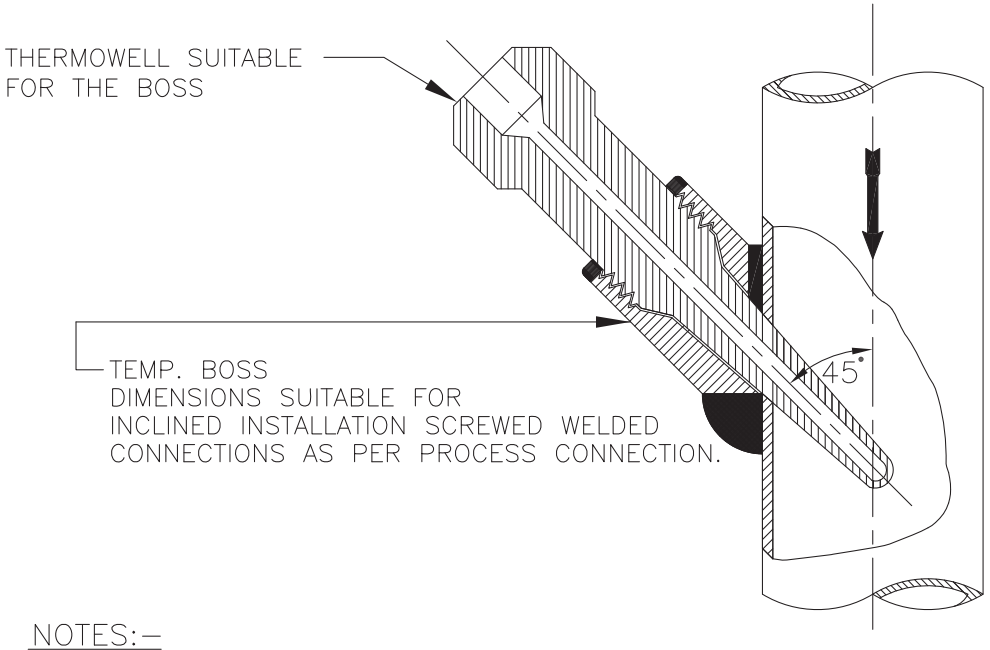
1. MATERIAL OF THE BOSS AND NIPPLE SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED AND CONFIRM TO ANSI B 16.11.
2. THE LENGTH OF THE NIPPLE SHOULD BE 250mm.
3. THE OTHER END OF THE NIPPLE SHALL BE SOCKET WELDED WITH 1" GLOBE VALVE OF MATERIAL AS PER ANSI B 16.1.
4. TWO ISOLATED VALVES ARE TO BE USED FOR PRESSURE = >40 Kg/Cm2.
5. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY (1/64" RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES.
6. ORIENTATION OF TAP WILL BE VARY WITH TYPE OF PROCESS FLUID AND NATURE OF RUN OF THE PIPE.
7. ACTIVITIES TO BE COMPLETED AT THE SHOP, WELD THE COUPLING (OR BOSS) ON THE PIPE AND DRILL PRESSURE CONNECTION HOLE (SAME AS I D OF NIPPLE) IN THE PIPE IN ALLIGNMENT WITH HOLE IN THE COUPLING.
8. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE STATED.

FOR TENDER PURPOSE ONLY



NOTES:–

1. THIS TYPE OF THERMOWELL INSTALLATION IS SUITABLE FOR THE PROCESS PIPE OF 2" NPS AND SMALLER.
2. FOR STEAM SERVICE THIS TYPE OF THERMOWELL INSTALLATION 90° BEND MAY BE USED ONLY IN VERTICAL PLANE.
3. THE LENGTH OF THE LARGER PIPE SECTION SHALL BE MINIMUM 150mm (IT MUST BE GREATER THAN THERMOWELL LENGTH).

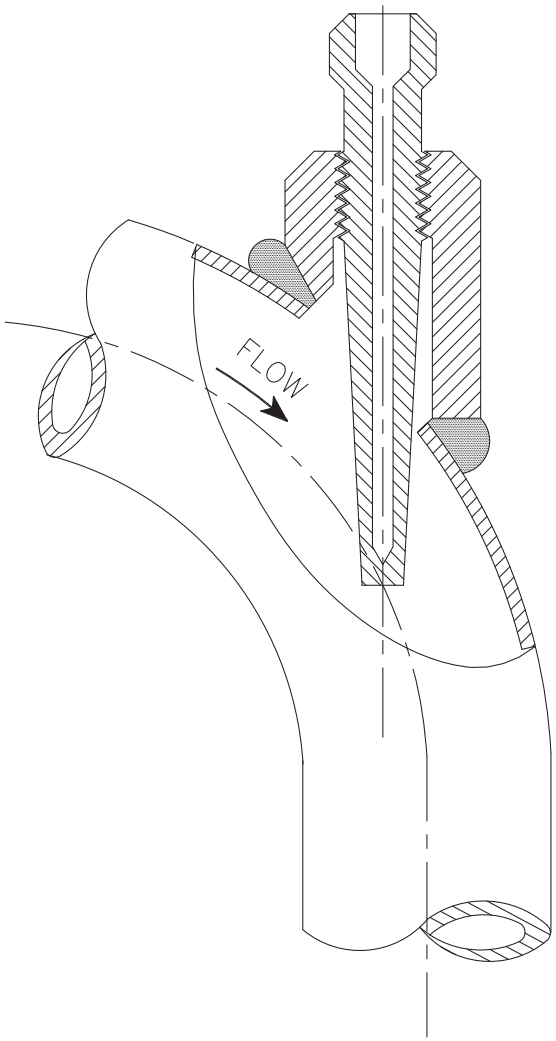


NOTES:–

1. INCLINED INSTALLATION OF THERMOWELL SHALL BE APPLICABLE FOR 4" AND SMALLER LINE SIZE BUT LIMITED TO MIN. 3" LINE SIZE.
2. FOR 2" AND SMALLER LINE SIZE NECESSARY EXPANDER OF MIN. 3" SIZE OF MAIN PIPING SPECIFICATION SHALL BE USED.
3. THIS TYPE OF INSTALLATION IS APPLICABLE FOR HORIZONTAL AND VERTICAL PIPE SECTION.
4. FOR STEAM SERVICES EXPANDER SECTION MAY BE USED ONLY IN VERTICAL RUN.
5. THE EXPANDER SECTION SHALL BE OF ADEQUATE LENGTH (ATLEAST 3–4 TIMES DIA OF THE MAIN PROCESS PIPE AT BOTH SIDE OF THE INSTALLED THERMOWELL).

This document is the property of NATIONAL THERMAL POWER CORPORATION LTD.
No part of this document will be reproduced by any means without the written permission.

This document is the property of NATIONAL THERMAL POWER CORPORATION LTD.
No part of this document will be reproduced by any means without the written permission.



NOTES:–

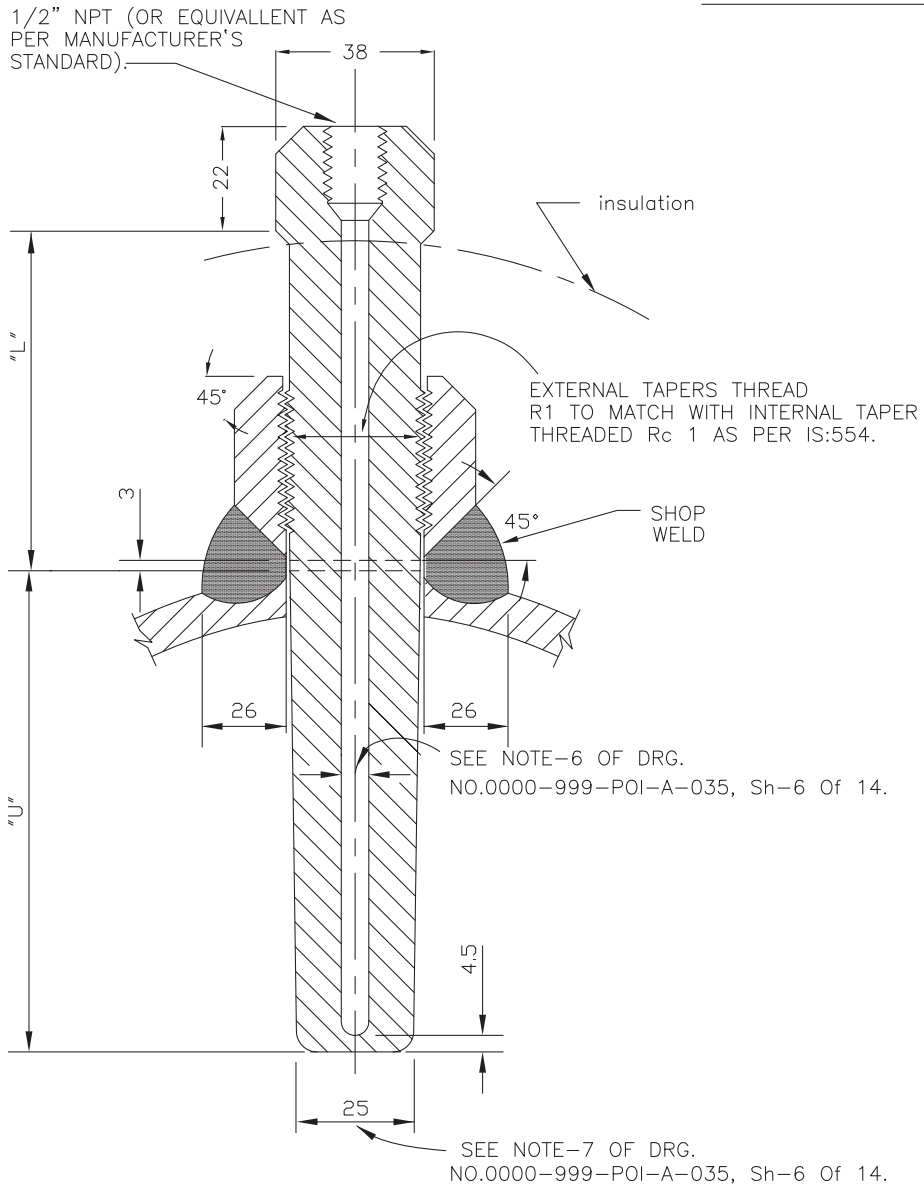
1. FLOW INSTALLATION OF THERMOWELL SHALL BE APPLICABLE FOR 4" AND SMALLER LINE SIZE BUT LIMITED TO MINIMUM 3" LINE SIZE.

2. FOR 2" AND SMALLER LINE SIZE NECESSARY EXPANDER OF ELBOW FORM (AS SHOWN) OF MINIMUM 3" SIZE SHALL BE USED.

3. ELBOW EXPANDER SECTION IN HORIZONTAL PLANE MAY BE USED FOR LIQUID SERVICES. ONLY STEAM SERVICES EXPANDER SECTION MAY BE USED IN VERTICAL PLAN.

This document is the property of NATIONAL THERMAL POWER CORPORATION LTD.
No part of this document will be reproduced by any means without the written permission.

TEMP. MEASUREMENT

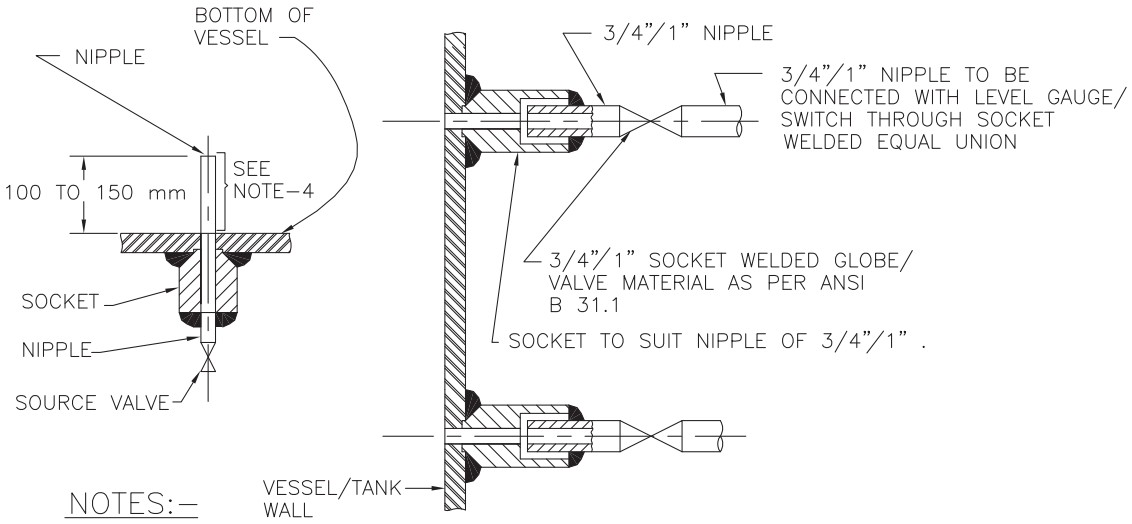


NOTES:-

1. THIS TYPE OF TEMPERATURE BOSS IS APPLICABLE FOR THE PROCESS PRESSURE/TEMPERATURE BELOW 40 Kg/Cm2(g)/400°C
2. FOR PRESSURE TIGHT JOINTS THE BOSS SHOULD HAVE INTERNAL TAPERED PIPE THREAD Rc 1 AS PER IS:554. THE LENGTH OF THREAD ENGAGEMENT SHOULD BE AS PER ABOVE STANDARD.
3. PIPES HAVING PROBABILITY OF PROLONGED VIBRATION SEAL WELDING MAY BE DONE ALL AROUND AFTER TIGHTENING THERMOWELL WITHIN THE BOSS.
4. SEE NOTES-2 TO 14 OF DRG. NO. 0000-999-POI-A-035, Sh-6 Of 14.

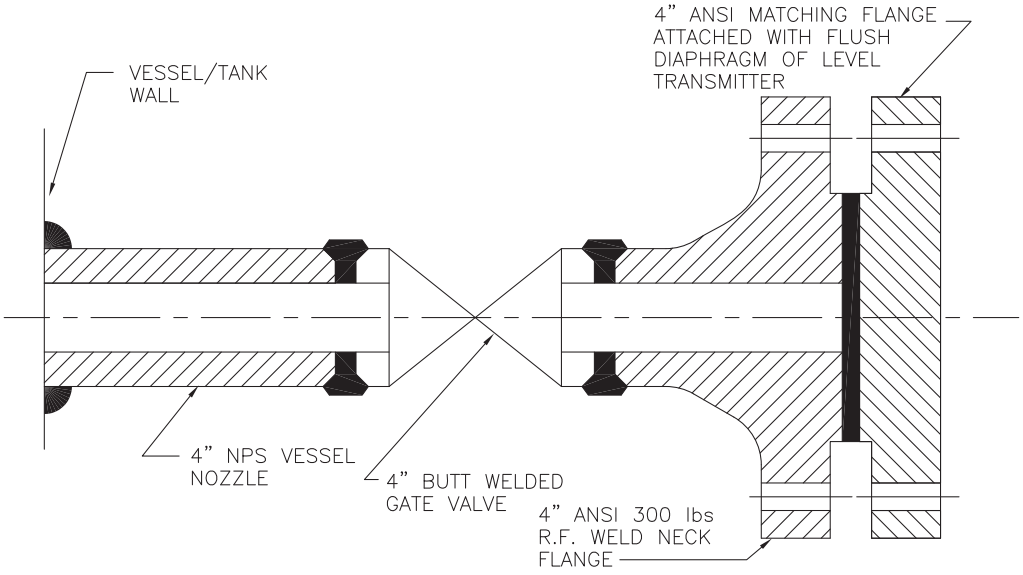
This document is the property of NATIONAL THERMAL POWER CORPORATION LTD.
No part of this document will be reproduced by any means without the written permission.

LEVEL MEASUREMENT



NOTES:-

1. THIS TYPE OF PROCESS CONNECTION SHALL BE USED FOR LEVEL GAUGE AND EXTERNAL CAGE TYPE FLOAT OR DISPLACER OPERATED LEVEL SWITCH.
2. FOR GAUGES 3/4" NIPPLE ALONG WITH 3/4" SW SOURCE VALVE AND FOR SWITCHES 1" NIPPLE ALONG WITH 1" SW SOURCE VALVE SHALL BE PROVIDED AS PROCESS CONNECTION.
3. SOURCE CONNECTION ON VESSEL SHOULD NOT BE LOCATED AT PLACES SUBJECTED TO INTERFACE AND TURBULENCE FROM INLETS AND OUTLETS.
4. IF LOWER CONNECTION IS TAKEN FROM BOTTOM OF THE VESSEL THEN THE NIPPLE MUST BE 100 mm TO 150 mm ABOVE THE BOTTOM OF THE VESSEL.



NOTES:-

1. THIS TYPE OF PROCESS CONNECTION SHALL BE PROVIDED FOR TANK LEVEL MEASUREMENT OF VISCOUS OR CORROSIVE LIQUID USING FLUSH DIAPHRAGM/WAFER TYPE LEVEL TRANSMITTER.
2. WELDING OF MATCHING FLANGE TO GATE VALVE SHALL BE DONE BY BIDDER.

VOLUME: II-F

SECTION-III

ELECTRIC MOTOR ACTUATORS

1.00.00 SCOPE

1.01.00 This Section covers the general requirements of Electric Motor Actuators for valves, dampers and gates.

1.02.00 All electric motor actuators shall be furnished in accordance with this general specification and the accompanying driven equipment specification.

2.00.00 CODES & STANDARDS

2.01.00 All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS), IEC, ANSI & NEMA Standards except when otherwise stated herein or in the driven equipment specification.

2.02.00 Equipment and material conforming to any other standards, which ensure equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.

2.03.00 The electrical installation shall meet the requirements of Indian Electricity Rules as amended up-to-date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

3.00.00 SERVICE CONDITIONS

3.01.00 The actuator shall be suitable for operation in hot, humid and tropical atmosphere, highly polluted at places with dust and/or fly ash.

3.02.00 Unless otherwise noted, electrical equipment / system design shall be based on the service conditions and auxiliary power supply given in the annexure to this specification.

4.00.00 RATING

4.01.00 For isolating service, the actuator shall be rated for three successive open-close operation of the valve / damper or minimum S2-15 minutes.

4.02.00 For regulating service, the actuator shall be suitably time-rated for the duty cycle involved with necessary number of starts per hour, but in no case less than 150 starts per hour.

4.03.00 A safety factor of 300% shall be used for sizing of operators for valves and dampers and all drive system components. Operators shall be capable of transmitting design torque (including safety factor) within the torque range specified by the actuator manufacturer. The strength of the operator mounting, based on the required operator torque, shall not exceed 30% of the yield strength in any mode of stress.

5.00.00 PERFORMANCE

The actuator shall meet the following performance requirements:

5.01.00 Open and close the valve completely and make leak-tight valve closure without jamming.

5.02.00 Attain full speed operation before valve load is encountered and impart an unseating blow to start the valve in motion (hammer blow effect).

5.03.00 Operate the valve stem at standard stem speed and shall function against design differential pressure across the valve seat.

5.04.00 The motor reduction gearing shall be sufficient to lock the shaft when the motor is de-energised and prevent drift from torque switch spring pressure.

5.05.00 The entire mechanism shall withstand shock resulting from closing with improper setting of limit switches or from lodging of foreign matter under the valve seat.

6.00.00 SPECIFIC REQUIREMENT

6.01.00 Construction

6.01.01 The actuator shall essentially comprise the drive motor, torque / limit switches, gear train, clutch, hand wheel, position indicator / transmitter, in-built thermostat for over load protection, single phase preventer protection, space heater and internal wiring. Actuator shall be integral type. Two sets of torque and limit switches shall be provided to use in PLC logic and electrical logic/ interlock independently.

6.01.02 The actuator enclosure shall be totally enclosed IPW-67, dust tight, weather-proof suitable for outdoor use without necessity of any canopy.

6.01.03 All electrical equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth.

6.01.04 The actuator shall be designed for mounting in any position without any lubricant leakage or operating difficulty.

6.02.00 Motor

6.02.01 The drive motor shall be three phase, 415V, 50Hz squirrel cage, induction machine with minimum Class F insulated with three thermoswitches embedded, one in each winding of the motor for protection against burnout and IPW-67 enclosure, designed for high torque and reversing service.

6.02.02 The motor shall be designed for full voltage direct on-line start, with starting current limited to 6 times full-load current.

6.02.03 The motor shall be capable of starting at 85 percent of rated voltage and running at 80 percent of rated voltage at rated torque and 85 percent rated voltage at 33 percent excess rated torque for a period of 5 minutes each.

6.02.04 Earthing terminals shall be provided on either side of the motor.

6.03.00 **Limit Switches**

Each actuator shall be provided with following limit switches: -

6.03.01 2 torque limit switches, one for each direction of travel, self-locking, adjustable torque type.

6.03.02 4 end-of-travel limit switches, two for each direction of travel.

6.03.03 2 position limit switches, one for each direction of travel, each adjustable at any position from fully open to fully closed positions of the valve/damper.

6.03.04 Each limit switch shall have 2 NO + 2 NC potential free contacts. Contact rating shall be 5A at 240V A.C. or 0.5A at 220V D.C.

6.03.05 Limit switches shall be drum type and adjustable to open, close and intermediate position.

6.03.06 The motor actuators shall have 2 nos. potentiometric type transmitters.

6.04.00 **Hand Wheel**

Each actuator shall be provided with a hand wheel for emergency manual operation. The hand wheel shall declutch automatically when the motor is energized.

6.05.00 **Position Indicator/Transmitter**

The actuator shall have:

6.05.01 One (1) built-in local position indicator for 0-100% travel

6.05.02 One (1) position transmitter, potentiometer type, for remote indicator

6.06.00 **Space Heater**

A space heater shall be included in the limit switch compartment suitable for 240V, 1 phase, 50 Hz supply.

6.07.00 **Wiring**

All electrical devices shall be wired up to and terminated in a terminal box. The internal wiring shall be of sufficient size for the power rating involved but in no case less than 1.5 Sq.mm copper. All wiring shall be identified at both ends with ferrules.

6.08.00 **Terminal Box**

The terminal box shall be weather proof, with removable front cover and cable glands for cable connection. The terminal shall be suitable for connection of 2x2.5 Sq.mm copper conductor.

6.09.00 **Interfaces**:

i) Open/Close command termination logic with position & torque Limit Switches, positioner circuit shall be suitably built in the PCB inside the actuator.

ii) For Binary Drive (both ON-OFF and Inching type) :- Open/Close command & status thereof and disturbance monitoring signal (common contact for Overload, Thermostat, control supply failure, L/R selector switch at local & other protections operated) shall be provided.

iii) Interface with the control system shall be through hardwired signal only. Inter posing relays provided in the actuator shall be energized to initiate opening and closing, by 24V DC signal from the external control system.

iv) For Modulating drive: - the command to actuator shall be in form of 4-20mA signal. The necessary positioning circuit and motor protection shall be provided.

v) Open/close command termination logic shall be suitably built inside actuator.

7.00.00 ACCESSORIES

As required for the driven equipment, the actuator shall be furnished with starting equipment mounted on the actuator. This shall include:

7.01.00 One (1) triple pole breaker

7.02.00 One (1) reversing starter, with mechanically interlocked contactors, 3 thermal overload relays, 2 N.O. + 2 N.C. auxiliary contacts for each contactor.

7.03.00 One (1) remote-local selector switch

7.04.00 CLOSE-STOP-OPEN oil tight push buttons with indication lights

7.05.00 415/110V control transformer with primary & secondary fuses.

8.00.00 TEST

8.01.00 The actuator and all components thereof shall be subject to tests as per relevant standards. In addition, if any special test is called for in equipment specification, the same shall be performed.

8.02.00 Following routine test for integral starters shall be conducted as per IEC/IC standard. (a) Meggar Test, (b) Continuity test, (c) Operational test. Test certificates duly signed by inspecting agency shall be furnished.

8.03.00 The actuator shall be type tested as per IEC/National Standard, by international/national recognized test house. The test certificates issued by this house shall be furnished. Otherwise, the equipment shall have to be type tested, free of charge, to prove the design.

9.00.00 DRAWINGS, DATA & MANUALS

9.01.00 **To be Submitted with Bid**

Data sheet for each type of actuator shall be furnished along with internal wiring diagram, suggested control schematic and torque limit switch contact development and manufacturer's catalogues.

9.02.00 **To be Submitted after Award of Contract**

a) Actuator Data Sheet

b) Internal wiring diagram and suggested control schematic

c) Torque switch and limit switch contact development

d) Manufacturer's Catalogue

e) Instruction manual indicating clearly the installation methods, check ups and tests to be carried out before commissioning of the equipment.

9.03.00 The Bidder may note that the drawings, data and manuals listed herein are minimum requirements only. The Bidder shall ensure that all other necessary write-ups, curves and information required to fully describe the equipment are submitted with his bid.

LIST OF DELIVERABLES OF PEM C&I FOR WWTS			
SNO	Drawing No.	Drawing /Document Title	Category
1	PE-V0-483-145-I901	Control write up of the system	A
2	PE-V0-483-145-I902	Control scheme (to be implemented in DCS)	A
3	PE-V0-483-145-I903	HMI /Plant Schematics	A
4	PE-V0-483-145-I904	Instrument schedule with set points	A
5	PE-V0-483-145-I905	I/O list (Analog & Binary)	A
6	PE-V0-483-145-I906	Drive list (Analog & Binary)	A
7	PE-V0-483-145-I907	Field JB/LIE/LIR terminations	A
8	PE-V0-483-145-I908	Datasheet for instruments, JB etc	A
9	PE-V0-483-145-I909	Quality plan	A
10	PE-V0-483-145-I910	Cable schedule & interconnection	A
11	PE-V0-483-145-I911	Hook up drawing and drawings for open rack and closed racks	A
12	PE-V0-483-145-I912	Annunciation and SOE list	A

KKS PHILOSOPHY

KKS NUMBERING PHILOSOPHY

For identifying (tagging) an instrument / equipment in Power plant KKS numbering scheme is used. The purpose is to assign a unique number to every equipment in the power plant. For C&I equipment unique number are to be provided up to the signal level so that a unique number Input / Output exist in DCS for every signal.

Normally KKS number is a 10 digit alpha-numeric code and is typically split into the following:

X	X	X	A	A	Y	Y	B	B	B

First three digits indicate the Sub-System. The Code for the major system are given as per **Annexure-**1.

Fourth and Fifth digits are the **Numerical Keys at System Code Level** and used to distinguish between main systems having same Alpha Codes.

Sixth and Seventh digits are the **Equipment / Apparatus / Measuring Circuit Code**. The code of various Equipment / Apparatus / Measuring Circuit is shown in **Annexure-2**

Eight, Nine and tenth digits are the **Numerical Keys at Equipment / Apparatus / Measuring Circuit Code** and used to distinguish between various instruments in the same sub-group. Numerical keys at System / Equipment / Apparatus / Measuring Circuit is shown in **Annexure-3**.

ANNEXURE-1

List of System / Sub-System Codes used in Power Plant:

ANNEXURE-2

Standard Equipment Codes:

AA	Valves including drives, also hand operated
AB	Seclusions, Lock, Gates, Doors
AC	Heat Exchanger
AE	Turning, Driving, Lifting equipment
AF	Continuous conveyors, Feeders
AG	Generator Units
AH	Heating and Cooling Units
AK	Pressing and Packaging equipment
AM	Mixer, Stirrer
AN	Blower, Air Pumps / Fans, Compressor Units
AP	Pump Units
AT	Purification, Drying, Filter
AV	Combustion Equipment e.g. grates

Standard Apparatus Codes:

BB	Vessels and Tank
BF	Foundation
BG	Boiler Heating Surfaces
BN	Injector, Ejector
BP	Flow and throughput limitation equipment (Orifice)
BQ	Holders, Carrying Equipment, Support
BR	Piping, Ducts, Chutes, Compensator
BS	Sound Absorber
BU	Insulations, Sheatings

Standard Measuring Circuits Codes:

CD	Density
CE	Electrical Quantities
CF	Flow, throughput
CG	Distance, Length, Position
CK	Time
CL	Level

CM	Humidity
CQ	Analysis (SWAS)
CS	Speed, Velocity, Frequency
CT	Temperature
CY	Vibration, Expansion

ANNEXURE-3

Numerical Keys

A) Numerical Keys at System Code Level

i) Use 10, 20, 30... To distinguish between main systems having same Alpha Codes. Examples:

a) Main Steam (Left) and Main Steam (Right)

b) BFP – A/B/C

c) ID Fan – A/B, FD Fan A/B, AH – A/B

ii) For branch off from main system path having code say 10, keep the same alpha code and use 11, 12, 13 etc. Similarly for other branch off from main system path having code say 20, keep the same alpha code and use 21, 22, 23 etc and shall carry on further in the same way.

iii) If the branch off from main system / sub system path is used for some other system, where different alpha codes can be applied, then in that case the said branch line will be designated by the alpha codes of the system to which it is providing the input.

B) Numerical keys at Equipment Code level:

There are three numerical keys available for each type of equipment code. Following has been agreed upon considering present practice, better flexibility and ease in sorting.

i) Valves and Dampers --- *Equipment Code – AA*

		N1	N2 N3
Motorised *(on/off duty)*	-	*0*	*01 to 50*
Motorised (inching duty)	-	*0*	*51 to 99*
Pneumatic (Control)	-	*1*	*01 to 50*
Motorised (thyrestor Control)	-	*1*	*51 to 99*
Sol. Operated	-	2	01 to 99
(Open / Close duty (Valves, NRVs, Gate)			
Hydraulic	-	3	01 to 99

NRV (Without actuation)	-	4	01 to 99
Manual	-	5	01 to 99
Manual	-	6	01 to 99
Relief & Safety Valves	-	7	01 to 99
Reserve	-	8	01 to 99
Reserve	-	9	01 to 99

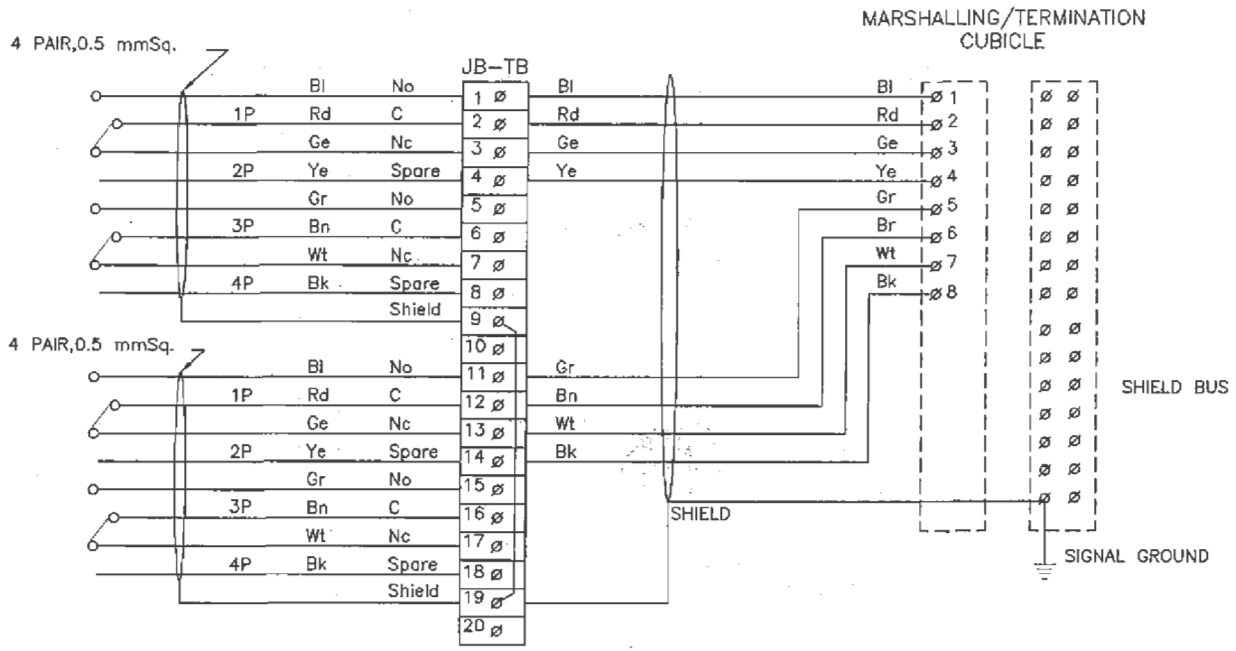
ii) Field Instruments

Field Transmitters & Analog Signals	-	0	01 to 99
Field Switches & Binary Signals	-	1	00 to 99
PG Test Point	-	4	00 to 99
Gauges	-	5	00 to 99
Automatic Turbine Tester (ATT)-HWR	-	2	00 to 99
(Reserved for protection Signals used by Hardwar)			

Example of Numerical Key Usage:

In line with the philosophy adopted for Valves / Dampers /instruments etc. pumps and fans in the main systems (having different system code) can be numbered as AP/N100 and as AP/N101, 102, ……. Where system code is same.

This document is the property of NATIONAL THERMAL POWER CORPORATION LTD.
No part of this document will be reproduced by any means without the written permission.



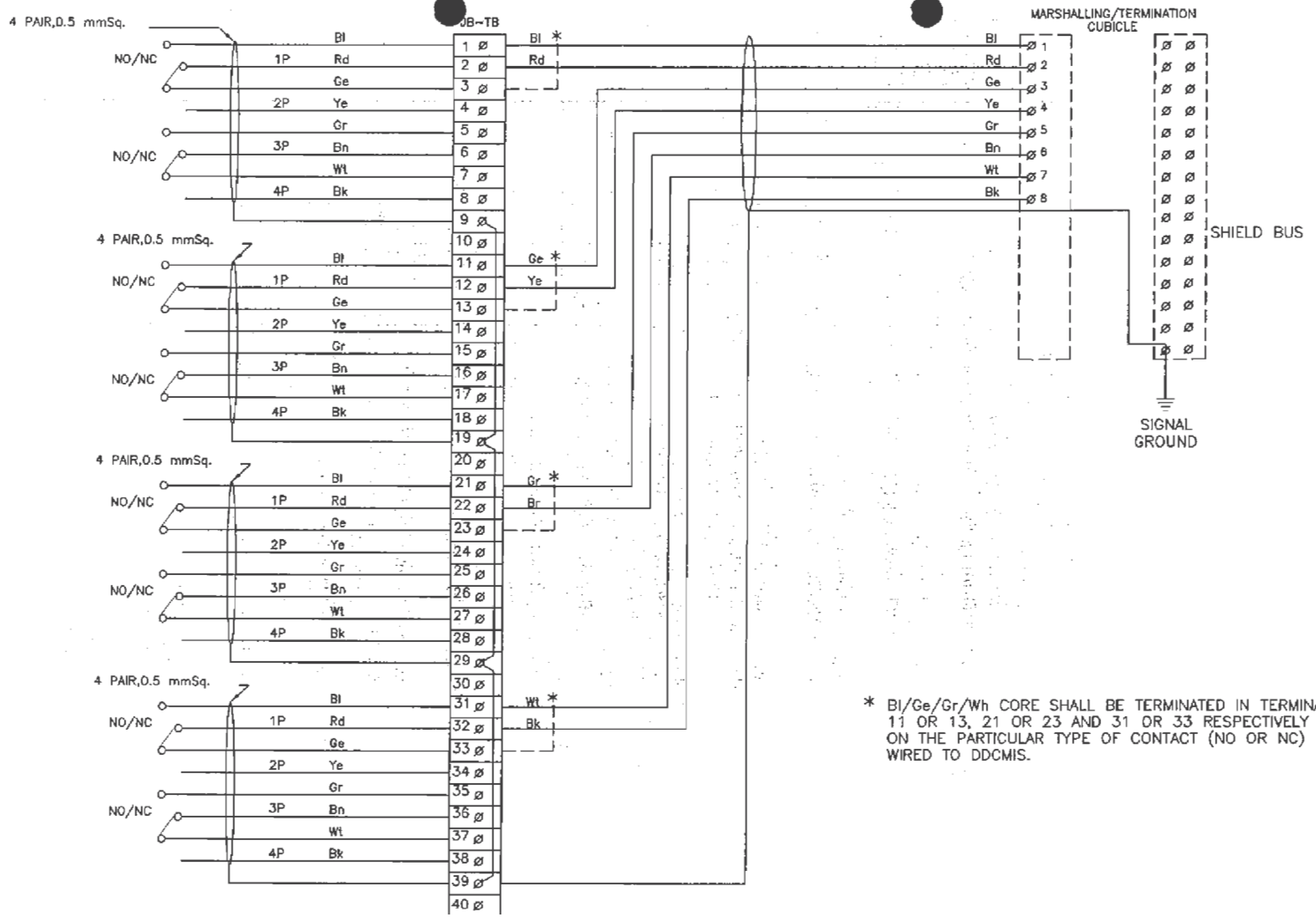
REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										29.04.06

CLEARED BY

TITLE: INTERFACING OF FIELD INSTRUMENTS/ SWGR SWITCH (COC) TERMINATION DETAILS

SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 01 OF 14	A

This document is the property of NATIONAL THERMAL POWER CORPORATION LTD.
No part of this document will be reproduced by any means without the written permission.



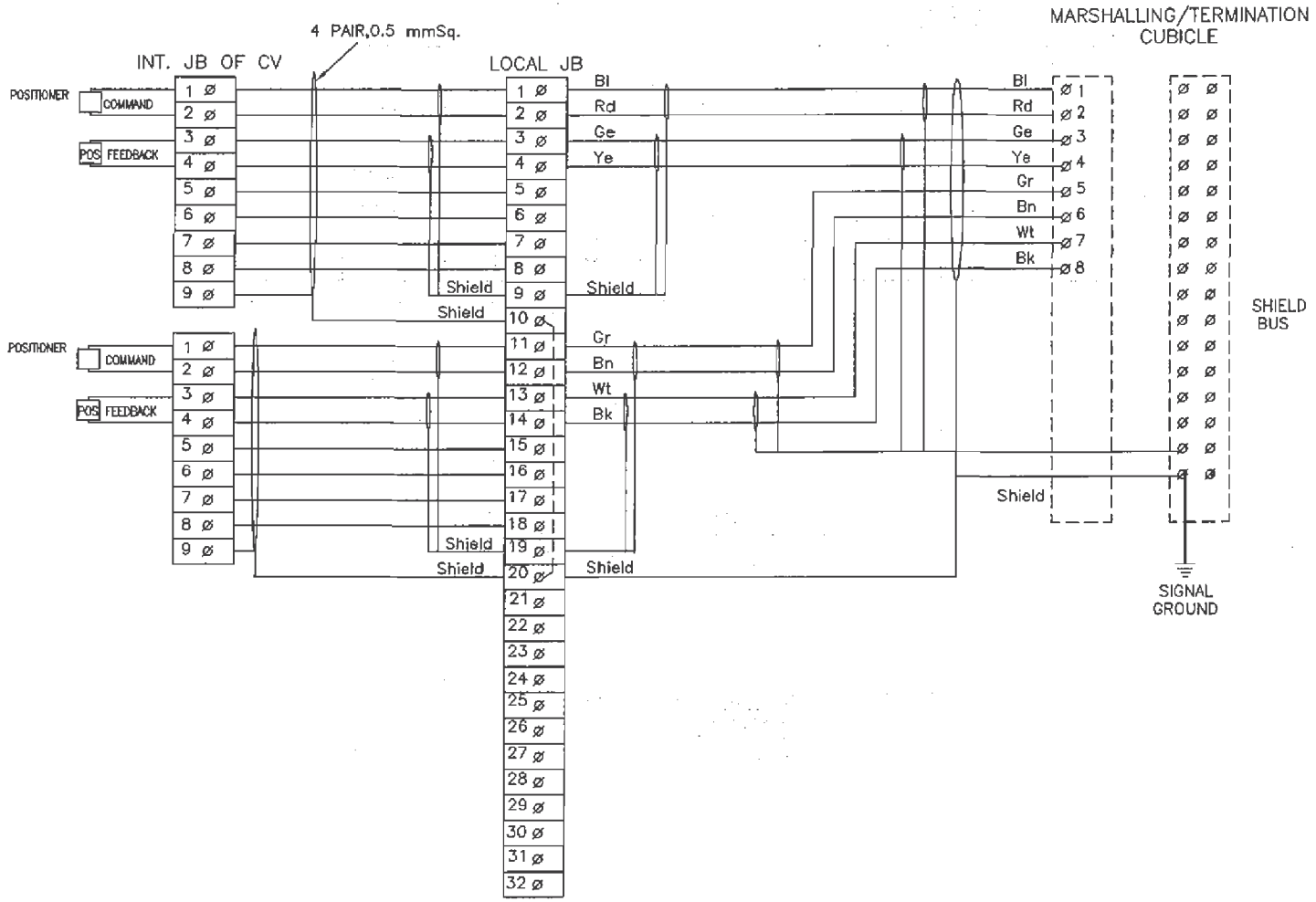
* Bl/Ge/Gr/Wh CORE SHALL BE TERMINATED IN TERMINAL 1 OR 3, 11 OR 13, 21 OR 23 AND 31 OR 33 RESPECTIVELY DEPENDING ON THE PARTICULAR TYPE OF CONTACT (NO OR NC) IS TO BE WIRED TO DDCMIS.

REV.NO.	DESCRIPTION	DRAWN	DESIGN	CHKD.	M	E	C	C&I	ARCH.	APPD	DATE
A	FIRST ISSUE										29.04.08

CLEARED BY.

TITLE	SIZE	SCALE	DRG. NO.	REV. NO.
INTERFACING OF FIELD INSTRUMENTS SWITCH TERMINATION DETAILS NO/NC	A3	NTS	0000-999-POI-A-065 SH 02 OF 14	A

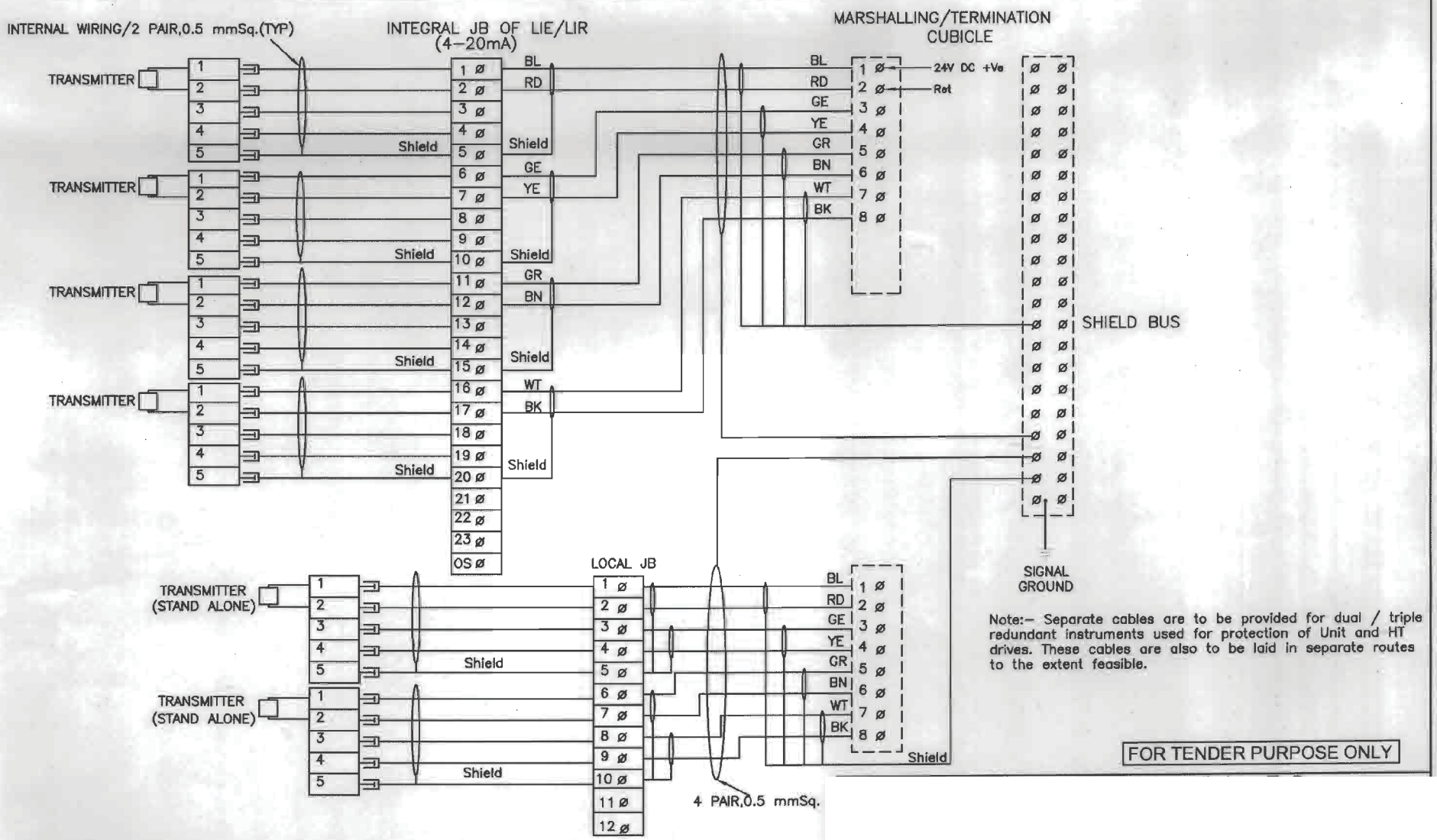
This document is the property of NATIONAL THERMAL POWER CORPORATION LTD.
No part of this document will be reproduced by any means without the written permission.



INTERFACING OF FIELD INSTRUMENTS
CONTROL VALVE

DRG. NO.	REV. NO.
0000-999-POI-A-065 SH 03 OF 14	A

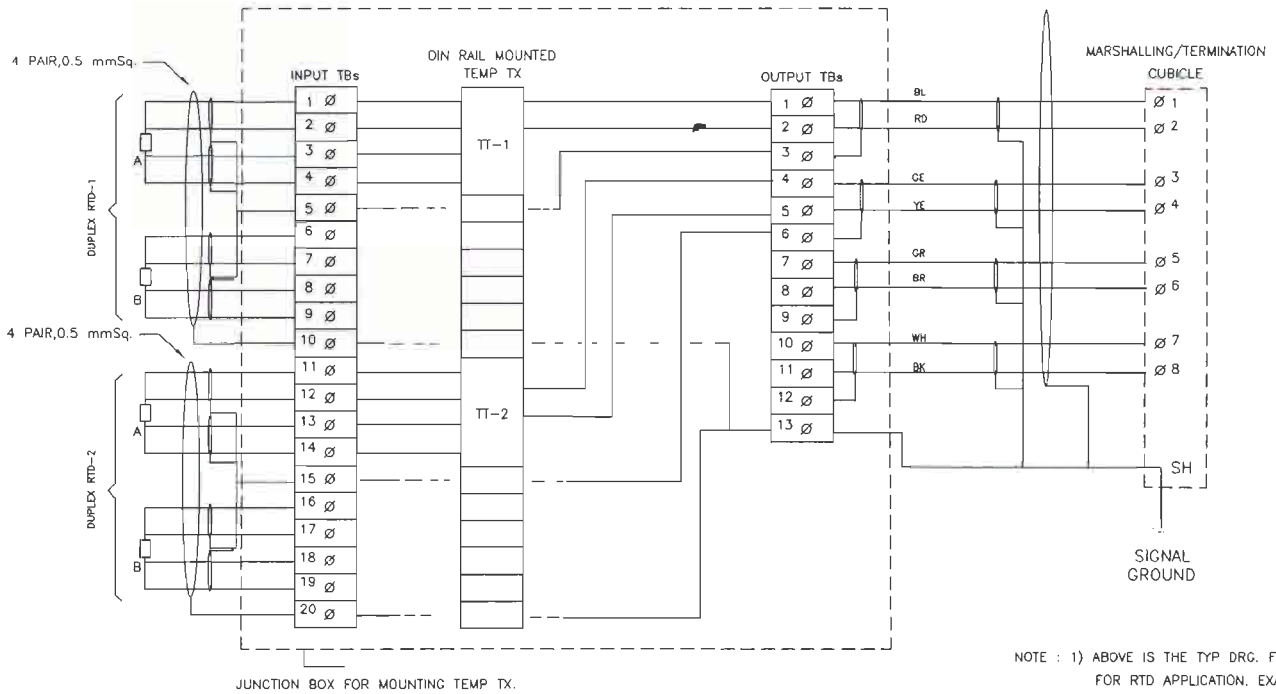
This document is the property of NATIONAL THERMAL POWER CORPORATION LTD.
No part of this document will be reproduced by any means without the written permission.



INTERFACING OF FIELD INSTRUMENTS
4-20mA

ALE TS	DRG. NO. 0000-999-POI-A-065 SH 04 OF 14	REV. NO. C

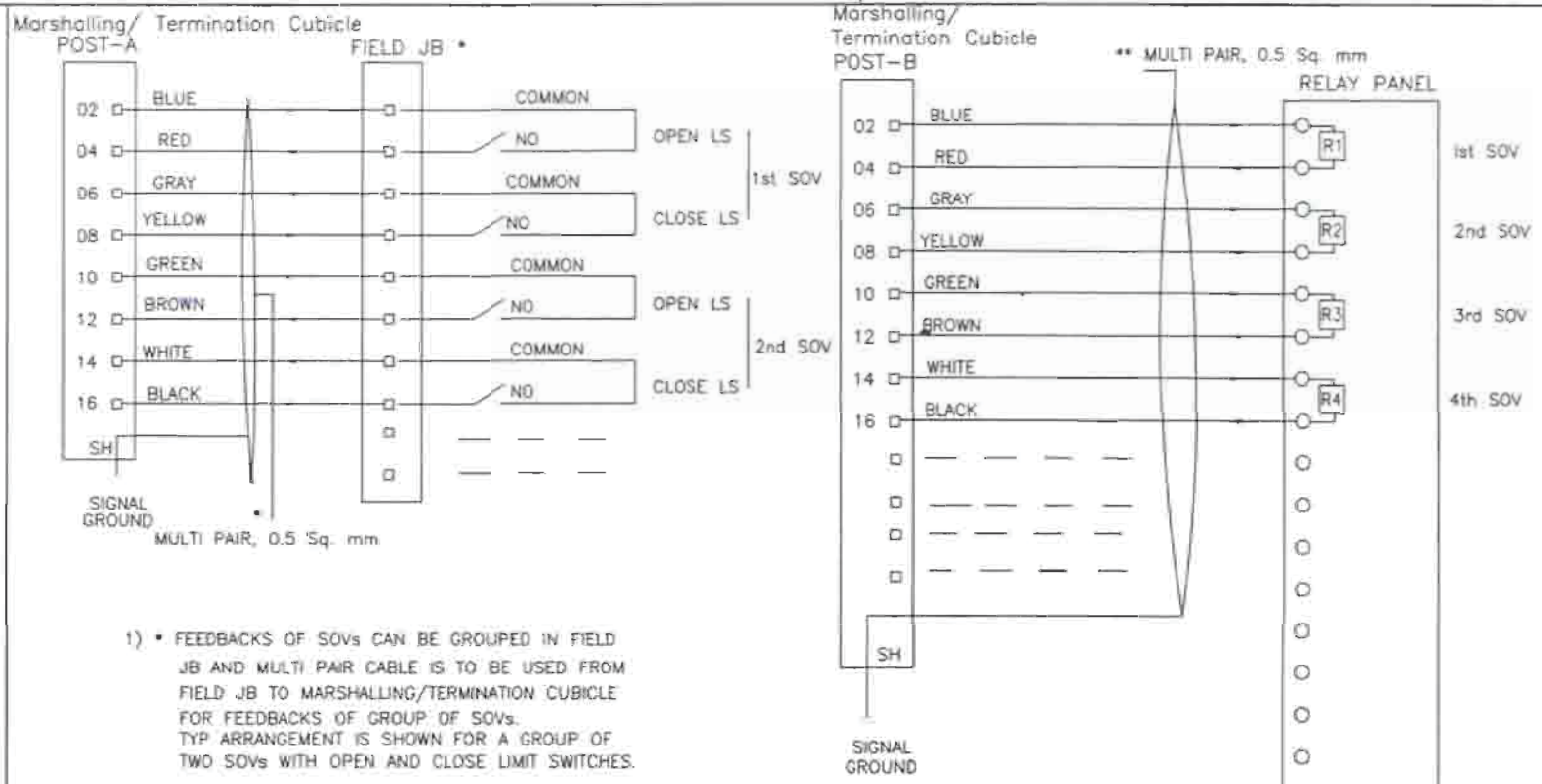
This document is the property of NATIONAL THERMAL POWER CORPORATION LTD.
No part of this document will be reproduced by any means without the written permission.



NOTE : 1) ABOVE IS THE TYP DRG. FOR DIN RAIL MOUNTED TEMP TRANSMITTERS FOR RTD APPLICATION. EXACT TYPE OF TEMP TRANSMITTER SHALL BE AS PER PART-A OF SPECIFICATION.
2) THE EXACT GROUPING OF TEMP TXs SHALL BE FINALISED DURING DETAILED ENGG. STAGE.

TITLE			
INTERFACING OF FIELD INSTRUMENTS TYPICAL RTD CONNECTION WITH TEMP TRANSMITTERS INJBs			
SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 06 OF 14	C

This document is the property of NATIONAL THERMAL POWER CORPORATION LTD.
No part of this document will be reproduced by any means without the written permission.

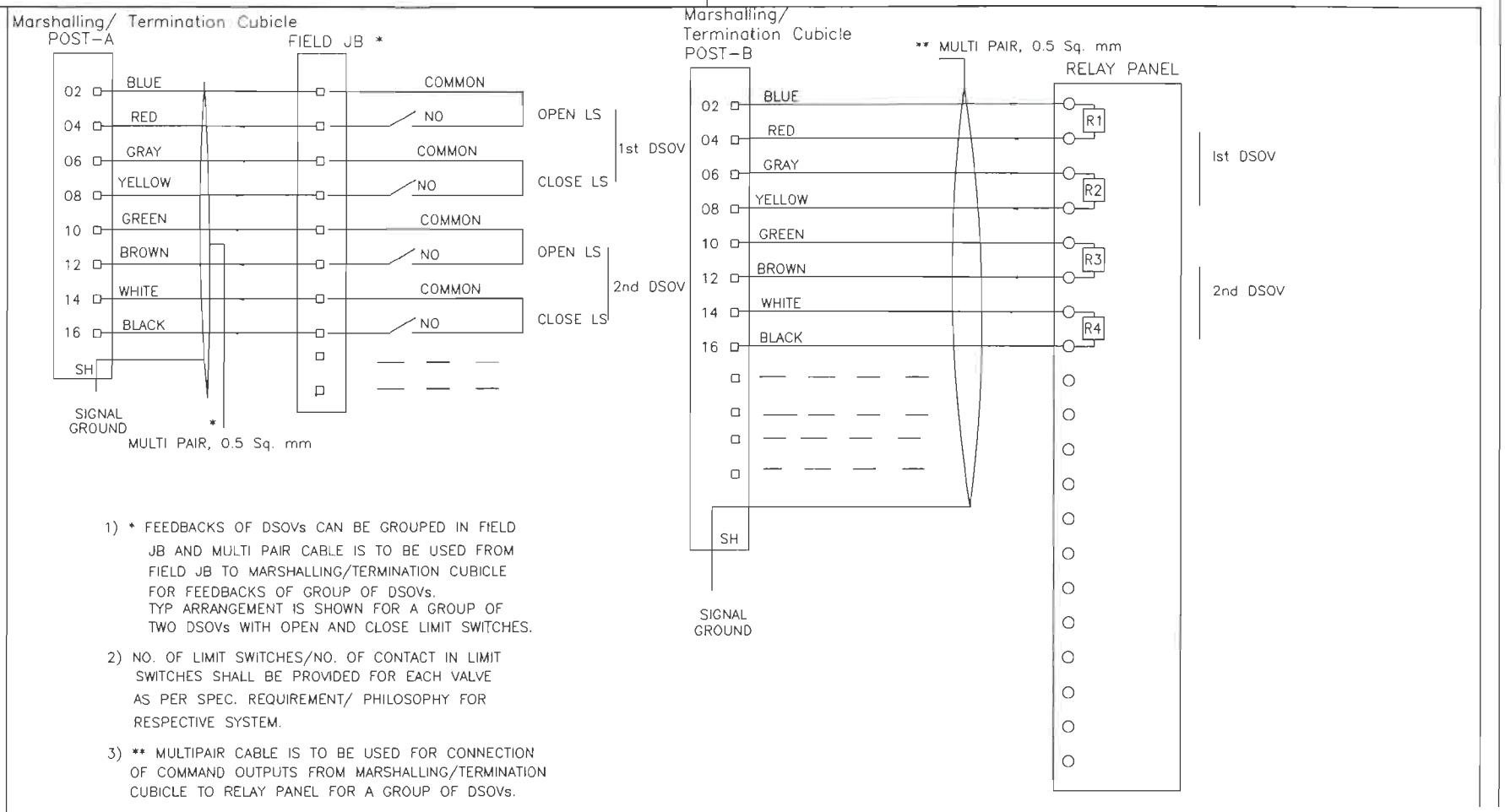


1) * FEEDBACKS OF SOVs CAN BE GROUPED IN FIELD JB AND MULTI PAIR CABLE IS TO BE USED FROM FIELD JB TO MARSHALLING/TERMINATION CUBICLE FOR FEEDBACKS OF GROUP OF SOVs. TYP ARRANGEMENT IS SHOWN FOR A GROUP OF TWO SOVs WITH OPEN AND CLOSE LIMIT SWITCHES.

2) NO. OF LIMIT SWITCHES/NO. OF CONTACT IN LIMIT SWITCHES SHALL BE PROVIDED FOR EACH VALVE AS PER SPEC. REQUIREMENT/ PHILOSOPHY FOR RESPECTIVE SYSTEM.

3) ** MULTIPAIR CABLE IS TO BE USED FOR CONNECTION OF COMMAND OUTPUTS FROM MARSHALLING/TERMINATION CUBICLE TO RELAY PANEL FOR A GROUP OF SOVs.

TITLE	INTERFACING OF FIELD INSTRUMENTS INTERFACE OF DDCMIS WITH MCC/SWGR/ACTUATOR (SINGLE COIL SOLENOID)		
SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 08 OF 14	C



1) * FEEDBACKS OF DSOVs CAN BE GROUPED IN FIELD JB AND MULTI PAIR CABLE IS TO BE USED FROM FIELD JB TO MARSHALLING/TERMINATION CUBICLE FOR FEEDBACKS OF GROUP OF DSOVs. TYP ARRANGEMENT IS SHOWN FOR A GROUP OF TWO DSOVs WITH OPEN AND CLOSE LIMIT SWITCHES.

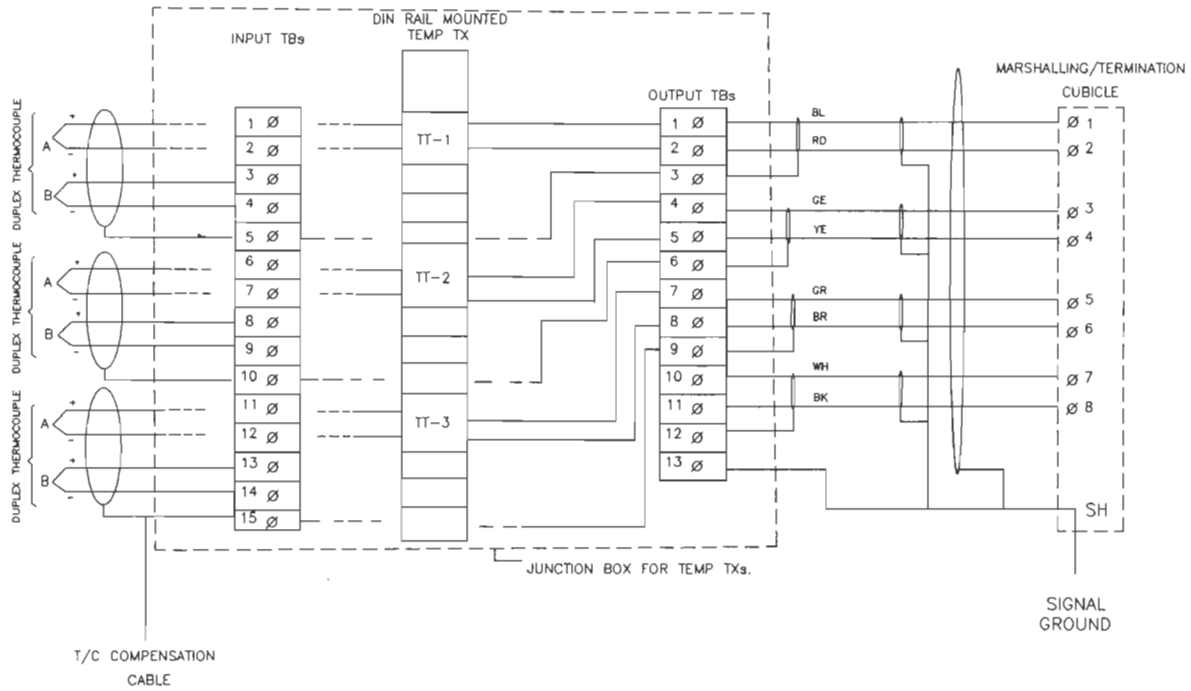
2) NO. OF LIMIT SWITCHES/NO. OF CONTACT IN LIMIT SWITCHES SHALL BE PROVIDED FOR EACH VALVE AS PER SPEC. REQUIREMENT/ PHILOSOPHY FOR RESPECTIVE SYSTEM.

3) ** MULTIPAIR CABLE IS TO BE USED FOR CONNECTION OF COMMAND OUTPUTS FROM MARSHALLING/TERMINATION CUBICLE TO RELAY PANEL FOR A GROUP OF DSOVs.

This document is the property of NATIONAL THERMAL POWER CORPORATION LTD.
No part of this document will be reproduced by any means without the written permission.

TITLE			
INTERFACING OF FIELD INSTRUMENTS INTERFACE OF DDCMIS WITH MCC/SWGR/ACTUATOR (DOUBLE COIL SOLENOID)			
SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 09 OF 14	C

This document is the property of NATIONAL THERMAL POWER CORPORATION LTD.
No part of this document will be reproduced by any means without the written permission.



NOTE: 1) ABOVE IS THE TYP DRG. FOR DIN RAIL MOUNTED TEMP TRANSMITTER FOR T/C APPLICATION. EXACT TYPE OF TEMP TRANSMITTERS SHALL BE AS PER PART-A OF SPECIFICATION.

2) THE EXACT GROUPING OF TEMP TXs SHALL BE FINALISED DURING DETAILED ENGG. STAGE.

3) AFTER GLANDING OF T/C CABLES ON JB, THE CABLE PAIR OF FIRST ELEMENT WILL BE DIRECTLY CONNECTED TO TT AND FOR CABLE PAIR OF SECOND ELEMENT LOOP SHALL BE KEPT, BEFORE TERMINATION AT INPUT TBs FOR FUTURE USE.

TITLE			
INTERFACING OF FIELD INSTRUMENTS TYPICAL T/C CONNECTION WITH TEMP TXs IN JBs			
SIZE	SCALE	DRG. NO.	REV. NO.
A3	NTS	0000-999-POI-A-065 SH 11 OF 14	C

SECTION III

LIST OF DOCUMENTS TO BE SUBMITTED ALONG WITH BID

1.0 Bidder to furnish following documents/information along with the bid (For electrical and C&I please refer the respective section of the specification).

- Deviation if any strictly in the enclosed Schedule of deviation with cost of withdrawal only with mention of specification clause for which deviation is being asked. (Stamped & Signed). In case of No Technical Deviation, bidder to furnish the same format stating “No Deviation” duly Stamped & Signed.
- Compliance certificate. (Stamped & Signed)
- Schedule of Declaration. (Stamped & Signed)
- Un Price Schedule duly filled as “Quoted”. (Stamped & Signed)

Any other documents submitted by bidder except as asked in the bid’s specification shall not be evaluated & considered as null & void.

SCHEDULE OF DEVIATIONS WITH COST OF WITHDRAWAL

PROJECT:- 2X500 MW COAL FIRED UNITS,TUTICORIN

FGD WASTE WATER TREATMENT PLANT

TENDER ENQUIRY REFERENCE:-

NAME OF VENDOR:-

SL NO	VOULME/ SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATION/ TENDER DOCUMENT	COMPLETE DESCRIPTION OF DEVIATION	COST OF withdrawal OF DEVIATION	REFERENCE OF PRICE SCHEDULE ON WHICH COST OF withdrawal OF DEVIATION IS APPLICABLE	NATURE OF COST OF withdrawal OF DEVIATION (POSITIVE/ NEGATIVE)	REASON FOR QUOTING DEVIATION
TECHNICAL DEVIATIONS									
COMMERCIAL DEVIATIONS									

PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE

NAME	**DESIGNATIONS**	**SIGN & DATE**	

NOTES:

1. For self manufactured items of bidder, cost of withdrawal of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.
2. For directly dispatchable items, cost of withdrawal of deviation will be applicable on the basic price including taxes, duties & freight.
3. All the bidders have to list out all their Technical & Commercial Deviations (if any) in detail in the above format.
4. Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of.
5. Bidder shall submit duly filled unpriced copy of above format indicating "quoted" in "cost of withdrawal of deviation" column of the schedule above along with their Techno-commercial offer, wherever applicable.
6. Bidder shall furnish price copy of above format along with price bid.
7. The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.
8. Bidders to note that any deviation (technical/commercial) not listed in above and asked after Part-I opening shall not be considered.
9. For deviations w.r.t. Payment terms, Liquidated damages, Firm prices and submission of E1/ E2 forms before claiming 10% payment, if a bidder chooses not to give any cost of withdrawal of deviation loading as per Annexure-VIII of GCC, Rev-06 will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of this format submitted with Priced bid, the cost of withdrawal of deviation shall be taken as NIL.
10. Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not be accepted.
11. All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in unpriced copy of this format.
12. Cost of withdrawal is to be given seperately for each deviation. In no event bidder should club cost of withdrawal of more than one deviation else cost of withdrawal of such deviations which have been clubbed together shall be considered as NIL.
13. In case nature of cost of withdrawal (positive/negative) is not specified it shall be assumed as positive.
14. In case of descrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.

SCHEDULE OF PRE-BID CLARIFICATION

All clarification from the Technical Specification shall be filled in by the BIDDER clause by clause in this format only.

VOLUME	SECTION	CLAUSE NO.	PAGE NO.	SPECIFICATION REQUIREMENT	CLARIFICATION	REASONS FOR CLARIFICATION

Note: Bidder to furnish all the pre bid in the above indicated pre bid clarification format only. General Pre bid clarification will not be considered.

COMPLIANCE CUM CONFIRMATION SCHEDULE

The bidder shall confirm compliance with following by signing/ stamping this compliance certificate and furnishing same with the offer:

a.) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions/ deviations with regard to same.

b.) QP/ test procedures shall be submitted in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL/Customer approval in the event of order & customer hold points for inspection/ testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. The charges for 3rd party inspection (Lloyds, TUV or equivalent) for imported components shall be included in the base price of the equipment by the bidder.

c.) All drawings/data – sheets etc. to be submitted during contract shall be subject to BHEL/Customer review/ approval. GA drawings, as submitted with offer at tender stage are for reference purpose only and shall be subject to approval during contract stage.

d.) There are no other deviations with respect to specification other than those furnished in the 'Schedule of Deviations'.

e.) The offered materials shall be either equivalent or superior to those specified. Also for components where material is not specified it shall be suitable for intended duty, materials shall be subject to approval in the event of order.

f.) The commissioning spares (if any) are supplied on 'As Required Basis' & prices for same included in the base price (If bidders reply to this is "No commissioning spares are required" and if some spares are actually required during commissioning same shall be supplied by bidder without any cost to BHEL).

g.) All sub vendors shall be subject to BHEL/CUSTOMER approval.

h.) Any special tools & tackles, if required, shall be in bidder's scope.

i.) Demonstration parameters shall stand valid till the satisfactory completion of demonstration test and its acceptance by BHEL/Customer.

DECLARATIONS

I ……..……certify that all the technical data and information pertaining to this specification are correct and are true representation of the equipment/system covered by our format proposal number Dated …….. and there is no deviation to the specification.

I hereby certify that I am duly authorized representative of the Bidder's company whose name appears above my signature.

Bidders Company Name …….

Authorized representative's Signature ……..

Name …….

Bidder's Name

The bidder hereby agrees to fully comply with the requirements and intent of this specification for the price indicated