



**TELANGANA STATE POWER GENERATION
CORPORATION LTD.**

4 X 270 MW BHADRADRI TPS

**AT
MANUGURU, KHAMMAM, TELANGANA**

**TECHNICAL SPECIFICATION
FOR
MILL REJECT HANDLING SYSTEM**

SPECIFICATION NO.: PE-TS-411-160-A001, Rev-01



BHARAT HEAVY ELECTRICALS LIMITED

(A Govt. of India Undertaking)

POWER SECTOR

PROJECT ENGINEERING MANAGEMENT

NOIDA, U.P

INDIA

	TITLE 4 x 270 MW BHADRADRI TPS INDEX MILL REJECT HANDLING SYSTEM	SPECIFICATION NO. PE-TS-411-160-A001
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**TITLE**

4 x 270 MW BHADRADRI TPS
MILL REJECT SYSTEM (CONVEYOR TYPE)
SPECIFIC TECHNICAL REQUIREMENTS

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4 x 270 MW BHADRADRI TPS
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SUB-SECTION – IA
SPECIFIC TECHNICAL REQUIREMENTS (MECHANICAL)

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1.0 INTENT OF SPECIFICATION

- 1.1 The specification is intended to cover design, engineering, manufacture, inspection and testing at vendor's/sub-vendor's works, painting, forwarding, proper packing and shipment and delivery at site, unloading, handling & transportation at site, Mandatory spares, E&C spares and maintenance tools and tackles, Erection & Commissioning, structural work, minor civil works as required performance and guarantee testing and handing over of Mechanical Conveyor Type Mill Reject Handling System as per details in different sections of this specification for 4x270 MW Bhadradri TPS is being set up by Telangana State Electricity Corporation Limited (TSGENCO) at Manuguru in the district of Khammam, Telangana, India.
- 1.2 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 contractor of the responsibility of providing such facilities to complete the supply, erection & commissioning and PG testing of the MILL REJECT SYSTEM (CONVEYOR TYPE) and its accessories.
- 1.3 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 judgement is not in full accordance herewith.
- 1.4 The extent of work under the contract includes all items shown in the flow diagram, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly extent of work also includes all items mentioned in the specification and/or schedules, notwithstanding the fact that such items may have been omitted in the drawing.
- 1.5 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 is subject to compliance to all attachments referred to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.
- 1.6 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 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 **within 10 days of receipt of tender documents**. 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 and delivery 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.
- 1.7 The bidder's offer shall not carry any sections like clarification, interpretations and /or assumptions.

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1.8 Deviations, 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 NIT specification.

1.9 In the event of any conflict between the requirements of two clauses of this specification documents or requirements of different codes and standards specified, the more stringent requirement as per the interpretation of the owner shall apply.

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

1.11 Unless specified otherwise, all through the specification, the word contractor shall have same meaning as successful bidder /vendor and Customer/ Purchaser/Employer will mean BHEL and /or customer including their consultant as interpreted by BHEL in the relevant context. For details refer the relevant clause in GCC.

Note:
Bidder to note that BHEL reserves the right for drawing/document submission through web based Document Management System. Bidder would be provided access to the DMS for drawing/document 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://dmsserver.bhelpem.com/Wrench%20Web%20Access/Login.aspx>).

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1.0 The mill rejects handling system shall be designed on the basis of the followings:-

S. No	Descriptions	Unit	Quantity
1	Number of mills (Working + Standby) at 100% BMCR	Nos	4 Nos.(W)+2 Nos.(S)
2	Maximum mill rejects generation rate per mill (@ 1% of mill capacity)	t/h	0.604
3	Mill rejects temperature (normal/ max)	°C	180 /200
4	Mill arrangement		Rear mill arrangement
5	Density of material	Kg / m ³	1600 kg/m ³ for volumetric calculation; 2400 kg/m ³ for civil & structural design calculation
6	Normal size	mm	(-) 40 mm (about 80-85 % of total reject)
7	Maximum size	mm	+40mm (about 15-20 % of total reject), however system shall be designed for maximum particle size of 100 mm.

Note: Material of Pyrite hopper and the chain conveyor shall be designed to withstand the temperature of 200 deg. C. However, occasional burning coal shall also be considered for system sizing.

2.0 System Description

The mill rejects or pyrites, transferred from each coal mill are collected in a small pyrite hopper through inlet chute. The water filled volume of the pyrite hopper has been considered as 150 litres (minimum). Each pyrite hopper shall be provided with pneumatically operated plate valve / gate valve with limit switch at the inlet and outlet of the pyrite hopper. Therefore, Limit switch shall be used to monitor the inlet valve open / close position whenever the pyrite hopper is to be emptied. In normal condition, the inlet valve shall be open and outlet valve will be closed. However, when rejects are required to be removed from the pyrite hopper, inlet valve will be closed first and outlet valve shall open to discharge the pyrites / rejects to conveyor to transport these in to the bunker.

Spray quenching arrangement shall be provided to bring the surface temperature of rejects below set point. For this, service water shall be sprayed over hot reject in the pyrite hopper or conveyor at suitable location after a pre-set time. Frequency of water quenching may be changed as required. One no. RTD and two nos. level switches

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(radio frequency type) shall be provided in each pyrite hopper which shall sense the temperature and level in the pyrite hopper respectively.

At the bottom of this pyrite hopper, pneumatically actuated plate / gate valve shall be provided to allow the discharge of the material onto main conveyor. Each pyrite hopper will feed the main conveyor through discharge spout sequentially. The main conveyor will collect the pyrites from all four (4) working coal mills. Pyrites will be then discharged to vertical conveyor (Bucket conveyor) and then to bunker (silo).

A bunker of effective storage capacity 24 hours of rejects generation rate shall be provided for each unit. Manual discharge sector gate shall be provided at the bottom of the bunker along with canvass chute to unload the material onto purchaser's truck.

A DDCMIS control system based control system will be provided for mill reject handling system. Various controls and interlocks will be provided for the trouble free operation of the plant. Suitable alarm / annunciation system will be provided to warn of any malfunctioning of the mill reject handling system.

The mill rejects handling system shall be overground and shall be designed for minimum dust nuisance.

3.0 SCOPE OF WORK

Design, engineering, manufacture, inspection and testing at vendor's / sub-vendor's works, painting, forwarding, proper packing, shipment and delivery at site, unloading, handling & transportation at site including mandatory spares, maintenance tools & tackles and erection & commissioning spares, Erection & Commissioning, structural work, minor civil works as required, Performance and guarantee testing and handing over of drag link / steel pan / steel apron / steel mesh belt type **Mill Reject Handling System** as per details in different sections of this specification.

Detailed system write up & control philosophy shall be furnished by the successful bidder during detail engineering & the same shall be subject to customer approval during detail engineering.

3.1 SCOPE OF SUPPLY

Scope of supply shall comprise of but not necessarily limited to the following:

- 1) Pyrite Hoppers : 24 nos. of pyrite hoppers complete with flexible / expansion joint at its inlet / outlet, rupture disc, by pass chute, inspection window, fasteners and connecting chutes, water spray nozzles & steel supporting structures. Necessary insulation & cladding, if required, to maintain surface temperature of pyrite hopper within 60° C shall be provided. Also, Also, 48 nos. of RTDs for pyrite hoppers (two at each pyrite hopper) shall be provided.
- 2) 48 nos. (2 Nos. per pyrite hopper) of RF type level switches for pyrite hoppers.
- 3) 24 nos. of pneumatic cylinder operated plate / knife gate valve with open and close limit switches at mill outlet / pyrite hopper inlet.

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4) 24 nos. of pneumatic cylinder operated plate / knife gate valve with open and close limit switches at pyrite hopper outlet.

5) 24 nos. of pneumatic cylinder operated plate / knife gate valve at by pass chute of pyrite hopper with manual override to provision hand-wheel operation of valve. It should be provided with both open & close limit switches for interlock with pyrite hopper inlet plate / knife gate valve.

6) 24 nos. vibrating feeders (if required) at pyrite hopper outlet for smooth unloading of rejects from pyrite hopper, shall be provided. The vibrating feeders shall be provided with electromagnetic drives, connection joints, inlet & outlet chutes along with steel supporting structures.

7) The chutes shall be provided between mill outlet and pyrite hopper, between pyrite hopper and conveyor, between conveyor discharge end pulley and bunker. The chutes shall also be provided between pyrite hopper and vibrating feeder (if applicable), between vibrating feeder and conveyor and between conveyor and bucket elevator if vibrating feeders are provided in the system.

8) Mechanical conveyor system of following types along with accessories including steel belt, pans, carrying idlers, head pulley, tail pulley, take up device, suitable electric drives / gear box / geared motor, tensioning arrangement, safety guard, sensors for automatic control system, bearings, shafts, etc. as applicable for the system shall be provided :-
Drag link conveyor / steel pan type conveyor / steel apron type conveyor / steel mesh belt type.

9) All necessary supporting structural, supporting frame, short support, stringers, conveyor gallery with walkway, platforms, anchor fasteners as required for mechanical conveyor system shall be provided. In case bidder feels that maintenance is required from both sides of the conveyor, they shall provide the walkways on both sides of the conveyor.

10) All insert plates, embedment plate, foundation bolts / anchor bolts etc. as required for bidder's equipment shall be provided by the bidder.

11) 4 nos. bucket elevators (inclined conveyor not acceptable due to layout constraint) along with all accessories and auxiliaries for successful installation and operation of the system shall be provided.

12) Mill reject storage silos: Four nos. mill reject bunker (i.e. one no per unit) along with structures, complete with lining in the conical portion, lever operated bunker discharge gate with canvas chute at bunker outlet, staircase up to bunker top, operating & maintenance platform, hand railing, bag filter, 1 no. RF type level transmitter (if RF type level transmitter is not available then radar type level transmitter can be used) at each silo, pressure relieve valve, vent fan, 1 no. Electric hoist at each silo and monorail arrangement etc. The capacity of bunker shall be as indicated elsewhere in the specification.

13) All piping / tubing, fittings, isolation valves, solenoid valves etc. as required for the water / air service shall be provided to complete the system shall be provided by the bidder. All counter- flanges with nuts, bolts and gaskets at all the terminal points shall be provided by the bidder.

14) One (1) lot of Pneumatic boxes or panels / Local Control Panel / JBs properly mounted on rack / pyrite hopper structure as required to complete the system. All signals from

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instruments sensors on each pyrite hopper are to be terminated on local control panel / pneumatic panel dedicated to each pyrite hopper.

15) One (1) common instrumentation JB to be located at each unit to terminate the cables from individual mills, conveyors and bunker for further termination to DCS.

16) Four (4) nos. trolley mounted/ fixed sump pumps, which applicability shall be as per requirement of pits in the system design of MRHS, complete with suction (min 5 m long) & discharge hose (min 10 m long) for pumping out water drains from local pit to nearest plant drain, control panel, instruments and all other accessories shall be provided.

17) Initial fill of all lubricants and fluids.

18) Electrical scope and requirements are indicated elsewhere in the specification.

19) C&I requirements are indicated elsewhere in the specification.

20) Mandatory spares as per **Annexure-II**

21) One set of Erection & commissioning spares and start up spares as required to complete the system shall be provided.

22) One set of maintenance tools & tackles, as defined in **Annexure-IV** in specification. These tools shall not be used for erection / commissioning purposes and shall be in an unused and new condition when they are handed over to the customer at site. Each tool shall be stamped so as to be identified easily for its use. The tools shall be supplied in steel toolbox and with a copy of instruction manual. The items supplied shall be of the best quality and specially protected against rusting in tropical climate. Items indicated in Annexure-IV are mandatory, further if bidder feels necessary to provide additional tools and tackles for smooth maintenance of equipments, may supply the same shall be quoted.

23) Relevant scope of supply as per GTR, GCC & SCC.

24) Any other instrument, item, structural items etc. as required for making the installation complete in all respect within battery limits and for satisfactory operation of the system (Refer system write up Annex-I), **unless specifically EXCLUDED from the scope under Clause No. 2.0 below.**

3.2 SCOPE OF SERVICES

Scope of services will include but not necessarily limited to the following:

1) Unloading, Storage, handling and transportation at site

2) Minor civil work like chipping of foundation, grouting etc.

3) Pre- Commissioning work such as flushing, hydraulic testing etc. Necessary instrumentation for pre-commissioning activities shall be arranged by the successful bidder at their own cost.

4) Erection & Commissioning of Mill Reject Handling System.

5) Inspection & testing, PG test/Functional Guarantee (FG) test

6) Painting of all equipment within the battery limit.

7) Electrical scope of services as per enclosure elsewhere in the specification.

8) Preparation of civil input drawings & documents for foundation details (including load data, GA, foundation pocket details etc.) of storage bunkers / silos, Mechanical chain



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conveyor foundation details, drive unit foundation details, trenches, pyrite hopper foundation details, any other equipment foundation details etc. shall be provided.

- 9) Review of civil drawings prepared by customer / customer nominated agency based on civil input drawing furnished by the successful bidder.
- 10) Preparation of all necessary drawings / data / documents for obtaining necessary approval of statutory authorities on behalf of the customer. Necessary fee for obtaining such approval shall also be borne by the bidder.
- 11) Relevant scope of services as per GTR, GCC, ECC & SCC.
- 12) Any other service required for making the installation complete in all respect within battery limits and for satisfactory erection & commissioning of the system, **unless specifically EXCLUDED from scope under Clause No. 4.0 below.**

4.0 EXCLUSION

- 1) Civil work associated with Mill Reject Handling system including the followings:-
 - a) Road approach for various facilities related to Mill Reject Handling System.
 - b) Pit & Trench as required in mill bay
 - c) Chain conveyor drive unit foundation
 - d) Mill Reject bunker foundation
- 2) Lighting of Mill bay and bunker area.
- 3) Electrical exclusion as per Electrical scope sheet enclosed elsewhere in the specification.
- 4) Relevant exclusion as per GTR, GCC, SCC & ECC.

5.0 SERVICES TO BE PROVIDED BY THE CUSTOMER

Relevant services as per GCC, SCC & ECC.

6.0 TERMINAL POINTS

Mill Reject inlet towards pyrite hopper side	:	Mill reject spout (tramp iron) as per details indicated in enclosed GA of Mills. Work down stream up to mill reject bunker outlet with canvas chute and discharge gate is by bidder.
Mill Reject outlet towards road tanker / Truck	:	Mill reject bunker outlet with canvas chute. Bidder shall terminate his work with the canvas chute and lever operated discharge gate.
Instrument Air	:	A 25 NB line for instrument air shall be provided by BHEL and terminal point shall be the first mill bay column of each unit. Isolation valve shall be provided by BHEL. Instrument air system supplier. Quantity (per unit) and pressure at terminal point shall be 1.0 Nm ³ /min and 5 – 7 kg/cm ² .

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Service Water for
quenching

:

Total 3 - 4 m³/Hr water with Service water quality for quenching of mill rejects at 2.5 to 3 Kg/cm² shall be provided per unit. Tapping / terminal point for the same shall be the first mill bay column of each unit. Isolation valve shall be provided by BHEL.

All terminal points are provided with Isolation valves by BHEL. Any additional isolation valves, expander reducer and any other fittings required at the terminal points from system design point of view shall be in the scope of the bidder.

Further bidder shall check the adequacy of service water being provided by BHEL as indicated above. In case these are not adequate, water requirement for these services shall be indicated by the bidder along with their bid.

7.0 LAYOUT REQUIREMENTS

Conveyor and equipment installation shall be according to the regulations and recommendations of recognized Indian/International Standards, Codes and Statutes, as and where applicable, practice in vogue (to be supported with back up document to the satisfaction of customer).

8.0 EQUIPMENT DESIGN CRITERIA

8.1 The minimum design criteria to be followed for various equipment shall be as per requirements indicated under **Annexure-A** and standard technical specifications & Data Sheet-A for various equipment placed under Section-D. In case of any contradictory requirement in specification of particular equipment, the stringent requirement as per the BHEL's engineer shall prevail. Further In case of any contradictory requirement within the same section, and clarifications not having been sought by the bidders within the stipulated period, the most stringent requirement as per interpretation of the BHEL's engineer / customer will prevail. Successful bidder will furnish detailed data sheets / specifications / design calculations for various equipment for customer's / consultant's approval during detail engineering. All comments made by customer / consultant shall be incorporated by the successful bidder without any commercial and delivery implication.

Note: All equipment sizing, capacity of pyrite hopper shall be subject to customer's approval during detail engineering without any cost implication to the customer.

9.0 SUB-VENDOR ITEMS

The tentative make of sub-vendor items shall be as per **Annexure-I** enclosed. All these makes along with make of any other bought out items required for the system will be subject to approval of Customer during detail engineering and before the main vendor places order on the sub-vendor. There will, however, be no commercial implication on account customer's comment on the same

10.0 Mandatory spares

List of mandatory spares is attached as **Annexure-II**.

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11.0 Quality of service water
Analysis of service water, required for quenching, is attached as **Annexure-III**.

12.0 List of drawings/ documents along with schedule of submission
The main drawings list along with schedule of submission after award of contract shall be done as per attached **Annexure-V**.

13.0 Painting
Relevant input drawings are listed below and attached as **Annexure VI**.

14.0 General Technical Requirement
General technical requirement of end customer is attached as **Annexure VII**.

15.0 Input drawings
Relevant input drawings are listed below and attached as **Annexure VIII**.

1) Flow diagram for Mill Rejects Handling System, Drg. No.PE – DG – 411 – 160 – A001, R0

2) Layout for Mill rejects handling system, Drg. No.PE – DG – 411 – 160 – A002, R0

3) Plot plan, Drg. No.PE – DG – 411 – 100 – M001, R0

4) General Arrangement of Bowl Mill XRP 943 (with planetary gear box), Drg. No. 0 – 00 – 620 - 87042, R0

5) Foundation plan of Bowl Mill XRP 943 (with planetary gear box), Drg. No. 0 – 00 – 610 - 87041, R0

The flow diagram shows the minimum requirement to be followed including minimum requirement of instruments. Any additional equipment/instruments required for safe, efficient & reliable operation of the system within the battery limit shall also be considered as included in bidder's scope without any commercial/ cost implication to BHEL.

15.0 OTHER REQUIREMENTS

i) Site Visit before submission of offer

Bidders shall make Site visit in order to familiarize themselves with the existing facility and condition of site before submitting the bid in order to make their offer complete. BHEL shall not entertain any cost implication for making the system complete for any lack of input data during detail engineering.

ii) Technical Requirements

1) End connections for IA pipelines for sizes 50 NB & below shall be screwed and then seal welded with zinc rich electrode.

2) Chain, drag link, sprocket and sprocket shaft shall be designed considering factor of safety as 5 (min).

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3) Bag filter with vent fan shall be provided in the bunker and in no case, conveyor shall be kept open to the atmosphere. Dusty air from the conveyor shall pass through vent fan only. 4) SS tubing is to be provided for pneumatic connection / instrument air connection. 5) All valves including isolation valves (water lines, air lines, before and after solenoid valves etc.) as required for successful operation shall be provided by bidder. 6) All structural supports excepts columns and pipe rack, as required for supporting of pipes of mill reject handling system, shall be provided by bidders. 7) Operation philosophy and control philosophy shall be submitted by the vendor during detail engineering stage for BHEL /CUSTOMER /CONSULTANT approval and approved document shall be adhered and the system shall be provided accordingly for which no commercial implication shall be entertained by BHEL. 8) Minor civil and structural works shall be carried out by the bidder if required at site for which no additional commercial implication shall be entertained by BHEL. 9) All possible efforts shall be made by the bidder to get the approval of drawings and documents from BHEL / customer / consultant at the earliest and the documents prepared / generated by them or their sub-vendors shall be checked by their competent authority before submission to BHEL. 10) Revision made by the bidder in any drawings and documents shall be highlighted by indicating the no. of revisions in a triangle without fail so that the minimum time is required by BHEL to review the drawings and documents. 11) Civil works will be provided by BHEL / customer. Hence, bidder has to furnish the civil inputs in time. Bidder has to carry out the rectification in the civil works in the event of any changes in the civil input data furnished by them or delay in submission of input data by them. Bidder to furnish the civil foundation drawing along with the loading data for approval during detailed engineering stage showing / indicating the followings :- a) Scope of work by BHEL / customer and bidder shall be indicated with different legend or in the form of note. b) Recommended locations of earthing pads. c) Civil loads shall be furnished showing detailed calculation. d) Details of pockets as required for anchor bolts. 12) Bidder to depute competent designer (s) at BHEL's/ CUSTOMER /CONSULTANT office during detailed engineering stage to discuss drawings and other technical documents as and when required by BHEL. However, minimum 7 days notice shall be served for the same. 13) All the drawings which are required to be furnished to BHEL during detailed engineering stage shall include technical parameters, details of paints, BOQ / BOM etc in tabular			

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form indicating all components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc. 14) All drawings and documents including general arrangement drawing, data sheet, calculation etc. shall be furnished to BHEL during detailed engineering stage and shall include / indicate the following details for clarity w.r.t. inspection, construction, erection and maintenance etc.:- a) All drawings and documents shall bear BHEL's title block and drawing / document number. b) All drawings and documents shall indicate the list of all reference drawings including general arrangement. c) 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. 15) Bidder shall check that specification of all the items are available in the NIT specification. However, in the event of absence of specification for any item, bidder will approach BHEL to furnish the specification of missing items and new specification will be adhered by the bidder for which no commercial implication shall be entertained by BHEL. 16) Bar chart, list of drawings and documents including data sheet, manual calculation, quality plan, field quality plan, PG test procedure, list of sub – vendors (mechanical, C & I and erection and commissioning), technical specification and material of construction, painting specification / schedule, dispatch schedule etc. of various items as required by BHEL / customer / consultant shall be submitted to BHEL / customer / consultant during detail engineering stage for approval and the approved drawings / documents shall be adhered by the bidder without any commercial implication. 17) “Technical deviations” shall be clearly indicated in bidder’s offer in “Schedule of deviation format” only. 20) The specific technical requirements of various items of mill reject handling system shall be as per enclosed technical specification. In case of any contradictory requirement, the stringent requirement as per the interpretation of BHEL’s engineer shall be final and binding on the bidder for which BHEL shall not entertain any commercial implication during detail engineering stage.			



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ANNEXURE A : EQUIPMENT DESIGN/SELECTION CRITERIA

S. No.	Equipment	Design / Selection / Sizing Criteria
01.	Chain conveyor/ Metallic belt conveyor/ En-mass conveyor	1) Rated capacity of the conveyor – 8 T/Hr, Design capacity of the conveyor – 10 T/Hr. 2) Max. Conveyor speed – 13 m / min (Approximately) 3) Should have provision of variable speed through VVVF drive 4) Min. Belt width – 300 mm
02.	Pyrite Hopper & Accessories	a) Capacity of pyrite hoppers : 150 litres minimum (water filled) b) MOC : MS to IS 2062 Gr. A (min), min 8 mm thk. c) Rupture Disc Bursting Pressure – 0.5 kg /cm ² (g)
03.	System Sizing Basis and Reject size to be handled	+40mm (about 15-20 % of total reject), however system shall be designed for maximum particle size of 100 mm. System shall be sized for one normal cycle. Max. size of rejects to be handled – up to 50 mm (5% of total reject) rest 25 mm & below
04.	Bunker & its Accessories	a) Quantity – One (1) per unit b) Effective Storage Capacity – 60 T c) Minimum free board – 500 mm d) Bunker Plate – 10 mm thk. MS Plate conforming to IS 2062 Gr A e) Liner : 3 mm thick SS - 304 in conical portion of the bunker f) Manually operated sector Gate i. Size – 400 mm x 400 mm (clear open) ii. Type – Twin Sector, manually lever operated iii. MOC – CI to IS 210/ MS 10 mm thick (min) to IS 2062 (Gr. A min) with 10 thick SAILHARD / TISCRA L LINER on inner surface g) Staircase on Silo: Complete staircase to be provided up to top of silo with operating / maintenance platform at all levels having any equipment requiring operation & maintenance. Bag Filter a) Material of Filter Cloth – Polyester felt needle suitable for Prolonged operation up to a temperature of 150°C without losing its collection efficiency & durability. b) Air to Cloth Ratio – 1.0 (Further 10 % additional bags shall be provided) c) Filter body – MS, IS 2062, Gr. A (min), 3.0 mm thick (min) d) Bag cage – MS, IS 1079, galvanised e) Outlet Air Quality – 50 mg/nm³ (max) f) Bag Cleaning Mechanism – Automatic and shall comprise of solenoid valves, air nozzles, adjustable solid state timer, one no. pressure switch for supply air for filter cleaning, one no. differential pressure switch across bag filter, piping and fittings etc..



TITLE

4 x 270 MW BHADRADRI TPS

MILL REJECT SYSTEM (CONVEYOR TYPE)

SPECIFIC TECHNICAL REQUIREMENTS

SPECIFICATION NO. PE-TS-411-160-A002

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		g) Electric Hoist over bag filter: Shall have 25% margin over weight of bag filter, but in no case the capacity shall be lower than 1.0 T. h) Vent fan	
05.	Lines for Various Services	Service	Velocity in m/sec
		Compressed / Instrument Air / water lines	Pipe size below 50 mm, 15 m / sec
			Material of Construction & other details
			Pipes 50 NB & below shall have screwed / socket welded end. Material of construction of instrument air and water lines shall be IS 1239, Part –2. Instrument air pipe shall be galvanised internally as per IS 4736.
06.	Knife Gate/Plate Valve (pyrite hopper inlet, emergency discharge, hopper isolation/maintenance)	Material of Construction Body – CI to IS 210 Gr FG 260 Gate/Plate – SS or ASTM A240-Type 304 (min. 10 mm thickness) Size – 200 NB (min) for all valves	
07.	Fittings, Flanges, Fasteners & Gaskets	Fittings (Elbow, Tees and Reducers)	
		Service	Requirements
		Instrument Air	IS 1239, Part-2 (Galvanized)
		Water (if applicable) and conveying air	IS 1239, Part –2
		Flanges	
		Service	Requirement
	All services	Fabricated out of IS 2062 Gr.A Plates/ Equivalent as per ASME B 16.5	
08.	Valves for Air & Water (if applicable) Lines	Instrument air line Type : Ball Valve full bore, screwed end. MOC : Body : CS, Internals - 13% chrome steel Service Water line for Quenching Type : Gate/Globe valve. Flat faced with flanged end for size 65 NB & above and SW end for size 50 NB & below. MOC : For size 65 NB & above : Body – CI , internals & Stem – Gun Metal For size 50 NB & below : Body– Gun Metal, Internals & Stem – Gun Metal	
09.	Trolley or fixed type Sump Pumps (If applicable)	Capacity – To meet system requirement but not less than 5 m3/hr MOC i. Casing & suction bell – 2.5 % Ni-CI to IS 210, FG260 ii. Impeller – 2.5 % Ni-CI to IS 210 , FG260 iii. Shaft/Sleeves – EN-8	

**TITLE**

4 x 270 MW BHADRADRI TPS
MILL REJECT SYSTEM (CONVEYOR TYPE)
SPECIFIC TECHNICAL REQUIREMENTS

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TRIAL OPERATION, COMMISSIONING, PERFORMANCE/ DEMONSTRATION GUARANTEE TESTS AND HANDING OVER:

General clause

A) Trial Operation

- i. On completion of erection of any major items along with its auxiliaries, the same shall be thoroughly inspected by the Contractor together with TSGENCO's Engineers for correctness and completeness and acceptability for Pre-Commissioning Tests. Though the TSGENCO's Engineers associate themselves with such inspection, the responsibility for declaration for correctness, completeness and acceptability shall rest with the Contractor and the pre-commissioning tests shall be carried out after such declaration. The pre-commissioning tests to be performed at site as well as necessary documentation and formats for the protocols to be signed during and after the tests shall be prepared by the Contractor taking into account relevant Indian/International Manufacturers' standards as applicable and finalized by the TSGENCO sufficiently in advance through mutual discussions. On conclusion of satisfactory pre-commissioning tests of each individual equipment, the trial operation of each unit (total 4 units) shall start consistent with parameters of the technical specifications.
- ii. The duration of trial operation shall be for 14 days during which period the unit shall run as follows:
 - a) Half to full load or any other load cycle mutually agreed to during which period the unit shall also run on economical load (90% of Full! Available Load) for 48 hours continuously.
 - b) During the above trial operation the standby auxiliary equipment shall also run for a minimum period of more than 72 hours during which period the equipment including standby equipment shall run at its rated capacity for a maximum period of 24 hrs subject to (a) above.
 - c) Full load continuous operation for seventy two (72) hours.

Any interruption caused by the Contractor up to 24 hours will not affect the period of 14 days trial operation indicated above. In case of such interruption occurring for more than 24 hours, the above period shall be extended correspondingly. The unit is deemed to be commissioned on successful completion of the above trial operation. Upon successful completion of trial operation, a protocol shall be signed by the both parties.

- iii. A document shall be prepared on the results of trial operation. This document besides recording of the details of the various observations .during the trial run will also include the date of start and finish of the trial operation and will be signed by the representative of both the parties. The document of the trial operation shall have log sheets and all adjustments, repairs, interruptions etc., shall be recorded therein.
- iv. The readiness of the unit for the trial operation shall be intimated by written notice to TSGENCO. After receipt of such notice and a consent within 15 days from TSGENCO, if the trial operation could not be performed or could not be completed due to any reasons not attributable to the Contractor, the Contractor shall be absolved of the responsibility for the delay and the plant shall be deemed to have been taken over by the TSGENCO at the end of 60 days after the Contractor's notifications of readiness of the same. In case TSGENCO does not reply within 15 days from contractors notification of readiness

	TITLE 4 x 270 MW BHADRADRI TPS MILL REJECT SYSTEM (CONVEYOR TYPE) SPECIFIC TECHNICAL REQUIREMENTS	SPECIFICATION NO. PE-TS-411-160-A002	
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of Trial Operation, the responsibility of insurance of plant and equipment shall pass on to TSGENCO.

v. The trial operation shall be carried out in compliance with relevant manufacturers standards and/or relevant Indian / International standards and manufacturers operation directions before starting them.

vi. Defects which are minor in nature and do not endanger the safe operation of the plant, shall not be considered as reasons for not taking over the plant by the TSGENCO. These defects shall be listed in the above mentioned documents and shall be rectified by the Contractor in accordance with the agreement made in this respect.

B) PERFORMANCE / DEMONSTRATION GUARANTEE TESTS AND HANDING OVER:

i. TSGENCO shall provisionally take over the Unit upon completion of Trial Operation conducted as per clause 9 (A) above, acceptable to the TSGENCO. Contractor may apply to TSGENCO for Final Taking Over Certificate by notice enclosing the Protocol, referred to in clause 9 (A) above, and test results, after successful completion of Performance Guarantee Tests. TSGENCO shall, within fourteen (14) days after the receipt of the Contractor's application:

a) Issue the Taking over Certificate to the Contractor, stating the date on which the Performance Guarantee Tests are completed in accordance with the Contract including the date of passing of the Test on Completion. The Performance Bank Guarantees shall be returned to the contractor at the end of Warranty Period.

Or

b) Reject the application, giving reasons and specifying the work required to be done by Contractor to enable the Taking Over Certificate to be issued. Contractor shall then complete such work before issuing a further notice under this section.

ii. The unit shall be taken over or deemed to have been taken over by the TSGENCO when the Trial Operation is completed or TSGENCO utilises the facilities for generation of power (incl. Infirm Power) whichever is earlier and the responsibility of Insurance will get transferred to the Owner.

iii. Commercial operation shall begin from the date of successful completion of the trial operation as in 9(A) above or taking over by TSGENCO, whichever is earlier.

Specific Clause:

Performance/Demonstration guarantee tests of Mill reject system shall comprise of

i) Continuous effective discharge and conveying at the rated capacity of Mill rejects without spillage or blockage in the system.

ii) Guarantees of all equipment as per approved data sheet & quality plan.

iii) Particulate emission rate from bag filters less than 30 mg/nm³ of air shall be demonstrated at site

In case during test it is found that the equipment/system has failed to meet the guarantees, the contractor shall carry out all necessary modifications and/or replacements to make the equipment/system comply with the guaranteed requirements

	TITLE 4 x 270 MW BHADRADRI TPS MILL REJECT SYSTEM (CONVEYOR TYPE) SPECIFIC TECHNICAL REQUIREMENTS	SPECIFICATION NO. PE-TS-411-160-A002	
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at no extra cost to the BHEL. However, if the contractor is not able to demonstrate the guarantees, even after the above modifications/replacements within a reasonable period allowed by BHEL, after the tests have been completed, BHEL will have the right to Reject the equipment / system / plant and recover the payments already made or accept the equipment / system after assessing the deficiency in respect of the various ratings, performance parameters and capabilities and recover from the contract price an amount equivalent to the damages as determined by BHEL..

QUALITY ASSURANCE

QUALITY PLANS, INSPECTION & TESTING PROCEDURE

The following Quality plans/ Check lists of mechanical items are attached for ready reference of supplier.

- a) Local Panel
- b) Pyrite Hopper
- c) Terminal Box
- d) Bunker Discharge Gate
- e) Pressure Relief Valve
- f) Chain Pulley Block
- g) Bag Filter
- h) Expansion bellow
- i) Knife Gate Valves
- j) Sump Pumps
- k) Pipes
- l) Plates & Structures

The inspection requirements indicated in the above QP's / CL's shall be adhered to as a minimum. However, manufacturer specific changes shall be suitably reflected for customer / client consideration. Inspection requirement of some of the items are also elaborated in the technical specification under Sec-IIA. The QP's for above items as well as other items not listed above but required, as part of the system shall be prepared by the successful bidder in project specific format to be finalised with the successful bidder after award of contract.

Standard Quality Plans of few instruments & motors are enclosed elsewhere in the specification, for compliance by the bidder.

All QP's/CL's shall be submitted by the bidder for Customer/Consultant's review and approval. All comments made by customer / consultant shall be incorporated by the successful bidder without any commercial and delivery implication.

		S/Contactor :-			Manufacturing Quality Plan			Project:-					
		Manufacturer :-			Item :- Rupture Disc QAP No. :- LOI Nos:- Contractor :- M/s BHEL			Package :- Mill Rejects System Client :- Consultant :-					
Sl. No.	Components / Operations	Characteristics	Classification	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Records		Agency for Checking			Remarks
1	2	3	4	5	6	7	8	9		10			11
								TYPE	D	M	C	U	
1	Materials -> Rupture Disc Material	Physical & Chemical Properties	Major	Chemical Analysis, YTS & UTS	1 per Heat	ASTM A240 Type - 304 / Appved Data Sheet / Drg.	ASTM A240 Type - 304 / Appved Data Sheet	MTC	√	V	V	V	
2	Final Inspection -> Dimension -> Burst Test of Rupture Disc	Measurement Functional	Major Major	Mesurement Burst Test @ 200 Degree Centigrade	100% 1 per lot offered	App. Drawing Approved drawing / Datasheet	App. Drawing Min 0.4 bar (g) @ 200 degree C Max 0.6 bar (g) @ 200 degree C / App. Data Sheet	IR IR / Burst Test Certificate	√ √	P P	W W	W W	
Manufacturer / Sub Vendor		Contractor	LEGENDS:- Records identified by √ shall be essentially included in QA documentation. TC- Test Certificate, IR - Insp. Report M-> Manufacturer/Sub Contractor, C-> Contractor (BHEL) or their nominated agency & N -> CLIENT P->Perform, V-> Verification, W-> Witness				For Client Use:-		Document No.:-				
SIGNATURES									Name & Signature of Approving Authority with Seal				

Note :- In case of any difference in parameters specified in Drawing / Data Sheet & QAP, Value specified in Drg / Data Sheet shall be Final

		S/Contactor :-			Manufacturing Quality Plan			Project:-						
					Item:- ELECTRIC HOIST									
		Manufacturer :-			QAP No. :-			Package :- Mill Rejects System						
					LOI Nos:-			Client :-						
			Contractor :- M/s BHEL			Consultant :-								
Sl. No.	Components / Operations	Characteristics	Classification	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Records	Agency for Checking					Remarks
1	2	3	4	5	6	7	8	9	10					11
								TYPE	D	M	C	N		
1	RAW-MATERIALS													
1.1	a) STRUCTURAL MATERIAL b) RAW MATERIAL FOR HOIST AND GEAR BOX HOUSEING, TROLLEY PLATE, ROPE DRUM IF FABRICATED	Mech. & , CHEM. PROPS	MA	Chemical composition & Hardness	1	APPD. DRG./ DATA SHEET		Mill.s TC	√	V	V	V	TEST SHALL BE CARRIED OUT IN ABSENCE OF MILL T.C	
1.1 A	ROPE DRUM (SEAMLESS	CHEMICAL , MECHANICAL	MA	Lab analysis	1/pipe	Approved drg/ASTM A Grade B		LAB report	√	V	V	V		
		Flattening & Acid Etching test	MA	Mech test	1/pipe	No cracks, pitting, rusting , damage etc		IR	√	V	V	V		
		SURFACE DEFECTS	MA	Visual	1				√					

1.2	GEARS,PINION S, 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	# If wheel, gears, pinions, shafts & axle diameter / thickness is equal to or more than 50 mm UT shall be carried out, ref & acceptance norm at S.no.1.4(UT of hook) to be followed .
		U.T FOR DIA/THK > 50mm	CR	NDT	1	ASTM A 388	NOTE 4	INSPN. REPORT	√	P	V	V	
		Hardeness , surface defects after machining	MA	DPT	1	ASTM E -165 , No linear indication		MTC	√	P	V	V	
1.3	WIRE ROPE	Dimensional, type, EXAMINATION OF	MI	measurement	1	APPD. DRG./ DATA SHEET	APPD. DRG./ DATA SHEET	MFRS' TEST	√	P	V	V	
			CR	Review of TC	1	IS: 2266		MFRS'	√	P	V	V	
1.4	HOOKS	MECH. , CHEM. PROPS.	MA	LAB analysis	1	APPROVED DRG/DATA SHEET IS:15560		MFRS' TEST CERT.	√	P	V	V	
		U.T IF SHANK DIA > 50mm	CR	NDT	1	ASTM A 388	NOTE 1	INSPN. REPORT	√	P	W	V	SHANK PORTION ONLY
		Dimension & PROOF LOAD CAPACITY	CR	Measurment , PROOF LOAD TEST	1	APPROVED DRG/DATA SHEET / IS:3938 / IS:15560		QCR	√	P	W	V	
		NDT AFTER PROOF LOAD	CR	MPI	1	ASTM	NO CRACKS	INSPN. REPORT	√	P	W	V	
1.5	Sheaves	Mech	MA	Tensile &	1/lot	Approved drgs		MTC	√	P	V	V	
2	IN-PROCESS								√				
2.1	WPS, POR &	Verification of approval	MA	SCRUTINY	1	ASME Sec.IX	ASME SEC	WPS,POR	√	P	V	V	IN CASE OF
2.2	Welding of trolley, rope	DPT if welds (all)	MA	LPI	100% on Butt & 10%	ASTM E165 or Eq/ No cracks or linear		INSPN. REPORT	√	P	V	V	
		RT of butt welds	MA	RT	100%/10%	ASME SEC VIII, DIV		RT FILM &	√	P	V	V	100% RT for butt
2.3	GEAR BOXES								√				
	COMPLETE ASSEMBLY	OVERALL DIMENSIONS	MA	MEAS.	1	MFG. DRG.	MFG. DRG.	INSPN. REPORT	√	P	V		

		No load run test for 2 hours , back lash & contact pattern ,CHECK FOR OIL LEAKAGE, VIBRATION, NOISE TEMP. RISE	MA	performance	1	apprvd drg Noise 85dbA max, vibration 75 microns max, oil temp rise 30 deg above ambient max		- DO -	√	P	V	V	
		WHEELS, GEARS AND PINIONS	HARDNESS TEST	MAJOR	HARDNESS	1	APPROVED DRAWING	INSPECTION REPORT	√	P	V	V	
3	ELECTRICALS								√				
1	MOTORS & Cables	Make, type , rating	MA	Visual /measurment	1	Apprvd drg	IS325/IS:3938	IR, STC	√	P	V	V	For motor refer Note: 2
		ROUTINE TESTS							√				
3	LIMIT SWITCHES,SFU, RELAY, MCB, FUSES,PUSH BUTTONS etc	Make , type , rating, functional, Continuity,Routine test	MA	Review of TC,Routine Test	1	Approved drgs		QCR/ Routine TC	√	P	V	V	
4	BRAKES	Make , type , rating, HV/IR, Functional test	MA	Review of TC,Routine Test	1	Approved drgs		IR, STC	√	P	V	V	
5	DSL	Make , type , rating, dimension	MA	Review of TC	1	Approved drgs		QCR/ Routine TC	√	P	V	V	
6	Control transformer	Make , type , rating, input/output	MA	Review of TC	1	Approved drgs		QCR, Routine TC	√	P	V	V	
7	CONTROL PANEL, PENDANT SWITCH	* FIXING OF COMPONENTS WIRING MARKING CONTINUITY * FUNCTIONAL TEST * IR & H.V. TEST * IP - PROTECTION TEST * PAINT SHADE, THICKNESS, SHEET THICKNESS	MA	VISUAL PHYSICAL	1	APPD.DRG. WIRING DIAGRAM, Paper insercion method	APPD. DRG. WIRING DIAGRAM, Paper inserion method- Paper should not go	INSPN. REPORT	√	P	V	V	BOUGHT OUT ITEMS AS PER BHEL / CUSTOMER APPROVAL LIST
4	FINAL INSPECTION								√				

4.1	COMPLETELY ASSEMBLED HOIST	1. COMPLETENESS, CORRECTNESS, OVERALL DIMENSIONS	MA	VISUAL, MEAS	1	APPD. DRG.	APPD. DRG.	MNFRS' TEST CERT.	√	P	V	V	CHP
4.2	ASSEMBLED HOIST PERFORMANCE along with control panel and pendent	1. LOAD TEST	CR	LOAD TEST AT SWL	1	IS:6547 / IS:3938	IS:6547 / IS:3938	MNFRS' TEST CERT.	√	P	V	V	CHP
		2. HOISTING & LOWERING SPEED, PERFORMANCE OF CONTROLLERS SWITCHES CONTRACTORS, RELAYS AND OTHER CONTROL DEVICES CORRELATIONS OF CIRCUITS AND INTERLOCKS AND SEQUENCES OF OPERATION , CURRENT MEASUREMENT, Limit switch operation	CR	MEAS & VISUAL	1	IS:3938, TECH SPEC.	TECH SPEC.	MNFRS' TEST CERT.	√	P	V	V	CHP
		3. OPERATION OF ALL PROTECTIVE DEVICES	CR	VISUAL	1	TECH SPEC	TECH SPEC.	MNFRS' TEST CERT.	√	P	V	V	CHP
4.3	OVER LOAD TEST	1. 1.OVER LOAD TEST INCLUDING HOLDING CAPACITY OF BRAKES, SOUNDNESS OF WELD AFTER OVERLOAD TEST.OVER LOAD	CR	TEST AT 125 % OF-SWL	1	IS:3938	IS:3938	INSPN. REPORT	√	P	V	V	CHP
5	PAINTING												

5.1	PRIMER & FINISHING AND SHADE	Examination - Shade	MI	visual		1	DRG. & DATA SHEET & RELV. IS SPEC.		MNFRS' TEST CERT.		P	V		
		DFT	MA	measurement	Sample						P	V		
1	Materials													
->	Load Chain	Mech. Properties Breaking Load Test, Proof Load test	Major	Review of Mfr's Test Certificate	1 per Lot	IS:6216 /Appr. Drg / Appr. Data sheet	IS:6216 /Appr. Drg / Appr. Data sheet	MTC	√	P/V	V	V		
->	Load Sheave	Mech. Properties Chemical Composition	Major	Lab Analysis	1 per Heat	IS:1865 /Appr. Drg / Data sheet	IS:1865 /Appr. Drg / Data sheet	MTC	√	P/V	V	V		
->	Gear & Pinion	Chemical Composition	Major	Lab Analysis	1 per Heat	IS:4432/Appr. Drg / Data sheet	IS:4432/Appr. Drg / Data sheet	MTC	√	P/V	V	V		
->	Hook	Mech. Properties Chemical Composition	Major	Lab Analysis	1 per Heat	IS:8610 / IS:1875 /Appr. Drg / Data sheet	IS:8610 / IS:1875 /Appr. Drg / Data sheet	MTC	√	P/V	V	V		
2	In Process													
->	Hook	Proof Load Test	Major	Load Test	100%	IS:8610 /Appr. Drg / Appr. Data sheet	IS:8610 /Appr. Drg / Appr. Data sheet	MTC / IR	√	P	V	V		
		DPT after Load Test	Major	DPT	100%	ASTM E-165	ASTM E-165 / No Defects	IR	√	P	V	V		
3	Final Inspection													
->	Assembly	Operation Check	Major	Visual	100%	Smooth Operation / IS 3832 Appr. Drg / App. Data Sheet	Smooth Operation / IS 3832 Appr. Drg / App. Data Sheet	IR	√	P	V	V		
		Functional Test	Major	Visual	100%			IR	√	P	V	V		
		Load Test & Over Load Test	Major	Load Test	100%			IR	√	P	V	V		
		Overall Dimensions	Major	Measurement	100%			IR	√	P	V	V		
		Visual (After Load Test)	Major	Visual	100%	IS 3832	IS 3832	IR	√	P	V	V		
			LEGENDS:-					For Client Use:-		Document No.:-				
			Records identified by √ shall be essentially included in QA documentation. TC- Test Certificate, IR - Insp. Report											
Manufacturer / Sub		Contractor	M-> Manufacturer/Sub Contractor, C-> Contractor (BHEL) or their					Name & Signature of Approving Authority with Seal						
SIGNATURES			P->Perform, V-> Verification, W-> Witness											
Note :- In case of any difference in parameters specified in Drawing / Data Sheet & QAP, Value specified in Drg / Data Sheet shall be Final														

		S/Contactor :- Manufacturer :-			Manufacturing Quality Plan Item :- Bag Filter (Without Enclosure) QAP No. :- LOI Nos:- Contractor :- M/s BHEL			Project:- Package :- Mill Rejects System Client :- Consultant :-						
Sl. No.	Components / Operations	Characteristics	Classification	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Records		Agency for Checking				Remarks
1	2	3	4	5	6	7	8	9		10				11
								TYPE	D	M	C	N		
1	Materials													
1.1	Manifold Body / Casings (MS Plate / Sheet / Pipe)	Chemical & Physical	Major	Chemical & Mechanical	1 per Lot	App. Drawing / Data Sheet / IS:2062 Gr. A / IS:1079 Gr. 0 / IS: 1239 Class Med.	App. Drawing / Data Sheet / IS:2062 Gr. A / IS:1079 Gr. 0 / IS : 1239 Class Med.	MTC	√	V	V	V		
1.2	Bag Cages (Inserts)	Chemical & Physical	Major	Chemical & Mechanical	1 per Lot	App. Drawing / data sheet / IS:7887 Gr.8 / IS:1079 Gr. 0	App. Drawing / data sheet / IS:7887 Gr.8 / IS:1079 Gr. 0	MTC	√	V	V	V		
1.3	Solenoid Valves	Functional	Major	Operational	100%	Approved Drawing / Appr. Data Sheet	Approved Drawing / Appr. Data Sheet	MTC	√	P	V	V		
1.4	Sequence Controller	Functional	Major	Operational	100%	Approved Drawing / Appr. Data Sheet	Approved Drawing / Appr. Data Sheet	MTC	√	P	V	V		
1.5	Filter Bags (Make :- Charminar / Supreme)	Physical	Major	Visual / Measurement	100%	Approved Drawing / Appr. Data Sheet	Approved Drawing / Appr. Data Sheet	MTC	√	P	V	V		
2	In Process												** -> DPT & Hydro - Test of Manifold to be witnessed by bidder	
2.1	Manifold	Dimensional & Visual	Minor	Dimensional & Visual	100%	As per Mfr's Drg.	As per Mfr's Drg.	IR	√	P	V	V		
2.2		Welding	Major	DPT on Final Weld	100%	ASTM E-165	No Defect	IR	√	P	V**	V		
2.3		Hydro Test for 30 Minutes	Major	Leakage	100%	Appr. Data sheet	No Leakage	IR	√	P	V**	V		

Document No.:-

Sl. No.	Components / Operations	Characteristics	Classification	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Records	Agency for Checking					Remarks
1	2	3	4	5	6	7	8	9	10					11
								TYPE	D	M	C	N		
3	Final Inspection													
3.1	Assembly \$-> Pneumatic Test at 1.1 times W/Pressure	Dimensional Pne. test \$of Manifold in Assly. Functional Test of Pulsing System	Major Major Major	Measurement Leakage by soap solution Pulse Sequence	100% 100% 100%	Appr. Drawing Appr. Data Sheet Appr. Data sheet / Testing Procedure	Appr. Drawing No Leakage Appr. Data sheet / Testing Procedure	IR IR IR	√ √ √	P P P	W W W	V V V	Pressure Drop across Filter Bags & Emission Level at Filter outlet shall be checked at Site	
4	Painting	Measurement & Visual	Major	DFT / Finish	100%	Appr. Painting Schedule	Appr. Painting Schedule	IR	√	P	-	-		
TESTING PROCEDURE TO BAG FILTER 1-> Functional test through compressed air , Sequential pulsing through valves and sequential controller on No - Load Condition to be conducted. 2-> The Soenoid valve shall be connected to the sequential timer and suitable electric supply shall be provided. Air header to be connected to supply of compressed air. The Timer is set and Sequential operation of Solenoid operated valve is observed.														
Manufacturer / Sub Vendor		Contractor	LEGENDS:- Records identified by √ shall be essentially included in QA documentation. TC- Test Certificate, IR - Insp. Report M-> Manufacturer/Sub Contractor, C-> Contractor (BHEL) or their nominated agency & N -> CLIENT P->Perform, V-> Verification, W-> Witness				For Client Use:-		Document No.:-					
SIGNATURES							Name & Signature of Approving Authority with Seal							

Note :- In case of any difference in parameters specified in Drawing / Data Sheet & QAP, Value specified in Drg / Data Sheet shall be Final

		S/Contactor :- Manufacturer :-			Manufacturing Quality Plan Item :- MS GI ERW Pipes (IS:1239/IS3589) QAP No. :- LOI Nos:- Contractor :- M/s BHEL			Project:- Package :- Mill Rejects System Client :- Consultant :-					
Sl. No.	Components / Operations	Characteristics	Classification	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Records		Agency for Checking			Remarks
1	2	3	4	5	6	7	8	9		10			11
								TYPE	D	M	C	N	
1	Final Inspection of Finished Pipes	Physical Dimensional Mechanical Properties Chemical Hydro Test	Major Major Major Major	Visual Measurement Tensile, elongation, Bend or Flattening Chemical Analysis Pressure Testing	100% 100% IS: 4711 1 per heat 100%	IS:1239 / IS:3589 / Approved Data Sheet	IS:1239 / IS:3589 / Approved Data Sheet	IR IR IR / TC TC IR / TC	- √ √ √	P P P / V P / V P	W* W* V V W *	V W* V V W*	* -> Random 5% of offered lot irrespective of size
2	Galvanising (For GI Pipes)	Uniformity & mass of Zinc Coating, Adhesion test, Free bore test	Major	As per IS:4736	As per IS:4736	As per IS:4736 / Approved Data Sheet	As per IS:4736 / Approved Data Sheet	IR	√	P	W #	V	# one sample for each size
3	Identification	Verification of Batch No. / Mfg stamp / Heat No.	Major	Visual	100%	Mfgr Practise / IS 1239 / IS 3589	Mfgr Practise / IS 1239 / IS 3589	IR	√	P	W	V	
4	Review of QA Documents	-----	-----	-----	-----	As per QAP	As per QAP	-----	√	V	V	V	
NOTES :- For SAIL Pipes verification of reports for the tests mentioned in Sl. No. 1 & 2 by BHEL & KPCL. For GI Pipes, Galvanising Check as per relevant standard shall be done. All material shall be as per approved data sheet in case of ambiguity in QAP, material as data sheet shall be final.													
Manufacturer / Sub Vendor SIGNATURES		Contractor SIGNATURES		LEGENDS:- Records identified by √ shall be essentially included in QA documentation. TC- Test Certificate, IR - Insp. Report M-> Manufacturer/Sub Contractor, C-> Contractor (BHEL) or their nominated agency & N -> CLIENT P->Perform, V-> Verification, W-> Witness			For Client Use:-		Document No.:-				
							Name & Signature of Approving Authority with Seal						

Note :- In case of any difference in parameters specified in Drawing / Data Sheet & QAP, Value specified in Drg / Data Sheet shall be Final

		S/Contactor :-		Manufacturing Quality Plan			Project:-							
		Manufacturer :-		Item :- Knife Gate Valve [Manual / Pneumatic] QAP No. : LOI Nos:-			Package :- Mill Rejects System Client :-							
					Contractor :- M/s BHEL			Consultant :-						
Sl. No.	Components / Operations	Characteristics	Classification	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Records		Agency for Checking				Remarks
1	2	3	4	5	6	7	8	9		10				11
								TYPE	D	M	C	N		
1	Raw Material / Bought Out's													
1.1	Body	Chemical & Mechanical	Major	Foundry TC	1 per Heat	Relevant IS / Appr. Drg / Data Sheet	Relevant IS / Appr. Drg / Data Sheet	TC	√	P/V	V	V		
1.2	Gate	do	Major	Lab Analysis	1 per lot	do	do	Mill / Lab TC	√	P/V	V	V		
1.3	Stem (For Manual Valve)	do	Major	Lab Analysis	1 per batch	do	do	do	√	P/V	V	V		
1.4	Pneumatic Cylinder (For Pneu. Valve)	Visual & Functional	Major	Mfr's TC Review	100%	Smooth Operation	Smooth Operation	Mfr's TC	√	P/V	V	V		
2	In - Process Inspection												# -> Test Pressure as per Data Sheet	
2.1	Body, Gate	Dimensional	Major	Measurement	100%	Mfr's Drawing	In-Process Insp. Record	-		P	V	V		
2.2	Body Shell Test	Leak Tightness	Major	Hydro Static Test #	100%	Approved Drg / Data Sheet	No Leakage	IR	√	P	V	V		
3	Final Inspection												BHEL / MBPL/CLIENT to Witness 10 % of Quantity.	
3.1	Assembled Valve	Dimension	Major	Measurement	100%	Approved Drg / Data Sheet	Approved Drg / Data Sheet	IR	√	P	W	W		
3.2	do	Function	Major	Operation	100%	Smooth Operation	Smooth Operation	IR	√	P	W	W		
3.3	do	Seat Leakage	Major	Hydro Static Test #	100%	Approved Drg / Data Sheet	Approved Drg / Data Sheet	IR	√	P	W	W		
Manufacturer / Sub Vendor SIGNATURES		Contractor	LEGENDS:-				For Client Use:-		Document No.:-					
			Records identified by √ shall be essentially included in QA documentation. TC- Test Certificate, IR - Insp. Report M-> Manufacturer/Sub Contractor, C-> Contractor (BHEL) or their nominated agency & N -> CLIENT P->Perform, V-> Verification, W-> Witness											
							Name & Signature of Approving Authority with Seal							

Note :- In case of any difference in parameters specified in Drawing / Data Sheet & QAP, Value specified in Drg / Data Sheet shall be Final

बी एच ई एल 		S/Contactor :- Manufacturer :-			Manufacturing Quality Plan Item :- Sump Pump QAP No. :- LOI Nos:- Contractor :- M/s BHEL			Project:- Package :- Mill Rejects System Client - Consultant :-					
Sl. No.	Components / Operations	Characteristics	Classification	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Records		Agency for Checking			Remarks
1	2	3	4	5	6	7	8	9		10			11
								TYPE	D	M	C	N	
1	<u>Raw Material / Bought Out's</u>												
1.1	Casing	Chemical, Mechanical, Hardness, Surface Defect	Major	Chem. Comp. Mechanical Hardness Visual	1 per Heat 1 per Heat 1 Per Heat 100 %	Relevant IS / Appr. Drg / Data Sheet	Relevant IS / Appr. Drg / Data Sheet	TC	√	P/V	V	V	
1.2	Impeller	do	Major	do	do	do	do	do	√	P/V	V	V	
1.3	Shaft	Chemical, Mechanical, Surface Defect	Major	Chem. Comp. Mechanical Visual & UT if Dia >50 mm	1 per Heat 1 per Heat 100 %	Relevant IS / Appr. Drg / Data Sheet / ASTM E 388 for UT	Relevant IS / Appr. Drg / Data Sheet / ASTM E 388	do	√	P/V	V	V	
1.4	Shaft Sleeve	Chemical Hardness	Major	Chem. Comp. Hardness	do	do	do	do	√	P/V	V	V	
2	<u>In - Process Inspection</u>												
2.1	Casing	Soundness of Casting / Leakage	Major	Hydro Static Test	100%	Appr drg. / Data Sheet / IS 5120	No Leakage	IR	√	P	V	V	Hyd. Test at 200% of pump rated head or 150% of Shut off head which ever is higher for 30 min.
2.2	Impeller	Residual unbalance	Major	Dyanamic / Static Balancing	100%	Approved Drg / Data Sheet / ISO 1940 Gr. 6.3	ISO 1940 Gr. 6.3	IR	√	P	V	V	

Sl. No.	Components / Operations	Characteristics	Classification	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Records	Agency for Checking	Remarks
1	2	3	4	5	6	7	8	9	10	11
								TYPE	D M C N	

3	Final Inspection												
3.3	Performance Test with Calibrated Test Lab Motor	Q Vs Head, Power & Efficiency, Noise & Vibration	Major	Measurement & Curves	100%	Approved Drg / Data Sheet / HIS	Approved Drg / Data Sheet / HIS	IR	√	P	W	W	Noise - 85 db max. & Vibration - 50 microns max.
3.2	Pump strip test in case of doubt due to abnormal sound	Undue Wear	Major	Visual / Strip Test	100%	Mfr's Standard	No Undue Wear	IR	√	P	W	W	
3.3	Painting	Visual & Measurement	Major	Visual & Measurement	100%	As per approved Painting Schedule	As per approved Painting	IR	–	P	-	-	
Manufacturer / Sub Vendor		Contractor	LEGENDS:- Records identified by √ shall be essentially included in QA documentation. TC- Test Certificate, IR - Insp. Report M-> Manufacturer/Sub Contractor, C-> Contractor (BHEL) or their nominated agency & N -> CLIENT P->Perform, V-> Verification, W-> Witness				For Client Use:-		Document No.:-				
			Name & Signature of Approving Authority with Seal										
SIGNATURES													

Note :- In case of any difference in parameters specified in Drawing / Data Sheet & QAP, Value specified in Drg / Data Sheet shall be Final

		S/Contactor :-			Manufacturing Quality Plan			Project:-					
		Manufacturer :-			Item :-EXPANSION BELLOW QAP No. :- LOI Nos:- -			Package :- Mill Rejects System Client :-					
					Contractor :- M/s BHEL			Consultant :-)					
Sl. No.	Components / Operations	Characteristics	Classification	Type of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Records	Agency for Checking				Remarks
1	2	3	4	5	6	7	8	9	10				11
								TYPE	D	M	C	N	
1	Raw Material												
1.1	Bellows	physical & Chemical	Major	Lab Analysis	1 per Heat	AS204 TP304/ Approved Drg.	AS204 TP304/ Approved Drg.	MTC	√	V	V	V	
1.2	Fianges/ End Pipe	physical & Chemical	Major	Lab Analysis	1 per lot	IS 2062 / Approved Drg.	IS 2062 / Approved Drg.	MTC	√	V	V	V	
2	In - Process Inspection												
2.1	Bellows & Pipe ** For Bellows	Dimension Soundness Of Weld of L-Seam	Major major	Measurement DPT **(Before & After Forming)	100% 100%	Approved Drg. ASTM E- 165	Approved Drg. No Cracks/ Linear Indication	IR IR	√	P P	V V	V V	
3	Final Inspection												
3.1	Assembly	DP Test of Fillet Weld of Bellows to Pipe & Pipe to Fiange	Major	visual	100%	ASTM E-165	No Crack / Linear Inication	IR	√	P	W	V	
3.2	Testing	Dimensions pressure	Major Critical	Measurement Hydraulic	100% 100%	Approved Drg EJMA D.3.2.1/ Data sheet	Approved Drg EJMA D.3.2.1/ Approved Drg.	IR IR	√ √	P P	W W	W W	
		Spring Rate Test (Axial)	Critical	Stiffness Test	100%	EJMA / Data Sheet	EJMA / Data Sheet	IR	√	P	W	W	
		Deflection	Critical	Deflection Test	100%	EJMA / Data Sheet	EJMA/Data Sheet	IR	√	p	W	W	
3.30	Painting	Visual/ Measurement	Major	DFT	100%	Approved Painting Schedule	Approved Painting Schedule	IR	√	p	-	-	
			LEGENDS:-				For Client Use:-		Document No.:-				
			Records identified by √ shall be essentially included in QA documentation. TC- Test Certificate, IR - Insp. Report										
Manufacturer / Sub Vendor		Contractor	M-> Manufacturer/Sub Contractor, C-> Contractor (BHEL) or their nominated agency & N -> CLIENT										
SIGNATURES			P->Perform, V-> Verification, W-> Witness				Name & Signature of Approving Authority with Seal						

Note :- In case of any difference in parameters specified in Drawing / Data Sheet & QAP, Value specified in Drg / Data Sheet shall be Final

Manufacturer's Name & Address : SAIL / TISCO		MANUFACTURING QUALITY PLAN					Project : BHEL Ref. : Contract No.: Contractor : BHEL SUB-CONTRACTOR-						
		Item : MS Plates & Structures			QP No. : Rev. No. : 0 Date : Page No.: 11 of 1								
		Sub-System :											
Sl. No.	Components & Operations	Characteristic/Item	Class	Type/method of check	Extent of Check	Reference Document	Acceptance	Format of Record	Agency			Remarks	
									P	W	V		
1	2	3	4	5	6	7	8	9	D	10			11
RAW MATERIAL													
1	Steel Plates	Chemical composition and Mechanical test	Major	Review of corelated MTC	One/heat	IS:2062	IS:2062	Mfgr. TC	✓	3		2,1	Refer Note Below
2		Visual and dimensional Check	Major	Visual and measurement	100%	Mfgr. TC	Mfgr. TC IS 1852	Mfgr. TC	✓	3	2,1		
3		Identification / Marking	Major	Co-relation establish	100%	AS per manufacturing practice	AS per manufacturing practice IS 2062	Mfgr. TC	✓	3	2	1	
			LEGEND : 1 - BHEL / CUSTOMER 2 - VENDOR 3 - Manufacturer CR - Critical Characteristics MA - Major Characteristics MI - Minor Characteristics					BHEL Doc. No. PE-QP-279-166-A801 Rev. 0					
MANUFACTURER/ SUBCONTRACTOR		CONTRACTOR						REVIEWED BY	NAME & SIGNATURE OF APPROVING AUTHORITY				
SIGNATURE													

Notes:

- 1 In case material is despatched directly from SAIL/TISCO plant/stockyard or procured from dealer against co-related TC's witnessing by BHEL is waived off and material will be accepted based on MTC of SAIL/TISCO.
- 2 In case material is procured from dealer and co- related TC's are not available, check on 100% quantity of plates will be performed on sample drawn from each plate at NABL certified/ approved laboratory or any govt approved laboratory for chemical & physical properties, However dimensional check shall be witnessed by BHEL.
- 3 There will not be any inspection by CUSTOMER.

		S/Contactor : Mfgr:- Works:-			Manufacturing Quality Plan Item :-Local Panels QAP No. LOI Nos:- Contractor :- M/s BHEL			Project:- Package :- Mill Rejects System Client :- Consultant :-					
Sl. No.	Components / Operations	Characteristics Checked	Category	Type/Method of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Records		Agency for Checking			Remarks
1	2	3	4	5	6	7	8	9		10			11
								TYPE	D	M	C	N	
1	Materials CRCA Sheet	Visual	Major	Visual	100%	Appr. Drg / IS: 513	Appr. Drg / IS: 513	IR	-	P	-	-	
		Chem. & Physical.	Major	Chem.& Physical.	100%	Do	Do	TC	√	V	V	V	
		Thickness	Major	Measurement	100%	App. Drawing	App. Drawing	IR/TC	√	V	V	V	
2	Bought outs Verification of type, size & Make of FLV unit, PG, PS, SV	Visual	Major	Visual	100%	Appr. Drawing / Data Sheet	Approved Drawing / Data Sheet	IR/TC	√	V	V	V	
3	Painting Pre Treatment 7 tank process	Physical	Major	DFT / Shade / Finish	100%	Appr. Painting Schedule	Appr. Painting Schedule	IR/TC	√	V	V	V	
4	Final Inspection	Visual	Major	Visual	100%	Appr. Drawing / Data Sheet	Appr. Drawing / Data Sheet	IR/TC	√	P	W	V	
		Dimension	Major	Measurement	100%	Appr. Drawing / Data Sheet	Appr. Drawing / Data Sheet	IR/TC	√	P	W	V	
		Check for Pneumatic Circuit	Major	Visual	100%	Appr. Drawing / Data Sheet	Appr. Drawing / Data Sheet	IR/TC	√	P	W	V	
		Check for Wiring / Mountings / Terminations	Major	Visual / Continuity	100%	Appr. Drawing / Data Sheet	Appr. Drawing / Data Sheet	IR/TC	√	P	W	V	
		Functional Check for Solenoid Valve	Major	Functional	100%	Appr. Drawing / Data Sheet	Appr. Drawing / Data Sheet	IR/TC	√	P	W	V	
5	QA Documents	Review	Major	verification	100%	-	-	-					
Manufacturer / Sub Vendor SIGNATURES		Contractor SIGNATURES		LEGENDS:- Records identified by √ shall be essentially included in QA documentation. TC-Test Certificate , IR - Insp. Report M-> Manufacturer/Sub Contractor, C-> Contractor (BHEL) or their nominated agency & N ->CLIENT P->Perform, V-> Verification, W-> Witness			For Client Use:-		Document. No.:				
							Name & Signature of Approving Authority with Seal						

		S/Contactor :			Manufacturing Quality Plan			Project:					
		Mfgr:- Works:-			Item :- Pyrite Hopper QAP No. LOI Nos Contractor :- M/s BHEL			Package :- Mill Rejects System Client :-					
Sl. No.	Components / Operations	Characteristics Checked	Category	Type/Method of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Records		Agency for Checking			Remarks
1	2	3	4	5	6	7	8	9		10			11
								TYPE	D	M	C	N	
1	Raw Materials												
1.1	Plates for Body	Dimensions Surface Defects Physical Check Chemical Check	Major	Measurement Visual TS & Elongation Chemical Comp.	100% 100% 1/Heat 1/Heat	App. Drg. / Data Sheet / IS Standard	App. Drg. / Data Sheet / IS Standard	- - MTC MTC	- - √ √	P P P/V P/V	- - V V	- - V V	
1.2	Spray Nozzle	Surface Defects Chemical Check Dimensions	Major	Visual Chemical Comp. Measurement	100% 1/Lot 100%	Mfr's Drg. / IS Standard	Mfr's Drg. / IS Standard	- MTC IR	- √ √	P P/V P	- V V	- V V	
2	In - Process Insp.												
2.1	Welders & Welding	WPS / PQR / WPQ Welding Defects	Major	Procedure / Qualification DPT on Root run DPT on Final run	100% 100% 10%	ASME sec - IX ASTM E-165 ASTM E-165	ASME sec - IX ASTM E-165 ASTM E-165	WPS / PQR IR IR	√ √ √	P/V P/V P/V	V V W	V V W	Welders to be approved by BHEL
2.2	Fabrication	Fit up, Marking, Cutting, Grinding	Minor	Visual, Measurement	100%	Mfr's Standard	Mfr's Standard	-	-	P	-	-	
3	Final Inspection												
3.1	Final Assly	Completeness & Dimension	Major	Visual	100%	App. Drg. / Data sheet	App. Drg. / Data sheet	IR	√	P/V	W*	W*	* -> Witness 10%
3.2	Painting	Finish / DFT	Major	Visual, Measurement	100%	App. Painting Schedule	App. Painting Schedule	IR	-	P/V	W	-	Painting shall be Heat Resistance
4	QA Documentation												
4.1	TC & IR	Completeness	Major	Verification & approval	100%	App. Quality Plan	App. Quality Plan		-	P/V	V	V	
Manufacturer / Sub Vendor		Contractor	LEGENDS:- Records identified by √ shall be essentially included in QA documentation. TC-Test Certificate , IR - Insp. Report M-> Manufacturer/Sub Contractor, C-> Contractor (BHEL) or their nominated agency & N -> Client P->Perform, V-> Verification, W-> Witness				For Client Use:-		Document No.:-				
							Name & Signature of Approving Authority with Seal						
SIGNATURES													

		S/Contactor :-			Manufacturing Quality Plan			Project:-					
		Mfgr:-			Item :- Terminal Box QAP No. :- LOI Nos:-			Package :- Mill Rejects System Client :-					
					Contractor :- M/s BHEL			Consultant :-					
Sl. No.	Components / Operations	Characteristics Checked	Category	Type/Method of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Records		Agency for Checking			Remarks
1	2	3	4	5	6	7	8	9		10			11
								TYPE	D	M	C	K	
1	Raw Materials												
1.1	Plates for Body	Dimensions Surface Defects Physical Check Chemical Check	Major	Measurement Visual TS & Elongation Chemical Comp.	100% 100% 1/Heat 1/Heat	App. Drg. / Data Sheet / IS Standard	App. Drg. / Data Sheet / IS Standard	- - MTC MTC	- - √ √	P P P/V P/V	- - V V	- - V V	
2	In - Process Insp.												
2.1	Welders Qualification & Welding	WPS / PQR / WPQ Welding Defects	Major	Procedure / Qualification	100%	ASME sec - IX	ASME sec - IX	WPS / PQR	√	P/V	V	V	Welders to be approved by BHEL / KPCL
			Major	DPT on Root run	100%	ASTM E-165	ASTM E-165	IR	√	P/V	V	V	
			Major	DPT on Final run	10%	ASTM E-165	ASTM E-165	IR	√	P/V	W	V	
2.2	Flange Machining and Drilling	Dimensions	Major	Measurement	100%	Mfr/Appr. Drg	Mfr/Appr. Drg	IR	-	P	-	-	
2.3	Connection -pipe to flange, pipe to body	Fit up	Major	Joint set up, PCD, Orientation	100%	Mfr/Appr. Drg	Mfr/Appr. Drg	IR	-	P	-	-	If Applicable
2.4	Fabrication	Fit up, Marking, Cutting, Grinding	Minor	Visual, Measurement	100%	Mfr's Standard	Mfr's Standard	-	-	P	-	-	
3	Final Inspection												
3.1	Final Assly	Completeness & Dimension	Major	Visual	100%	App. Drg. / Data sheet	App. Drg. / Data sheet	IR	√	P/V	W	W	
3.2	Painting	Finish / DFT	Major	Visual, Measurement	100%	App. Painting Schedule	App. Painting Schedule	IR	-	P/V	W	-	Painting before disp.
4	QA Documentation												
4.1	TC & IR	Completeness	Major	Verification & approval	100%	App. Quality Plan	App. Quality Plan	-	P/V	V	V		
Manufacturer / Sub Vendor		Contractor	LEGENDS:- Records identified by √ shall be essentially included in QA documentation. TC-Test Certificate , IR - Insp. Report M-> Manufacturer/Sub Contractor, C-> Contractor (BHEL) or their nominated agency & N -> CLIENT P->Perform, V-> Verification, W-> Witness				For Client Use:-		Document No.:-				
			Name & Signature of Approving Authority with Seal										
SIGNATURES													

		S/Contractor :- Mfgr:- Works:-		Manufacturing Quality Plan Item :- Bunker Sector Gate QAP No. :- LOI Nos:- Contractor :- M/s BHEL			Project:- Package :- Mill Rejects System Client :- Consultant :-						
Sl. No.	Components / Operations	Characteristics Checked	Category	Type/Method of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Records		Agency for Checking			Remarks
1	2	3	4	5	6	7	8	9		10			11
								TYPE	D	M	C	K	
1	Raw Materials												
1.1	Plates for Body	Dimensions Surface Defects Physical Check Chemical Check	Major	Measurement Visual TS & Elongation Chemical Comp.	100% 100% 1/Heat 1/Heat	App. Drg. / Data Sheet / IS Standard	App. Drg. / Data Sheet / IS Standard	- - TC TC	- - ✓ ✓	P P P/V P/V	- - V V	- - V V	
1.2	Shaft	Physical Check Chemical Check UT If Dia > 50 mm	Major	TS & Elongation Chemical Comp. Internal defect	1/Heat 1/Heat 100%	do	do	TC TC IR	✓ ✓ ✓	P/V P/V P/V	V V V	V V V	
1.3	Cylinder / Actuator	Visual / Specification	Major	Visual	100%	do	do	Mfr's TC	✓	V	V	V	
2	In - Process Insp.												
2.1	Welders & Welding	WPS / PQR / WPQ Welding Defects	Major Major Major	Procedure / Qualification DPT on Root run DPT on Final run	100% 100% 10%	ASME sec - IX ASTM E-165 ASTM E-165	ASME sec - IX ASTM E-165 ASTM E-165	WPS / PQR IR IR	✓ ✓ ✓	P/V P/V P/V	V V W	V V V	Welders to be approved by BHEL / CLIENT
3	Final Inspection												
3.1	Final Assly	Completeness & Dimension	Major	Visual	100%	App. Drg. / Data sheet	App. Drg. / Data sheet	IR	✓	P/V	W	W	
3.2	Operation with job / shop actuator	Opening & Closing of Gate	Major	Visual	100%	Proper Working	Smooth Operation	IR	✓	P/V	W	W	
3.3	Painting	Finish / DFT	Major	Visual, Measurement	100%	App. Painting Schedule	App. Painting Schedule	IR	-	P/V	W	-	Painting before disp.
4	QA Documentation												
4.1	TC & IR	Completeness	Major	Verification & approval	100%	App. Quality Plan	App. Quality Plan		-	P/V	V	V	
Manufacturer / Sub Vendor SIGNATURES		Contractor	LEGENDS:- Records identified by ✓ shall be essentially included in QA documentation. TC -Test Certificate, IR - Insp. Report M-> Manufacturer/Sub Contractor, C-> Contractor (BHEL) or their nominated agency & N-> CLIENT P->Perform, V-> Verification, W-> Witness				For Client Use:-		Document No.:-				
			Name & Signature of Approving Authority with Seal										

		S/Contactor :-		Manufacturing Quality Plan				Project:-					
		Mfgr:- Works:-		Item :- Pressure Relief Valve QAP No. : LOI Nos:- Contractor :- M/s BHEL				Package :- Mill Rejects System Client :- . Consultant :-					
Sl. No.	Components / Operations	Characteristics Checked	Category	Type/Method of Check	Quantum of Check	Reference Documents	Acceptance Norms	Format of Records		Agency for Checking			Remarks
1	2	3	4	5	6	7	8	9		10			11
								TYPE	D	M	C	K	
1	Raw Materials												
1.1	Plates for Body	Dimensions Surface Defects Physical Check Chemical Check	Major	Measurement Visual TS & Elongation Chemical Comp.	100% 100% 1/Heat 1/Heat	App. Drg. / Data Sheet / IS Standard	App. Drg. / Data Sheet / IS Standard	- - MTC MTC	- - √ √	P P P/V P/V	- - V V	- - V V	
2	In - Process Insp.												
2.1	Welders & Welding	WPS / PQR / WPQ Welding Defects	Major	Procedure / Qualification	100%	ASME sec - IX	ASME sec - IX	WPS / PQR	√	P/V	V	V	Welders to be approved by BHEL / KPCL
			Major	DPT on Root run	100%	ASTM E-165	ASTM E-165	IR	√	P/V	V	V	
			Major	DPT on Final run	10%	ASTM E-165	ASTM E-165	IR	√	P/V	W	V	
2.2	Fabrication	Fit up, Marking, Cutting, Grinding	Minor	Visual, Measurement	100%	Mfr's Standard	Mfr's Standard	-	-	P	-	-	
3	Final Inspection												
3.1	Final Assly	Completeness & Dimension	Major	Visual	100%	App. Drg. / Data sheet	App. Drg. / Data sheet	IR	√	P/V	W	W	
3.2	Painting	Finish / DFT	Major	Visual, Measurement	100%	App. Painting Schedule	App. Painting Schedule	IR	-	P/V	W	-	Painting before disp.
4	QA Documentation												
4.1	TC & IR	Completeness	Major	Verification & approval	100%	App. Quality Plan	App. Quality Plan		-	P/V	V	V	
Manufacturer / Sub Vendor		Contractor	LEGENDS:- Records identified by √ shall be essentially included in QA documentation. TC-Test Certificate , IR - Insp. Report M-> Manufacturer/Sub Contractor, C-> Contractor (BHEL) or their nominated agency & N -> CLIENT P->Perform, V-> Verification, W-> Witness				For Client Use:-		Document No.:-				
							Name & Signature of Approving Authority with Seal						
SIGNATURES													

ANNEXURE- I						
SUB VENDOR LIST FOR MILL REJECT HANDLING SYSTEM (CONVEYOR TYPE)						
Sl. No.	DESCRIPTION	MAKE	WORKS	INSPECTION CATEGORY	REMARKS	
A	SELF MANUFACTURED					
1	Chain Links/Steel belt/Apron	Self Manufactured	Supplier's works	I / II	In case bid has been submitted on collaboration route, items identified under self manufactured items shall be sourced from collaborator/ Principal/ approved and proven sources of principal	
2	Conveyor casing					
3	Pyrite Hopper					
5	Bunker Discharge Gate (Sector Gate)					
6	Pressure Relief Valve					
B	BOUGHTOUT ITEMS (ELECTRICAL)					
1	Motor	Marathon,	kolkata	I	Upto 15 KW	
		Crompton Greaves	Ahmednagar			
		NGEF	Bangalore			
		ABB	Bangalore/Faridabad			
		Siemens	Mumbai			
		Jyoti	Baroda			
		LHP	Solapur			
		BHEL	Bhopal			
		Bharat Electric (BHEL)				
		Bharat Bijlee	Mumbai			
2	Air Filter/Lubricator/Regulator	KEC	Bangalore/Hubli	III		
		SHAVONORGAN	MUMBAI/BANGLORE			
3	Annunciator	PLACKA	CHENNAI	III		
		IIC	MUMBAI			
4	Solenoid Valve	Minilec	AHEMDABAD	III		
		PROCON	CHENNAI			
		Rotex	Baroda			
		Avcon	Mumbai			
		Asco	Chennai			
5	Pulse Jet Valves	SMC	Noida	III		
		Nucon	Hyderabad			
6	Cable Lug	ASCO	CHENNAI	III		
		MANIK	PUNE			
		DOWELLS	MUMBAI			
		BILLET (3D)	VALSAD			
7	Limit Switch	WAGO	INDIA	III		
		COMETT	MUMBAI			
		BCH	NEW DELHI			
8	Interposing Relay	SIEMENS	NEW DELHI	III		
		JAIBALAJI	NEWDELHI			
9	ZERO SPEED SWITCHES	ECONIX	MUMBAI	III		
		PHEONIX	DELHI			
		JAYSHREE	PUNE			
10	JUNCTION BOX	PROTOCONTROL	PUNE	III	FOR GALVANIZED AND FRP JUNCTION BOXES	
		P&F	BANGALORE			
		AJMERA INDUSTRIAL & ENGINEERING WORKS	SHREE NAGESH INDL. ESTATE, STATION ROAD, MUMBAI		III	Metal type junction box only
		FLEXPRO ELECTRICALS PVT. LTD.	GIDC, Kabilpore, Navsari-Gujarat			
		K.S.INSTRUMENTS PVT.LTD.	Industrial Suburb, Yeshwanthpur Bangalore-Karnataka		Registered for FRP JB's AND METAL JB's.	
		SUCHITRA INDUSTRIES	REJAMAHALVILAS EXTN 2ND STG BANGALORE			
			Panchratna Industrial Estate, Sarkhej-Bavlva Road Ahmedabad-Gujarat			
		Shrenik & Company,				
		Hoffman	BANGALORE			
		Rittal	BANGALORE			
11	FUSE	GE	INDIA	III		
		Bussmann	INDIA			
12	MCCB /SFU, MPCB, MCB with 'C' Characteristics, Power Contactor	Schenider	INDIA	III		
		Siemens	INDIA			
		ABB	INDIA			
		L&T	INDIA			
13	VFD	Schenider	INDIA	III		
		Allen Bradelly	INDIA			
		ABB	INDIA			
		YASKAWA	INDIA			
		Toshiba	INDIA			
14	Selector Switch	Siemens	INDIA	III		
		Schenider	INDIA			
		Siemens	INDIA			
		L&T	INDIA			
15	Indication Lamps, PushButton, Aux. Contactor, Aux. Relays	Kaycee	INDIA	III		
		Schenider	INDIA			
		Siemens	INDIA			
		ABB	INDIA			
16	Timer	L&T	INDIA	III		
		BCH	INDIA			
17	Control Transformer, Reactors	EAPL	INDIA	III		
		Kappa	BANGALORE			
		TS International	BANGALORE			

18	Power Monitor Relay	Minilec		III	
19	TEMPERATURE ELEMENT	GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	Goa	II	
		DETRIVE INSTRUMENTATION & ELECTRONICS LTD.	WORLI, MUMBAI		
		PYRO ELECTRIC INSTRUMENTS GOA PVT.LTD.	GOA		
		TECHNO INSTRUMENTS	Gandhinagar-Gujarat		
		Tempsens Instrument (I) Pvt Ltd	UDAIPUR-RAJASTHAN		
		TM TECNOMATIC SPA	CREMONA--ITALY		
		TOSHNIWAL INDUSTRIES PVT. LTD.,	Ajmer.-Rajasthan		
		Thermal Instrument India Pvt. Ltd.	Mahim Mumbai		
		Baumer Technologies India Pvt. Ltd.	ANDHERI(E) MUMBAI		
20	TRANSMITTERS	ABB LIMITED	FARIDABAD-HARYANA	II	PRESSURE TRANSMITTER, DP TRANSMITTER and TEMP TRANSMITTER
		Endress + Hauser (India) Pvt. Ltd.,	New Delhi		For temperature transmitter only. . .
		Moore Industries International Inc.	CALIFORNIA-USA		INDIAN REPRESENTATIVE: CHEMTROL INDUSTRIES LTD.
		NIVO CONTROLS PVT. LTD.	Indore-M.P		For Capacitance type only
		Pune Techtrol Pvt. Ltd.	MIDC Bhosari, Pune-Maharashtra		Only for capacitance Type Level Transmitter
		EMERSON PROCESS MANAGEMENT (INDIA) PVT.LTD.	BANDRA EAST MUMBAI-MAHARASHTRA		
		SIEMENS LIMITED	Worli Mumbai-Maharashtra		
		SMART INSTRUMENTS LTD, BRAZIL	Agents: Digital Electronic Ltd. 74/11 'C' Cross Road MIDC Andheri (East) MUMBAI-MAHARASHTRA-INDIA Phone- 28208477 Pincode : 400093 Email : corp@delbby.rpgms.ems.vsnl.net.in		LD-301 & T-301 TRANSMITTER FROM M/S SMART EQUIPMENTS BRAZIL.
		SBEM PVT. LTD.	PUNE SATARA ROAD PUNE,-MAHARASHTRA		FOR CAPACITANCE TYPE.
		Honeywell Automation India Limited	NEW DELHI-DELHI-INDIA		
		TOSHNIWAL INDUSTRIES PVT. LTD.,	Ajmer.-Rajasthan,		
		V. AUTOMAT & INSTRUMENTS (P) LTD.	NEW DELHI-		a)DISPLACEMENT TYPE TRANSMITTERS. b)PRESSURE AND DP TRANSMITTERS
		YOKOGAWA INDIA LIMITED,	HOSUR ROAD, BANGALORE,- KARNATAKA		
		A.N. INSTRUMENTS PVT. LTD.	MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA-WEST BENGAL		
		ASHCROFT INDIA PVT LTD.	Plot No.2306, Phase II, GIDC Chhatral Kalol-Gujarat		
21	TEMPERATURE GAUGE	BUDENBERG GUAGE CO.LTD.	PO BOX-5, ALTRINCHAM CHESHIRE-UK-UK	III	
		FORBES MARSHALL (HYD) LTD.	PLOT NO.A-19/2, & T-4/2, IDA, NACHARAM, HYDERABAD-ANDHRA PRADESH-		
		GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	D2/5, Mapusa Industrial Estate, Mapusa, Goa,-MAHARASHTRA		
		GOA THERMOSTATIC INSTRUMENTS PVT.LTD.	FLAT -B , GF, HILL CROWN APTS., COLLEGE ROAD, MAPUSA-GOA		
		GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai,-Maharashtra,		
		H.GURU INDUSTRIES	10 B, HO-CHI-MINH SARANI, KOLKATA-		

		H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	32,INDUSTRIAL SUBURB YESWANTHAPUR BANGALORE- KARNATAKA		
		Baumer Technologies India Pvt. Ltd.	36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI-Maharashtra		
22	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA-WEST BENGAL	III	
		ASHCROFT INDIA PVT LTD.	Plot No.2306, Phase II, GIDC Chhatral Kalol-Gujarat,-INDIA		
		BOSE PANDA INSTRUMENTS PVT.LTD.	44, Saheed Hemanta Kumar Bose, Sarani, Kolkata-West Bengal-India		
		FORBES MARSHALL (HYD) LTD.	PLOT NO.A-19/2, & T-4/2, IDA, NACHARAM, HYDERABAD-ANDHRA PRADESH		
		GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai,-Maharashtra,		
		H.GURU INDUSTRIES	10 B, HO-CHI-MINH SARANI, KOLKATA-WEST BENGAL		
		H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	32,INDUSTRIAL SUBURB YESWANTHAPUR		
		Baumer Technologies India Pvt. Ltd.	36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI-Maharashtra		
23	Pressure/DP/Vacuum Switch	Indfoss	Ghaziabad	II	NTPC approved sub-vendors(No PEM-C & I list is avl in PMD)
		SOR	USA		
		Dressor	USA		
		Delta control	UK		
		Trafag	Ranipet		
		GIC(Gauges Bourdon)	Panvel		
		ASHCROFT INDIA PVT LTD	USA/GERMANY		
		Switzer	Chennai		
24	Level Switch (Float/Displacer)	DK Instruments	Kolkata	III	NTPC approved sub-vendors
		Levcon	Kolkata		
		Sigma	Mumbai		
		V-Automat	New Delhi		
		SBEM	Pune		
		Flow Star	Faridabad		
25	Level Indicator	Flow Star	Faridabad	III	NTPC approved sub-vendors (No PEM-C & I list is avl in PMD)
		Scientific Devices	Mumbai		
		Gauges Bourden	Panvel		
		SBEM	Pune		
		Pune Techrol	Pune		
		Levcon	Kolkata		
		Sigma	Mumbai		
		V-Automat	New Delhi		
		DK Instruments	Kolkata		
26	DC Lead Acid / Ni-Cd Batteries	AMCO SAFT INDIA LTD	ABBANAKUPPE WORKS HEBBAL BELLARY- JAKKUR ROAD BANGALORE- KARNATAKA-INDIA	III	Ni-Cd batteries only
		EXIDE INDUSTRIES LTD	8/42, Kirti Nagar Industrial Area, NEW DELHI		Lead Acid batteries only.
		HBL POWER SYSTEMS LTD	8-2-601,ROAD NO.10, BANJARA HILLS, HYDERABAD-ANDHRA PRADESH		Ni/Cd and TUBULAR TYPE for Lead acid
		HOPPECKE BATTERIEN GMBH & CO.KG,	BONTKIRCHENER STRASSE 1, D-59929 BRILON HOPPECKE, -- GERMANY,		
		AMARA RAJA POWER SYSTEMS LIMITED	TIRUPUTI, ANDHRA PRADESH TRIPUTI- TAMIL NADU-INDIA Phone- +91-877-2285561 Pincode : Email : amarakaraja@amararaja.co.in		
		CHHABI ELECTRICALS PVT.LTD.	MIDC , JALGAON-MAHARASHTRA		

27	DC BATTERY CHARGER	CHLORIDE POWER SYSTEMS & SOLUTIONS LIMITED	GARIAHAT ROAD KOLKATA-WEST BENGAL-INDIA	III	
		DUBAS ENGG PVT LTD	347/1A , BILEKAHALLI , 6TH CROSS 2ND STAGE,B.T.M LAYOUT OFF-BANNERGHATTA ROAD BANGALORE		
		HBL POWER SYSTEMS LTD	ROAD NO.10, BANJARA HILLS, HYDERABAD-ANDHRA PRADESH-INDIA		
		JEMA ENERGY	Paseo del Circuito 10, Lasarte-Oria--SPAIN		For Static SCR Type Full Wave fully Control type
		MASS-TECH CONTROLS PVT.LTD.	2/7 , MEGHAL INDL.ESTATE DEVIDAYAL ROAD MULUND MUMBAI		
		STATCON POWER CONTROLS LTD	A-34 , SECTOR-59 NOIDA-UTTAR PRADESH		APPROVED WORKS is , Khasara No. -509, Bama Road, Chhijarsi, Kullich Nagar, Pilkhuwa, Hapur, Ghaziabad, U.P. India- 245304
28	INSTRUMENT FITTINGS	AURA INCORPORATED	Delhi	III	
		Astec Valves & Fittings Pvt. Ltd.,	Mumbai		
		Arya Crafts & Engineering Pvt. Ltd.	Mumbai		
		Comfit & Valve Pvt. Ltd.	Nandasan		
		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		
29	Control / Power Cable	Cords Cable	Bhiwadi	I	
		Radiant Cables	Hyderabad		
		PolyCab	Daman		
		KEI	Bhiwadi		
		Nicco	Kolkata		
		Ravin Cables	Pune		
		Incab	Pune		
		HVPL	Faridabad		
		Torrent cable	Nadiad		
		Havells	Alwar		
		Paramount	Khushkhhera		
		SRI Ram Cables	Bhiwadi		
		Thermocables	Hyderabad		
		Torrent cable	Nadiad		
		Universal Cables	SATNA		
		Gemscab	Bhiwadi		
		Delton	Faridabad		
30	Cable Glands	SUNIL& COMPANY	KOLKATA	III	
		ARUP ENGG	KOLKATA		
		COMMET	MUMBAI		
		QUALITY PRECISION	KOLKATA		
31	cable lugs	Dowells	Mumbai	III	
		Billet 3D	Valsad		
		Chetna	Nasik		Galvanisation to be done at M/s Eros Infrastructure Pvt. Ltd. or from BHEL-PEM approved galvanizers.
32	Terminal Block	Phoenix	INDIA	III	
		Wago	INDIA		Galvanisation to be done from BHEL-
		Connectwel	INDIA		
		EROS METAL WORKS (P) LTD.	Nagpur		Galvanizing Unit located at Phas-3, E-11/1, MIDC, Pune ,
		INDUSTRIAL PERFORATION (I) PVT.LTD.	Kolkata		
		INDIANA GRATINGS PVT. LTD.	Mumbai		Galvanizing to be done from BHEL-PEM approved galvanizers.

33	Cable trays and its accessories	INDIA ELECTRICALS SYNDICATE	Kolkata	III	Galvanising can be done from their own galvanising plant or PEM approved galvanising units
		INDMARK FORMTECH PVT. LTD.	Pune		Galvanisation to be done at its own plant or from BHEL-PEM approved galvanizers.
		JAMNA METAL COMPANY	Delhi		
		Maheshwari Electrical Mfrs. Pvt. Ltd.,	Noida		Galvanisation to be done at its own plant or from BHEL-PEM approved galvanizers.
		NAMDHARI INDUSTRIAL TRADERS PVT. LTD	Ludhiana		
		PREMIER POWER PRODUCTS (CAL) PVT. LTD.	Kolkata		its galvanization plant M/s Galbro Ispat Galvanizers Pvt. Ltd.
		PATNY SYSTEMS (P) LTD	SEUNDRABAD		Galvanisation to be done at its own plant or from BHEL-PEM approved additional works at Raipur including galvanizing plant.
		PARMAR METALS PVT.LTD.	RAJKOT		MSED-MICRO: Galvanisation to be done at its own plant or from BHEL-PEM approved galvanizers. remarks changed w.e.f. 03.07.2014; , Additional Works at "Sankrail Industrial park, Bhagabatipur Mauja, Dhulagarh, Howrah-711302" approved w.e.f. 08.12.2014 ,
		PASSIVE INFRA PROJECTS PVT. LTD.	Delhi		Galvanisation to be done at its own plant or from BHEL-PEM approved galvanizers.,
		PENTAX FERRO INCORPORATE	Mumbai		Approved in permanent category for fabrication of Cable trays & Acc. only. Galvanizing to be done from BHEL approved galvanizers. , ,
		RUKMANI ELECTRICAL & COMPONENTS PVT LTD	Kolkata		Galvanisation to be done at its own plant or from BHEL-PEM approved galvanizers.
		RATAN PROJECTS & ENGINEERING CO. PVT.LTD.	Kolkata		
		RABI ENGINEERING WORKS PVT. LTD.	Kolkata		
		SARAL INDUSTRIES	Rae Bareilly		
		UNITECH FABRICATORS and ENGINEERS PVT LTD	Kolkata		
		VINFAB ENGINEERS INDIA PVT. LTD.	Mumbai		Galvanisation to be done at its own plant or from BHEL-PEM approved galvanizers.
34	CABLE TRAY SUPPORT SYSTEM -BOLTABLE	AM-TECH ENGG.SERVICES	Pune	III	
		INDUSTRIAL PERFORATION (I) PVT.LTD.	Kolkata		
		INDMARK FORMTECH PVT. LTD.	Pune		WORKS ADDRESSES ARE APPLICABLE FOR MANUFACTURING AND GALVANISING.
		PREMIER POWER PRODUCTS (CAL) PVT. LTD.	Kolkata		
		RATAN PROJECTS & ENGINEERING CO. PVT.LTD.	Kolkata		Galvanizing Unit located at Phas-3, E-11/1, MIDC, Pune ,
35	CABLE TRAY SUPPORT SYSTEM-WELDED(GALV)	STEELITE ENGINEERING	Mumbai	III	
		Associated Power Structures Pvt. Ltd.	G. I. D. C., Makarpura, Vadodara-Gujarat		Galvanisation to be done at its own plant or from BHEL-PEM approved galvanizers.
		INDUSTRIAL PERFORATION	DUM DUM KOLKATA-		
		INDMARK FORMTECH PVT. LTD.	MIDC BHOSARI PUNE-MAHARASHTRA		
		JAMNA METAL COMPANY	DSIDC, NARLA INDL. AREA DELHI		Galvanisation to be done at its own plant or from BHEL-PEM approved galvanizers.
		PREMIER POWER PRODUCTS	Kolkata, -West Bengal		Galvanisation to be done at its own
		PATNY SYSTEMS (P) LTD	SARDAR PATEL ROAD SEUNDRABAD		Galvanisation to be done at its own plant or from BHEL-PEM approved galvanizers.
		PASSIVE INFRA PROJECTS PVT. LTD.	VAISHALI, PITAMPURA Delhi-		Registered in permanent category along with galvanizer M/s Saral Projects and Processors , ,
		RUKMANI ELECTRICAL & COMPONENTS PVT LTD	KOLKATA-WEST BENGAL-INDIA	III	Galvanisation to be done at its own plant or from BHEL-PEM approved galvanizers.
		RATAN PROJECTS & ENGINEERING CO. PVT.LTD.	P.K. TAGORE STREET, MAIN BUILDING KOLKATA-WEST BENGAL		

		RABI ENGINEERING WORKS PVT. LTD.	R.N. GUHA ROAD, DUM DUM, KOLKATA-WEST BENGAL		
		SARAL INDUSTRIES	Industrial Area-1 Sultanpur Road Rae Bareli-Uttar Pradesh		
		UNITECH FABRICATORS and ENGINEERS PVT LTD	M.B.RAOD , BIRATI KALABAGAN KOLKATA		HEAT SHRINKABLE TYPE ONLY.
36	CABLE TRAY SUPPORT SYSTEM-WELDED(UNGALV)	RASHTRIYA ISPAT NIGAM LIMITED	AMBABAWADI AHMEDABAD-	III	
		STEEL AUTHORITY OF INDIA LTD.	ISPAT BHAWAN LODI ROAD NEW DELHI-		
37	CABLE TERM.& JOINT KITS	3M Electro and Communication India P.Ltd	Rajendra Place, DELHI	III	
		HARI CONSOLIDATED PVT.LTD.,NEW DELHI	JHANDEWALAN, NEW DELHI-Delhi		
		RAYCHEM RPG PRIVATE LIMITED	JANAKPURI NEW DELHI		
		YAMUNA CABLE ACCESSORIES PVT. LTD.	Ambala Road, Jagadhri Yamunanagar-Haryana		
38	MICRO-PROCESSOR / MICRO-CONTROLLER	ALLEN BRADLY SIEMENS	BANGALORE	II	
		GE	BANGALORE		
		SCHENIDER	BANGALORE		
39	Battery	EXIDE	Kolkata	III	
		HBL Power System	Hyderabad		
		AMAR RAJA	Tirupati		
		Amco saft	Bangalore		
		HBL Power System	Hyderabad		
		SAFT	France/Sweden		
C BOUGHTOUT ITEM (MECHANICAL)					
1	BUCKET ELEVATOR CHAIN	HEKO GMBH	GERMANY	II	
		Rud	GERMANY		
		Aumund	Chennai		for complete bucket elevator
2	BUCKET ELEVATOR SPROCKETS	HEKO GMBH	GERMANY	II	
		Rud	GERMANY		
		Aumund	Chennai		for complete bucket elevator
3	Knife Gate/Plate Valve (H/W Operated & Cylinder Optd)	DEZURIKK	CHENNAI	I	
		FOURESS	MUMBAI		upto 400NB 150 class
		VASS	CHENNAI		
		ORBINOX	COIMBATORE		
		JAASH	INDORE		upto 50 NB 800 Class: 350NB 150 class
		Precision Engg	Nasik		
		Microfinish Valves Ltd	Hubli		upto 50NB 800 class
		Weir BDK engg Industries	NEW DELHI		
		Flow chem. Industries	Ahemdabad		
		Audco	Chennai		(1) BALL VALVES: FCS/FSS - 1/2" to 2" #800 & CCS/CSS - 2.1/2" to 4" # 150 (2) BALL VALVES: GUN METAL VALVES SIZE 15 NB TO 80 NB - UPTO PN16.0
		Akay India	Hubli		
		A V Valves	Agra		Size up to 2" & #800 with MOC as FCS & FSS and for size from 65 NB to 150 NB & #150 with MOC as CCS and CSS.
		Asian Industrial valves & Instruments Ltd.	Chennai		Steel ball Valves upto 50NB, #800 and 65NB to 150NB. #150

4	Ball Valve	ATAM Valves	Jalandhar	I	
		GM ENGINEERING	Rajkot		
		Hawa Valves (India) Pvt. Ltd.	Navi Mumbai		
		INTERVALVE (INDIA) LTD.	Pune		
		NILON VALVES PRIVATE LIMITED	Ahmedabad		
		LEADER VALVES LTD.	Jalandhar		
		DEMBLA VALVES LTD.	Thane		
		SURYA VALVES AND INSTRUMENTS MFG CO.	Chennai		
		UNIFLOW	Chennai		
		VALTECH INDUSTRIES	Mumbai		
		VAAS AUTOMATION	NEW DELHI		
		Belgaum Aqua Valve	Belgaum		
		METALLIC BELLOWS	CHENNAI		
		Flexatherm			
5	Metallic Expansion Bellow(Metallic)			II	UPTO 20 TONNES
6	Rupture Disc	BS & B SAFETY SYSTEM	CHENNAI	II	
7	Electric Hoist	ARMSEL MHE PVT. LTD	Bangalore	II	
		Alpha Services	Bhiwadi		
		CONSOLIDATED HOISTS PVT LTD	Pune		
		CENTURY CRANE ENGINEERS PVT. LTD.	Faridabad		
		EDDY CRANES PVT. LTD.	Mumbai		
		Grip Engineers Pvt. Ltd.,	Faridabad		
		GLOBAL TECHNOLOGIES	Hydrabad		
		HERCULES HOISTS LTD.	Khalapur		
		LIFTING EQUIPMENTS and ACCESSORIES	Delhi		
		Mangla Hoists Pvt Ltd	Delhi		
		MEEKA MACHINERY PVT. LTD.	Ahemdabad		
		REVA INDUSTRIES LTD.	Faridabad		
		ROCKWELL HOISTO			
		CRANES PVT. LTD.	Bahadurgarh		
		SAFEX ENERGY PVT. LTD.	Ahemdabad		
		TUOBRO FURGUSON (INDIA) PVT LTD	Kolkata		
		TECHNO INDUSTRIES	Ahemdabad		
8	Mono Rail Hoist / Chain Pulley Block	HERCULES (INDEF)	MUMBAI	II	
		LEAP	NEW DELHI		
		TRACTEL	FARIDABAD		
		LIFTING EQUIPMENTS & ACESSORIES	DELHI		
9	Horizontal/Vertical Centrifugal Pump	KBL	Kirolskarwadi	I	
		M&P	Pune		
		Flowmore	Ghaziabad		
		Sulzer pumps india ltd.	Navi mumbai		
		Worthington	Ghaziabad		
		Bharat pumps & compressors ltd	Allahabad		
		Flowserve India Controls Pvt. Ltd.	Coimbatore		
		Jyoti ltd.	Vadodara		
	Vertical Centrifugal Pump	Kishore Pump	Pune		
		Sam Turbo	Coimbatore		
		KSB	Pune		
		Best and Crompton	Chennai		
		Voltas	Mumbai		
		V-Flo Pumps & Systems Co. Ltd.,	Beijing, China		
10	Pneumatic Actuator/Cylinder(Metallic)	SCHRADDER	MUMBAI	II	
		NUCON	HYDERABAD		
		Rotex	MUMBAI		
		VAAS	CHENNAI		
		M.S. Fittings	Kolkata		
		Metal lloyds	Mumbai		
		True Forge	Faridabad		
		Tube Products	Baroda		

11	Fittings	NL Hazra	Kolkata	II	
		Gujrat Infra Pipes	Baroda		
		Edwards	USA		
		Pipefit Engineers	Baroda		
		Siddarth & Gautam	Faridabad		
		EBY	Mumbai		Upto 400 NB ERW Pipes as per IS 3589 and SAW as per IS 3589
12	MS/GI ERW Pipes	SAIL	Rourkela	II	NTPC approved sub-vendors and BHEL list
		Jindal	Ghazibad/Hissar	I	Upto 300 NB ERW Pipes as per IS 1239/3589
		Surya Roshni	Bahadur Garh	I	Upto 400 NB ERW Pipes as per IS 1239
		TATA Tube	Jamshedpur	II	Upto 150 NB ERW Pipes as per IS 1239
		PSL	Chennai/Vizag/Ku	I	Spiral Weld SAW as per IS 3589
		Lalit Profile	Thane	I	Spiral Weld SAW as per IS 3589
		Samshi Pipes Industri	Vadodara	I	Spiral Weld SAW as per IS 3589
		Mukut Pipes	Rajpura	I	Longitudinal SAW (Single side weld) as per IS 3589
		Indus Tubes	G B Nagar	I	Upto 300 NB ERW Pipes as per IS 1239/3589
		Mann Ind	Indore	I	Spiral Weld SAW as per IS 3589
		Surendra Engg	Rajpura	I	Spiral Weld SAW as per IS 3589
		Pratibha Pipes & Stru	Thane	I	Spiral Weld SAW as per IS 3589
		JCO Gas Pipe	Chindwara	I	Spiral Weld SAW as per IS 3589
		Nukat Tanks and Vess	Tarapur		Longitudinal SAW (Single side weld) as per IS 3589
		DADU Pipes	Sikrandrabad	I	Upto 300 NB ERW Pipes as per IS 1239/3589
		Good Luck Tubes	Sikandrabad	I	
		Advance Steel Tubes	Sahibabad	I	
		Bihar Tubes	Sikandrabad	I	
		Hi Tech Pipes	Sikandrabad	I	
		Ratnamani	Kutch/Ahmedabad	I	Upto 400 NB ERW Pipes as per IS 3589 and SAW as per IS 3589
		Maharashtra Seamless	Raigad	I	200-500 NB ERW Pipes as per IS 3589
		Welspun	Anjar/Bharuch		1239/3589 and SAW as per IS 3589
13	Seamless Pipes	ISMT	Ahmednagar/Bara	III	
		Maharashtra Seamless	Raigad		
14	S.S. Pipes (For small Quantity 500 m)	REMI	Mumbai	III	
		Ratmani	Ahmedabad		
		Apex Tubes	Behror		
		Choksi	Ahmedabad		
15	Steel Plate, Structural Steel and section for Fire water storage tank	SAIL	ANY PLANT	III	For small quantity: Authorised stockist/ dealer of approved listed makes for which TCs/IRs will be furnished
		Essar Steel			
		TISCO			
		RINL			
		Jindal			
		Lloyd			
		Ispat			
		Indian Iron & Steel Co. Ltd			
16	Bag Filter	ORIENT FAN (FORMERLY - ACCO)	KOLKATA	II	
		THERMAX	PUNE		
		FLAKT	MUMBAI		
		BATLIBOI	DELHI		
		DCL	HYDERABAD		
17	GEARED MOTOR	PBL	ANAND - V.V NAGAR	III	
		PREMIUM	PUNE		
		BONFIGLIOLI	CHENNAI		
		SEW	Germany		
		IC	AURANGABAD		
		H.Sarkar	Howrah		SIZE UPTO 300NB & PR.CL.
		A.V. VALVES LTD	Agra		
		Leader	Jalandhar		

18	CI Gate/ Globe/NRV/SRV	SURYA VALVES AND INSTR	Chennai	III	FOR GV UPTO 450NB, GLV UPTO 300NB AND CHECK VALVES UPTO 350NB.
		ATAM VALVES PVT. LTD.	JALANDHAR		(1) CARBON IRON GATE VALVES: 65 NB TO 450 NB (UPTO PN-16.0) (2) CARBON IRON GLOBE VALVES & NON RETURN VALVES: 65 NB TO 150 NB (UPTO PN-16.0)
		FLUIDLINE VALVES COMP	Mumbai		1. CI Gate- CL125 & up to 900 NB, 2. CI Globe- CL125 & up to 450 NB, 3. CI SCNRV- CL125 & up to 600 NB.
		G.M. DALUI AND SONS PVT.	Howrah		
		KBL	Kondhapuri		Additionally approved for FM approved Gate valve 50-250 NB
		Bankim	Kolkata		
		VENUS PUMPS AND ENGG.	Kolkata		1) CI GATE VALVE SIZES 65NB-800NB, 2) CI GLOBE VALVE FOR SIZES 65NB-400 NB AND 3) CI SCNRV FOR SIZES 65 NB -600 NB.
19	GM valve	A.V. VALVES LTD	Agra	III	GUN METAL GATE/GLOBE/NRV: 15 NB TO 50 NB (UPTO PN-16.0) & 15 NB TO 50 NB (UPTO #150)
		ATAM VALVES PVT. LTD.	Mumbai		
		Leader	Jalandhar		GUN METAL SCREWED END TYPE, SCREWED IN BONNET, OUT SIDE SCREW & YOKE TPE, PN 16, SIZES UPTO 50.
		VALTECH INDUSTRIES			UP TO SIZE 100-NB ONLY.
20	GEAR BOX	SANT VALVES PVT. LTD.	Jalandhar	III	
		PBL	ANAND - V.V NAGAR		
		SHANTHI	COIMBATORE		
		PREMIUM	PUNE		
		BONFIGLIOLI	CHENNAI		
		IC	AURANGABAD		
21	COUPLINGS	FLENDER		III	
		ELECON	ANAND - V.V NAGAR		
		FENNER	CHENNAI		
		FLUIDOMAT	KOLKATA		
22	BEARINGS	FAG	INDIA	III	
		SKF	INDIA		
		NTN	INDIA		
23	BEARINGS (B/E BOOT SECTION)	HEKO	GERMANY	III	
24	Paint	Asian Paints (I) Ltd.	Mumbai	III	
		Berger Paints India Ltd	Delhi		
		Goodlass Nerolac	Mumbai		
		Jenson & Nicholson (I) Ltd	Gurgaon		
		CDC carboline (I) Ltd.	Delhi		
		Shalimar Paints Ltd.	Gurgaon		
		Addison Paints Ltd	Chennai		
		Grand Polycoat	Mumbai		
		Bombay Paints	Mumbai		
		Jotun Paints	Pune		
25	PLUMMER BLOCKS	Hemple Paints	Singapore	III	
		WINCO	BANGALORE		
		MASTA	AHMEDABAD		
26	TRANSMISSION CHAIN	COSMO	MUMBAI	III	
27	MAINTENANCE TOOLS BOX	RENOLD	KARUR	III	
		BRANDED		III	
INSPECTION CATEGORY TYPE					
CAT-I	The QAP for these items shall be approved by customer and joint inspection shall be done by Customer & BHEL as per approved QAP.				
CAT-II	The QAP/Check List for these items shall be approved by BHEL and inspection shall be done by BHEL as per approved QAP/Check List. Approved QAP/Check list shall be given for Information to Customer.				
CAT-III	These shall be COC (Certificate of Compliance) items. Only verification Test Certificates shall be done by BHEL.				
NOTE					
	1) Bidder to note that Make of various items and inspection category indicated against each item is tantetive and shall subject to approval of BHEL / Customer during detail engineering stage without any commercial implication at contract stage				
	2) In case of imported components, makes of BOI shall be subject to BHEL/ customer approval during detail engineering stage without any commercial implication at contract stage.				

ANNEXURE-II				
MANDATORY SPARES - MILL REJECT HANDLING SYSTEM (For 4 units)				
MECHANICAL				
SL.NO.	Name of Spares	Unit /Quantity (Nos./SET/%)	Multiplying factor	REMARKS
I.	Main conveyor			
1	Chain or equivalent component	10%(min) of total length per unit	4	
2	Chain connectors or equivalent component	10% of total requirements /unit	4	
3	Bearing for drive	1 set	1	
4	Conveyor Motor	1 pc	1	
II.	Vertical conveyor			
5	Chain with buckets	10%(min) of total length per unit	4	
6	Chain connectors or equivalent component	10% of total requirements /unit	4	
7	Bearing for drive	1 set	1	
III.	Filter			
8	Bags	10% of total no. of bags/ unit	4	
IV.	Knife gate valve			
9	Valves without actuator	4 nos.	1	
V.	LP piping valves & traps (complete assembly)	5% or min. 1 no. (whichever is more) for each size, type & rating for total population	1	
ELECTRICAL				
SL.NO.	Name of Spares	Unit /Quantity (Nos./SET/%) (For 4 units)		REMARKS
1	Vertical Conveyor motor	1 pc.	1	
CONTROL & INSTRUMENTATION				
SL.NO.	Name of Spares	Unit /Quantity (Nos./SET/%) (For 4 units)		REMARKS
1	Limit switches for knife gate valves	10 nos.	1	
2	Solenoid valves for knife gate valves	4 nos.	1	
3	Local gauges/ Switch (for Pressure, DP, Temperature, Flow, level, etc.)	(10% of total number of instruments offered for each model and type for the project or a minimum of one number, whichever is more.)	2	
4	Push buttons, electrical control switches and Illuminated push buttons etc	(20% of installed)	2	
Notes:				
(i) Unless stated otherwise, a "set" or "Lot" means items required for complete replacement in one equipment of each type / size/ range.				
(ii) Multiplying factor in column above, implies that quantity applicable for one unit shall be multiplied by mentioned multiplying factor.				
(iii) In case of Bought Out items, itemised spares list may be vendor specific and may differ from the list of spares mentioned above. In such cases, The quoted price shall be considered for applicable items only without any change in the contract price.				
(iv) In case spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to offered design with quantities generally in line with the approach followed as per the list.				

(v) Any item which is quoted as “not applicable” in the above list and is found to be “applicable” at a later date shall be supplied by the Bidder without any commercial implications.
(vi) Any change or variation in equipment or systems during detailed engineering stage which would cause changes / variations in the essential spares, shall be supplied by Bidder without any commercial implications.
(vii) Mandatory spares shall not be dispatched before dispatch of corresponding main equipment.
(viii) Wherever quantity has been specified as percentage (%), it shall mean percentage (%) of the item required for one unit of 270 MW in the station (project), unless specified otherwise and the fraction will be rounded off to the next higher whole number.
(ix) Wherever quantity is specified both as a percentage and a value, the Bidder has to supply the higher quantity until & unless specified otherwise.
(x) The spares shall be treated and packed for a long storage under the climatic condition prevailing at site.
(xi) Each spare part shall be clearly marked and 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 purpose of identification.
(xii) The Bidder shall note that if there is any change/ variation in equipment/ system during detail engineering which causes any change/ variation in the essential spares quantity, the same shall be supplied without any commercial implications. The price indicated for the mandatory spares shall be considered for the purpose of evaluation.

ANNEXURE-II				
MANDATORY SPARES - MILL REJECT HANDLING SYSTEM (For 4 units)				
MECHANICAL				
SL.NO.	Name of Spares	Unit /Quantity (Nos./SET/%)	Multiplying factor	REMARKS
I.	Main conveyor			
1	Chain or equivalent component	10%(min) of total length per unit	4	
2	Chain connectors or equivalent component	10% of total requirements /unit	4	
3	Bearing for drive	1 set	1	
4	Conveyor Motor	1 pc	1	
II.	Vertical conveyor			
5	Chain with buckets	10%(min) of total length per unit	4	
6	Chain connectors or equivalent component	10% of total requirements /unit	4	
7	Bearing for drive	1 set	1	
III.	Filter			
8	Bags	10% of total no. of bags/ unit	4	
IV.	Knife gate valve			
9	Valves without actuator	4 nos.	1	
V.	LP piping valves & traps (complete assembly)	5% or min. 1 no. (whichever is more) for each size, type & rating for total population	1	
ELECTRICAL				
SL.NO.	Name of Spares	Unit /Quantity (Nos./SET/%) (For 4 units)		REMARKS
1	Vertical Conveyor motor	1 pc.	1	
CONTROL & INSTRUMENTATION				
SL.NO.	Name of Spares	Unit /Quantity (Nos./SET/%) (For 4 units)		REMARKS
1	Limit switches for knife gate valves	10 nos.	1	
2	Solenoid valves for knife gate valves	4 nos.	1	
3	Local gauges/ Switch (for Pressure, DP, Temperature, Flow, level, etc.)	(10% of total number of instruments offered for each model and type for the project or a minimum of one number, whichever is more.)	2	
4	Push buttons, electrical control switches and Illuminated push buttons etc	(20% of installed)	2	
Note: (i) Unless stated otherwise, a "set" or "Lot" means items required for complete replacement in one equipment of each type / size/ range. (ii) Wherever quantity has been specified as percentage (%), it shall mean percentage (%) of the population of the item required for one unit of 270 MW in the station (project), unless specified otherwise. (iii) In case of Bought Out items, itemised spares list may be vendor specific and may differ from the list of spares mentioned above. In such cases, The quoted price shall be considered for applicable items only without any change in the contract price. (iv) Multiplying factor in column above, implies that quantity applicable for one unit shall be multiplied by mentioned multiplying factor.				

**TITLE**

4 x 270 MW BHADRADRI TPS
MILL REJECT SYSTEM (CONVEYOR TYPE)

SPECIFIC TECHNICAL REQUIREMENTS

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ANNEXURE-III
SERVICE WATER ANALYSIS

SL. NO.	Constituent	Unit	Value
1.	pH	-	7.73
2.	Color and Odor	-	-
3.	Oil and grease	mg/l	-
4.	BOD	-	-
5.	COD	-	-
6.	Suspended solids	mg/l	≤10
7.	Turbidity	NTU	16
8.	Calcium as Ca	mg/l	60
9.	Magnesium as Mg	mg/l	34
10.	Sodium as Na	mg/l	-
11.	Potassium	mg/l	-
12.	Total Hardness as CaCO ₃	mg/l	94
12.	Chloride as Cl	mg/l	30
13.	Sulphate as SO ₄	mg/l	58
14.	Sulphide	mg/l	-
15.	Total Alkalinity as CaCO ₃	mg/l	140
16.	P-Alkalinity as CaCO ₃	mg/l	-
17.	Nitrates as NO ₃	mg/l	-
18.	Nitrite	mg/l	-
19.	Silica as SiO ₂	mg/l	5.2
21.	Iron as Fe	mg/l	0.007
23.	Total dissolved solids	mg/l	218
24.	Conductivity at 25 degree C	Micro Siemens /cm	328
25.	Dissolved Oxygen as O ₂	mg/l	-
26.	Carbon dioxide free	mg/l	-

**TITLE**

4 x 270 MW BHADRADRI TPS
MILL REJECT SYSTEM (CONVEYOR TYPE)

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ANNEXURE-IV
MAINTENANCE TOOLS & TACKLES

SL. NO.	Constituent	Unit	Value
1.	Complete spanner sets	2	Nos.
2.	Grease gun	2	Nos.
3.	Multi meter	2	Nos.
4.	Pneumatic spanner (suitable for all sizes of fasteners)	2	Nos.
5.	Electrical winch with sling (Suitable for withdrawal of horizontal conveyor assembly during maintenance)	1	No.
6.	Any other item specific to offered design by bidder	1	lot



TITLE

4 x 270 MW BHADRADRI TPS

MILL REJECT SYSTEM (CONVEYOR TYPE)

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ANNEXURE – V

DRAWINGS / DOCUMENTS TO BE SUBMITTED AFTER AWARD OF CONTRACT

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

S.N.	Bhel DrgNo	Drg Title	Schedule schedule- week no. after date of LOI
1	PE-V0-411-160-A101	DESIGN PHILOSOPHY AND SYSTEM SIZING CALCULATION OF MILL REJECT SYSTEM (CONVEYOR TYPE)	4
2	PE-V0-411-160-A102	GA drawing of Pressure relief valve for MILL REJECT SYSTEM (CONVEYOR TYPE)	8
3	PE-V0-411-160-A103	GA of Bag Filter along with data sheet for MILL REJECT SYSTEM (CONVEYOR TYPE)	8
4	PE-V0-411-160-A104	Electrical Load List for MILL REJECT SYSTEM (CONVEYOR TYPE)	6
5	PE-V0-411-160-A105	Flow diagram/P&ID of MILL REJECT SYSTEM (CONVEYOR TYPE)	4
6	PE-V0-411-160-A106	Instrument Schedule for MILL REJECT SYSTEM (CONVEYOR TYPE)	10
7	PE-V0-411-160-A107	Detailed BOM for MILL REJECT SYSTEM (CONVEYOR TYPE)	20
8	PE-V0-411-160-A108	PG Test Procedure for MILL REJECT SYSTEM (CONVEYOR TYPE)	20
9	PE-V0-411-160-A109	MRHS Layout drawing including air and water piping layout	8
10	PE-V0-411-160-A110	Subvendor list along with inspection category for MILL REJECT SYSTEM (CONVEYOR TYPE)	4
11	PE-V0-411-160-A111	WELDING PROCEDURE SPECIFICATION for MILL REJECT SYSTEM (CONVEYOR TYPE)	6
12	PE-V0-411-160-A112	QAP OF STRUCTURAL STEEL / PLATES for MILL REJECT SYSTEM (CONVEYOR TYPE)	6
13	PE-V0-411-160-A113	QAP OF PYRITE HOPPER, TERMINAL BOX for MILL REJECT SYSTEM (CONVEYOR TYPE)	8
14	PE-V0-411-160-A114	QAP OF CHAIN AND CHAIN CONVEYOR for MILL REJECT SYSTEM (CONVEYOR TYPE)	8
15	PE-V0-411-160-A115	QAP OF BUCKET ELEVATOR for MILL REJECT SYSTEM (CONVEYOR TYPE)	8
16	PE-V0-411-160-A116	QAP of LOCAL CONTROL PANEL for MILL REJECT SYSTEM (CONVEYOR TYPE)	8
17	PE-V0-411-160-A117	GA drawing for Pyrite Hopper with Data Sheet and civil load data & foundation location details for MILL REJECT SYSTEM (CONVEYOR TYPE)	6
18	PE-V0-411-160-A118	QAP OF SECTOR GATE for MILL REJECT SYSTEM (CONVEYOR TYPE)	10
19	PE-V0-411-160-A119	QAP OF KNIFE GATE for MILL REJECT SYSTEM (CONVEYOR TYPE)	10



TITLE

4 x 270 MW BHADRADRI TPS MILL REJECT SYSTEM (CONVEYOR TYPE)

SPECIFIC TECHNICAL REQUIREMENTS

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20	PE-V0-411-160-A120	GA drawing of chain conveyor with Data Sheet and civil load data & foundation location details for MILL REJECT SYSTEM (CONVEYOR TYPE)	6
21	PE-V0-411-160-A121	QAP OF RUPTURE DISC for MILL REJECT SYSTEM (CONVEYOR TYPE)	10
22	PE-V0-411-160-A122	GAD for Silo (G.A with tentative location) with DS and civil load data & foundation location details for MILL REJECT SYSTEM (CONVEYOR TYPE)	6
23	PE-V0-411-160-A123	QAP OF EXPANSION BELLOW for MILL REJECT SYSTEM (CONVEYOR TYPE)	10
24	PE-V0-411-160-A124	QAP OF BAG FILTER for MILL REJECT SYSTEM (CONVEYOR TYPE)	10
25	PE-V0-411-160-A125	GAD of Bucket elevator with DS & civil load data & foundation location details for MILL REJECT SYSTEM (CONVEYOR TYPE)	8
26	PE-V0-411-160-A126	QAP OF GEARED MOTOR for MILL REJECT SYSTEM (CONVEYOR TYPE)	10
27	PE-V0-411-160-A129	GA & TDS of Chain Pulley Block for MILL REJECT SYSTEM (CONVEYOR TYPE)	10
28	PE-V0-411-160-A130	QAP OF VALVES for MILL REJECT SYSTEM (CONVEYOR TYPE)	12
29	PE-V0-411-160-A132	GA drawing for Sector Gate with Data Sheet for MILL REJECT SYSTEM (CONVEYOR TYPE)	8
30	PE-V0-411-160-A133	QAP OF INSTRUMENTS for MILL REJECT SYSTEM (CONVEYOR TYPE)	12
31	PE-V0-411-160-A135	GA drawing for Knife gate valve alongwith data sheet for MILL REJECT SYSTEM (CONVEYOR TYPE)	8
32	PE-V0-411-160-A136	QAP OF SUMP PUMP WITH MOTOR for MILL REJECT SYSTEM (CONVEYOR TYPE)	12
33	PE-V0-411-160-A137	QAP OF CABLES for MILL REJECT SYSTEM (CONVEYOR TYPE)	12
34	PE-V0-411-160-A138	GA of Metallic Expansion Bellow with data sheet for MILL REJECT SYSTEM (CONVEYOR TYPE)	8
35	PE-V0-411-160-A139	GA of Rupture Disc with data sheet for MILL REJECT SYSTEM (CONVEYOR TYPE)	8
36	PE-V0-411-160-A140	GA of Sump Pump along with data sheet and wiring diagram for MILL REJECT SYSTEM (CONVEYOR TYPE)	12
37	PE-V0-411-160-A141	Block Logic Diagram/Control Scheme of the MRHS with HMI screen for MILL REJECT SYSTEM (CONVEYOR TYPE)	8
38	PE-V0-411-160-A142	GA and data sheet of C&I Instruments for MILL REJECT SYSTEM (CONVEYOR TYPE)	10
39	PE-V0-411-160-A143	Data sheet of Geared Motor (For All Motors)for MILL REJECT SYSTEM (CONVEYOR TYPE)	10
40	PE-V0-411-160-A144	Technical data sheet of cable tray for MILL REJECT SYSTEM (CONVEYOR TYPE)	12
41	PE-V0-411-160-A146	GA & int-con wiring details for Pyrite Hopper LCP, Drag Link Chain Convytr, Bucket Elevtr, Silo LCP. for MILL REJECT SYSTEM (CONVEYOR TYPE)	12
42	PE-V0-411-160-A147	Technical data sheet of cables for MILL REJECT SYSTEM (CONVEYOR TYPE)	12
43	PE-V0-411-160-A148	Painting Schedule for MILL REJECT SYSTEM (CONVEYOR TYPE)	8

**TITLE****4 x 270 MW BHADRADRI TPS
MILL REJECT SYSTEM (CONVEYOR TYPE)****SPECIFIC TECHNICAL REQUIREMENTS**

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44	PE-V0-411-160-A149	Pipe and valve schedule for MILL REJECT SYSTEM (CONVEYOR TYPE)	8
45	PE-V0-411-160-A150	Cable Schedule - Signal and Control for MILL REJECT SYSTEM (CONVEYOR TYPE)	10
46	PE-V0-411-160-A151	O & M for MILL REJECT SYSTEM (CONVEYOR TYPE)	24
47	PE-V0-411-160-A152	QAP OF PIPES for MILL REJECT SYSTEM (CONVEYOR TYPE)	6

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.

	TITLE 4 x 270 MW BHADRADRI TPS MILL REJECT SYSTEM (CONVEYOR TYPE) SPECIFIC TECHNICAL REQUIREMENTS	SPECIFICATION NO. PE-TS-411-160-A002	
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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
GENERAL TECHNICAL REQUIREMENTS

CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	CODES AND STANDARDS
2.00.00	RESPONSIBILITY FOR DESIGN
3.00.00	NAME PLATES (RATING PLATES)
4.00.00	SAFETY AND SECURITY
5.00.00	GUARDS
6.00.00	LOCATION AND LAYOUT REQUIREMENTS
7.00.00	OPERATION, MAINTENANCE AND AVAILABILITY CONSIDERATIONS
8.00.00	MATERIALS
9.00.00	LUBRICATION
10.00.00	LUBRICANTS & CONTROL FLUIDS
11.00.00	OPERATION AND MAINTENANCE
12.00.00	PLANT LIFE AND MODE OF OPERATION
13.00.00	PACKAGING & MARKING
14.00.00	PROTECTION
15.00.00	ENVIRONMENT PROTECTION AND NOISE LEVEL REQUIREMENT
16.00.00	INSPECTION AND TESTING
17.00.00	TRAINING OF OWNER'S PERSONNEL
18.00.00	DEVIATIONS
	ATTACHMENTS
ANNEXURE-I	LIST OF STANDARDS FOR REFERENCE
ANNEXURE-II	CRITERIA FOR LAYOUT

GENERAL TECHNICAL REQUIREMENTS

1.00.00 CODES AND STANDARDS

1.01.00 Except where otherwise specified, the Plant shall comply with the appropriate Indian Standard or an agreed internationally accepted Standard Specification as listed in the annexure 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 Plant in the same detail as would be possible had there been a Standard Specification.

1.02.00 Where the Bidder proposes alternative codes or standards 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 The plant will be designed in compliance with applicable National and International Codes and Standards such as ASME, ASTM, DIN, BS, IEC, IEEE, IS, etc. Wherever specified or required the Plant shall conform to various statutory regulations such as Indian Boiler Regulations, Indian Explosives Act, Indian Factories Act, Indian Electricity Act, Environmental Regulations, etc. Wherever required, approval for the plant supplied under the specification from statutory authorities shall be the responsibility of the Contractor.

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.

1.05.00 In case of any change of code, standards and regulations between the date of purchase order and the date the Contractor proceeds with manufacturing the Owner shall have the option to incorporate the changed requirements. It shall be the responsibility of the Contractor to advise Owner of the resulting effect.

1.06.00 Successful Bidder to furnish two (2) sets of latest of national/inter-national codes and standards to owner.

2.00.00 RESPONSIBILITY FOR DESIGN

2.01.00 The Contractor shall assume full responsibility for the design of the whole and every portion of the Plant, whether or not the design work was undertaken specifically in relation to the Contract and whether or not the Contractor was directly involved in the design work.

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- 2.02.00 Notwithstanding the Owner's wish to receive the benefits of new, advanced and improved technologies, a prime requirement is that all the systems and components proposed shall have been already adequately developed and shall have demonstrated good reliability under similar, or more arduous conditions elsewhere, at least for continuous 2 years in two different power station.
- 2.03.00 The successful bidder shall have to carry out surge analysis, BFP transient analysis and other transient condition studies as may be necessary and as required by the Owner as per proven engineering practice.
- 2.04.00 The Bid shall include a detailed discussion on the development status of, and the reasons for any changes made in proposed systems or components for the Plant, as compared with similar items previously supplied in other installations cited by the bidder as reference plants.
- 2.05.00 The Bidder may also make alternate offers, provided such offers are superior in his opinion in which case adequate technical information, operating feed back, etc. are to be enclosed with the offer, to enable the Owner to assess the superiority and reliability of the alternatives offered. In case of each alternative offer, its implications on the performance, guaranteed efficiency, auxiliary power consumptions, etc. shall be clearly brought out to the Owner to make an overall assessment. In any case, the base offer shall necessarily be in line with the specifications i.e. Base offer shall be as per the technical specifications and the same will be considered for techno-commercial evaluation.
- 3.00.00 **NAME PLATES (RATING PLATES)**
- 3.01.00 Instruction plates, name plates or labels shall be permanently attached to each main and auxiliary item of plant in a conspicuous position. These plates shall be engraved with the identifying name, type and manufacturers serial number, together with the loading conditions under which the item of plant has been designed to operate.
- 3.02.00 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. Direction of flow is also to be engraved.
- 3.03.00 All trade nameplates and labels shall be in English language. All measurements shall be in M.K.S. Units.
- 3.04.00 The size and location of nameplates shall be subject to Approval of the Engineer.
- 4.00.00 **SAFETY AND SECURITY**
- 4.01.00 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.

4.02.00 Ready and safe access with clear head room shall be provided to all parts of the plant for operation, inspection, cleaning and maintenance.

4.03.00 Escape routes and clear ways shall be provided to allow speedy evacuation of the plant 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 plant layout shall be designed to localise and minimise the effects of any fire or explosion. The recommendations of NFPA, OSHA, and TAC etc. as necessary shall be followed in all respects.

4.04.00 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 materials containing asbestos in any form.

5.00.00 **GUARDS**

5.01.00 Effective guards and fences must be provided to prevent injury to operators through accident or malpractice.

5.02.00 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.

5.03.00 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.

5.04.00 Guards for couplings and rotating shafts shall be in accordance with BS 5304-1975 or similar approved standard. All rotating shafts and parts of shafts must be covered.

5.05.00 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.

LOCATION AND LAYOUT REQUIREMENTS

The majority of plant and equipment (excluding steam generator and some other auxiliaries) 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 plant. 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 and other tender layout drawings show the location of major installations and auxiliary buildings. The Bidder shall try to retain these locations as far as practicable. The layout of equipment within the power house 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 as an alternative his own preferred layout clearly indicating the advantages and other implications, if any. Such alternative will not be considered for evaluating the bid, but may be considered with the successful Bidder if Owner/Engineer finds the proposal more attractive in terms of techno-economic consideration.

While developing the layout of buildings the following criteria shall be given effect :

- a) The minimum width of clear access corridors around equipment shall be 1.2 meter.
- b) 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.
- c) The minimum clear height available between two consecutive floor slabs shall not be less than five (5) meters. A clear head room of 2.5m shall be maintained between the floor and any overhead piping/ cables or other obstruction. Adequate provision for natural ventilation and illumination shall be made as per good engineering practices.
- d) 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.
- e) 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.

- f) All rail/road crossings for pipe/cable racks shall be done with minimum 8 meters headroom from top of rail/road to bottom of rack. Similarly top cover over underground pipes/cables shall be minimum one (1) meter. For other detail refer to Annexure-II.
- g) Cubicle for operating personnel shall be located at safe place near the equipment.
- h) Interplant cable routing will be on overhead cable trays on pipe cum cable trestle or on cable trestle except where approved by purchaser/consultant. In exceptional case, small stretch of outdoor run of interplant cable routing may be taken through cable trench only with the Employer's prior approval.
- i) Concept of various mechanical and electrical equipment location and building dimensions (including column-row spacing) as shown in Plot Plan/Floor Plan drawing are to be adhered to. Any departure from this suggestive layout is primarily not recommended.

7.00.00 OPERATION, MAINTENANCE & AVAILABILITY CONSIDERATIONS

7.01.00 Equipment/works offered shall be designed for high availability, high reliability, low maintenance and ease of operation & maintenance. The Bidder shall specifically state the design features incorporated to achieve high degree of reliability, availability, operability and ease of maintenance. He shall also furnish details of availability records in plants stated in his experience list.

7.02.00 Ample 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 access ladders shall be provided to facilitate operation and maintenance.

7.03.0 Motorised lifting devices, i.e. hoists, chain pulleys, jacks, etc. shall be provided for handling and carrying out maintenance of any equipment and/or part having weight in excess of 2000 Kg. Suitable beams, hooks etc. for this purpose shall be provided in the buildings.

No lifting arrangement is necessary for part having weight less than 500 Kg. Hoist shall be well protected by environment. Suitable painting and coating covering hoist at outdoor shall be provided.

Lifting devices like lifting tackles, slings, etc. to be connected to hook of the hoist/crane shall be provided by the Bidder for lifting the equipment, accessories covered under this specification.

7.04.00 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. Where feasible common

components shall be employed in different pieces of equipment in order to optimize the spares inventory and utilization.

8.00.00 **MATERIALS**

8.01.00 In selecting materials of construction of equipment, the Contractor 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.

8.02.00 In as far as is 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 to assess the suitability of the material for the particular application.

All materials used shall have performed lengthy satisfactory service in similar or more arduous conditions to those proposed by the Contractor.

8.03.00 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.

9.00.00 **LUBRICATION**

9.01.00 Provision shall be made for suitable efficient lubrication where necessary to ensure smooth operation free from undue wear.

9.02.00 Non ferrous capillary tubing shall be used throughout.

9.03.00 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.

9.04.00 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.

9.05.00 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.

9.06.00 The Contractor shall supply grease gun equipment suitable to service each type of nipple fitted.

10.00.00 **LUBRICANTS AND CONTROL FLUIDS**

10.01.00 The Contractor shall provide a detailed and comprehensive specification for all lubricating oils, greases and control fluids required for the entire plant. A sufficient supply of these shall be provided by the Contractor for initial commissioning, first fill and till COD of the unit.

10.02.00 The Contractor 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 and control fluids shall be provided. The Contractor shall endeavor to reduce the varieties and grades of required lubricants and control fluids to a minimum, matching them where possible 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.

10.03.00 No lubricant or control fluid shall have toxic or other harmful effects on personnel or on the environment.

11.00.00 **OPERATION AND MAINTENANCE**

11.01.00 The plant shall be designed and constructed so that operation and maintenance manpower requirements are minimised.

The design and layout shall facilitate inspection, cleaning, maintenance and repair. The importance of continuity of operation is second only to that of safety.

11.02.00 Spare parts for equipment shall be interchangeable with the original components and, so far as possible, be of common design and manufacture.

11.03.00 All similar standard components/parts of similar standard equipment provided shall be interchangeable with one another. Further identical equipments shall be provided for similar duties so that the same are interchangeable with one another in totality and component wise.

11.04.00 All heavy parts (500 Kg and above) must be provided with a convenient arrangement for slinging and handling during erection and overhaul. Any item of plant normally stripped or lifted during periods of maintenance and weighing one tonne or above, shall be clearly marked with its weight.

11.05.00 On completion of commissioning, a complete set of tools for the maintenance of the entire plant shall be provided by the Contractor. This shall include all necessary spanners, special wrenches, extraction equipment and any special tools reasonably required by the Engineer. Tools used during erection and commissioning shall not be accepted except with the specific approval of the Engineer.

11.06.00 All equipment and major valves should be provided with adequate maintenance approach and facility.

12.00.00

PLANT LIFE AND MODE OF OPERATION

The complete plant 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 Steam Generator, Turbine-Generator and Auxiliary equipment, the life of which is limited by time and temperature dependent mechanisms such as thermal stress, creep and low cycle fatigue, are to be designed considering expected (hot, warm and cold) start-up, shut-down 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 Bidder shall discuss this aspect in his technical proposal.

The unit would be operated on base load with cyclic load variation. The load variation is expected to be as per schedule depending on power demand.

The expected start-ups should be considered as minimum
(Based on HPT metal temperature)

Cold start-up (>72 hrs. shutdown)	:	6 per year
Warm start-up (between 10 to 72 hrs. of shutdown)	:	40 per year
Hot start-up (less than 10 hrs. shutdown)	:	160 per year

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 Contractor 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 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 Meters

The above indicates the dimensions which can be normally transported on the

wagons without infringement of the "moving gauge". This is however not indicative of the consignment which can be carried out with infringement of "moving gauge" duly authorised and approved by the Indian Railways. There may be difference between the "moving gauge" and the "fixed structure gauge" and consignments infringing the "moving gauge" can be moved after investigation regarding possible infringement with the fixed structures. As the critical fixed structures in each route are different, consignments infringing moving dimensions have to be individually investigated to select a route and also determine the restrictions under which such movement is to be carried out. Such routes selected or other mode of transport envisaged is to be clearly brought out in the proposal wherever transport of over dimensional equipment is involved.

Bidder to consider unloading of material delivered through rail transportation, at near by railway station/ site unloading siding. The subsequent transportation up to project work place shall be considered by road only. All unloading and handling equipment both at railway station siding and at project site shall be arranged by the Bidder. Necessary arrangement to be organized with the railway authority for such purpose shall also be under the scope of services of the Bidder. Bidder may consider entire material delivered up to site through rail transportation 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 Contractor 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 Contractor, the number and date of contract and names of the office placing the contract, nomenclature of contents and Bill of Material.

For imported equipment and material, suitable port facilities may be used in which case material may be transported from the port by tractor-trailer. Bidder may consider this aspect.

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 substantial type covering to ensure their full protection. All exposed threaded parts shall be greased and protected with metallic or other substantial type protectors.

All piping, tubing and conduit connections on equipment and other equipment openings shall be closed with rough usage covers or plugs. Female threaded openings shall be closed with rough usage covers or forged steel plugs. The closures shall be taped to seal the interior of the equipment. Open ends of

pipings, 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 Contractor's expense.

15.00.00 **ENVIRONMENT PROTECTION AND NOISE LEVEL REQUIREMENT**

15.01.00 **Environment Protection**

The plant 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 restrict pollution from the liquid effluent and stack emission within the limits as given below with due consideration of Environment (Protection) Rules 1986 as amended till date.

In case the Ministry of Environment & Forest stipulate any other conditions not specified hereunder while clearing the project shall be complied with the plant by the contractor.

15.01.01 For Liquid Effluent

- a) Provision laid down in schedule-I for Thermal Power Plants and also in Schedule-VI. General Standards for discharge of Environmental pollutants Part-A : Effects of Environmental (protection) Rules 1986, as amended till date.
- b) Any specific requirement of State Pollution Authorities over and above the above stipulation.

15.01.02 For Air Emission

- a) Suspended Particulate Matter i.e. dust burden at chimney outlet - Maximum 50 mg/Nm³ (with worst coal and one field out at TMCR).
- b) NO_x - 365 ppm Max. or 750 mg/Nm³ (Equivalent NO₂).
- c) SO₂ - Concentration based standard 2000 mg/Nm³. Load based standard 0.2 metric tonne /MWe/day (for first 500 MW and 0.1 metric tonne/MWe/day for rest of the capacity above 500 MW)

In absence of Indian Standard for emission from power plants as on date, for certain gaseous effluents, the internationally accepted World Bank Standard is to be followed. Indian Standard for emission of power plants are under formulation. Should this standard is published before finalisation of the contract, the bidder has to comply the more stringent of the above norm or the new Indian Standard.

The bidder shall include in his scope all necessary equipment and measuring instruments to comply with above requirements. Location and accessibility of the instruments shall be properly coordinated.

15.02.00 **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 1.0M away from the noise emission source.
- 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) 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 Ministry of Environment & Forest regulation during tenure of the contract, the contractor shall comply with the requirement.

An exception will be made for the plant at startup operations and other big pressure reducing devices operating during emergency periods and for the safety valves.

16.00.00 **INSPECTION AND TESTING**

16.01.00 **Inspection and Tests during Manufacture**

- 16.01.01 The method and techniques to be used by the Contractor for the control of quality during manufacture of all plant and equipment shall be agreed with the Owner prior to the Award of Contract.
- 16.01.02 The Owner's general requirements with respect to quality control and the required shop tests are set out elsewhere in this specification.
- 16.01.03 Before any item of plant or equipment 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.
- 16.01.04 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 Contractor may proceed with manufacture having forwarded to the Owner duly certified copies of his own inspection and test results.

The Contractor shall forthwith forward to the engineer duly certified copies of the Test Certificates in six copies (one to the Purchaser and five to the Consulting Engineer) for approval. Distribution of six (6) copies of Test Certificates for approval will be two(2) copies to owner and four(4) copies to consultant. These four(4) copies will be further distributed by consultant after approval to owner, site and bidder. One copy will be retained with the

consultant for record purpose.

Further, nine (9) copies of Shop Test Certificates shall be bound with Instruction Manuals referred to elsewhere. Distribution of nine (9) copies of Shop Test Certificates for approval will be Two (2) copies to owner, Three (3) copies to site, Two (2) copies to consultant, Two (2) copies to owner's library / record.

16.01.05 Under no circumstances any repair or welding of castings be carried out without the consent of the Owner's Engineer. Proof of the effectiveness of each repair by radiographic and/or other non-destructive testing technique, shall be provided to the Engineer along with Defect Map.

16.01.06 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 Contractor shall allow for trial assembly prior to despatch from place of manufacture.

16.01.07 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 Purchaser. The certificates shall include tests for mechanical properties and chemical analysis of representative material or any other test as required by approved QAP/ Material specification.

16.01.08 All pressure parts connected to pumping main shall be subjected to hydraulic testing at a pressure of 150% of shut-off head for a period not less than one hour. Other parts shall be tested for one and half times the maximum operating pressure or as required by design code of that part, for a period not less than one hour.

16.01.09 All necessary non-destructive examinations shall be performed to meet the applicable code requirements.

16.01.10 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 magnuflux 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.

16.01.11 Statutory payments in respect of IBR approvals including inspection for design and manufacturer of equipment shall be made by the Bidder. All payment for erection and testing at site (i.e. under IBR jurisdiction) shall also be made by the Bidder. In such case Contractor's scope shall also be extended to preparation of all necessary documents, co-ordination and follow-up with IBR authorities for above approval.

16.02.00 **Performance Tests at Site**

- 16.02.01 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 by the Contractor on site under normal operating conditions. The Contractor 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.
- 16.02.02 The Bidder shall provide complete details of his normal procedures for testing, for the quality of erection and for the performance of the erected plant. These tests shall include site pressure test on all erected pipe work to demonstrate the quality of the piping and the adequacy of joints made at site.
- 16.02.03 The Contractor shall furnish the quality procedures to be adopted for assuring quality from the receipt of material at site, during storage, erection, pre-commissioning to tests on completion and commissioning of the complete system/equipment.
- 16.03.00 For details of specific tests required on individual equipment refer to respective section of this specification.

17.00.00 TRAINING OF OWNER'S PERSONNEL

The Contractor shall extend all possible assistance and co-operation to the Purchaser regarding the transfer of technology and developing expertise in the area of engineering operation and maintenance of the Plant.

Number of man-days of training as mentioned below shall be included in his Tender.

17.01.00 Training at Contractor's Premises

The Contractor shall conduct training of sixty (60) engineers of the Owner on engineering, operation and maintenance of the Plant at the Contractor's or Associates or Sub-contractor's premises where adequate training facilities are available during the design and manufacturing stage of the Contractor.

The total man-months for training of engineers shall be maximum sixty (60), having following indicative break-up :

Discipline	No. of Engineers	No. of Man-month
Operation	20 heads	20
Maintenance Boiler, Turbine, Mechanical	20 heads	20
Electrical Maintenance	8 heads	4
Control & Instrumentation	8 heads	4
Maintenance Planning	4 heads	2
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However, the details of the training programme will be discussed and finalised with the successful Bidder.

The training may also be arranged by the Contractor in any Plant where the equipment manufactured by the Contractor or his Associates is under installation, operation or testing to enable the trainees to become familiar with the equipment being furnished by the Contractor. All expenses inherently related to the training shall be borne by the Contractor and shall include but not 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.

The training programme shall be adequate for the trainees to acquire the necessary expertise and competence in the area of engineering, operation and maintenance and as trainers for in-house technology transfer programme of the Purchaser.

The Contractor shall be responsible for the development of the Training Module and Programme Schedule which shall be submitted to the Purchaser for approval.

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 Purchaser upon completion of the training. An evaluation shall be jointly undertaken by the Contractor 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.

The content of the training programme shall include but not be limited to:

1. 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.

Said training programme shall be submitted to the Purchaser for approval.

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 Plant.

The Contractor shall provide qualified English speaking instructors and training

coordinator(s) during the tenure of the training programme.

17.02.00 Operation and Maintenance Training at Site

The Contractor shall provide a comprehensive training programme related to design application, plant management, operation and maintenance, including trouble shooting, of the Contractor's supplied system and equipment at the Site starting from Start of Commissioning and thereafter up to the Final Acceptance of the first Unit.

The following instructors shall be at the Site continuously during the training :

- a) One (1) for Steam Generator and Auxiliaries ;
- b) One (1) for Turbine Generator and Auxiliaries ;
- c) One (1) for Electrical Works ;
- d) One (1) for Instrumentation and Control (Boiler and Auxiliaries) ;
- e) One (1) for Instrumentation and Control (Turbine and Auxiliaries).

17.03.00 On-the-Job Training

During the period of pre-commissioning, commissioning and trial operation, the Purchaser shall provide operation and maintenance personnel to assist the Contractor in the operation and maintenance of his supply and work under the direction of the Contractor for the purpose of on-the-job training.

The Purchaser shall have the right to send to the Site his employees later intended to operate and maintain the equipment supplied under this Contract. The Contractor 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.

17.04.00 For detail C&I training refer to Volume-VI, Section-9.

18.00.00 DEVIATIONS

The Bidder is required to submit with his proposal in the relevant schedules a detail list of any and all deviations taken by him clearly without any ambiguity. In the absence of such a list it will be understood and agreed that the Bidder's proposal is based on strict conformance to this specification and no post-contract negotiations would be allowed in this regard.

Unless otherwise specifically indicated in the deviation list, it will be construed and agreed that details indicated in documents & drawings furnished by the Bidder along with the offer is in-line with the specification requirement.

ANNEXURE-I

LIST OF STANDARDS FOR REFERENCE

- a) International Standards Organisation (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 (IEC) Publications.
- t) Power Test Code for Steam Turbines (PTC).
- u) Applicable German Standards (DIN).
- v) Applicable British Standards (BS).
- w) Applicable Japanese Standards (JIS).

- 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) Emission regulation of Central Pollution Control Board (CPCB).
- gg) Pollution Control regulations of Dept. of Environment, Govt. of India
- hh) Central Board of Irrigation and Power (CBIP) Publications.
- ii) The Air Prevention and Control of Pollution Act.
- jj) The Environmental Protection Act
- kk) The Public Liability Insurance Act.
- ll) The Forest Conservation Act
- mm) The Wildlife protection Act.
- nn) The EIA Notification, 1994.
- oo) IS: 14665-Specification for Electric Traction Lift
- pp) Any other statutory Codes/Standards/Regulations

ANNEXURE-II

CRITERIA FOR LAYOUT

PLOT PLAN LAYOUT REQUIREMENTS

ITEM	SPECIFICATION REQUIREMENT
A. Site conditions to be considered	
1. Prevalent wind direction	See wind-rose in plot plan. Also refer Metrological Data.
B. Layout Requirements	
1. Maximum permissible slope in	
a) Rail track	1 in 400
b) Road	1 in 30
c) Sides of unpaved embankment	1 in 2
2. Required road width	
a) Main roads	As per Civil DBR
b) Auxiliary interconnections	
c) Road to the power house unloading bay :	
• Only for entry to the unloading bay	Yes
• To pass through the unloading bay	No
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 building/facility	As per the Tariff Advisory Committee/ LPA Rules
c) Fire water supply installation and any building/facility subject to fire risk.	As per the Tariff Advisory Committee/ LPA Rules
d) Inflammable liquid (fuel oil, etc.) storage & handling installation and their fencing and other buildings/facilities.	Rules of the Indian Explosive (Indian Explosives Act) and Indian Petroleum Code

ITEM	SPECIFICATION REQUIREMENT
4. Required minimum vertical clearance	
a) Under pipes/cable racks at road crossings	8.0 Metres
b) Soil coverage over underground pipes	1.0 Metre (minimum)
5. Railway Wagon clearance	Rules of the Indian Railways
6. Minimum Clearance between any road edge and building/structure/ any fixed installation.	3 Metres
7. Required level, above the local developed grade level, of	
a) top of all roads	150 mm above FGL
b) all outdoor paved areas	100 mm above FGL
c) Temporary storage areas, workshops, offices, residence etc. required at the time of erection work.	Yes
d) Green belt around power plant area	As per environmental guidelines of MOEF, Govt. of India.

BUILDING/ EQUIPMENT LAYOUT REQUIREMENTS

A. Minimum clear space required at all working and walking areas for operating & maintenance personnel	
1. Horizontal, in all directions	
a) Adjacent to any electrical equipment, electrical cables, running (rotating/reciprocating) equipment, safety valve or vent/drain pipe outlet, pipe/ equipment of surface temperature exceeding 60°C.	1200 mm
b) Adjacent to any other plant facilities (including walls/structures)	1000 mm
2. Vertical (head-room clearance)	
a) Under any pipe/equipment surface of temperature exceeding 60°C and any electrical cables or other electrical items.	2.5 Metre
b) Under any other plant facilities (including structures, pipes etc.)	2.5 Metre

ITEM	SPECIFICATION REQUIREMENT
3. For all areas where any equipment (including trucks, trolleys and other material handling equipment) will move or maneuver.	Minimum 500 mm clear in all direction from the outer edges of the equipment
4. Minimum clear hand space required for	
a) The application of thermal insulation	100 mm
b) Welding work	150 mm
c) Bolt tightening	150 mm
B. Floors, platforms, staircase, ladders, walls, doors & windows	
1. Statutory Requirement	As per the regulations of Tariff Advisory Committee, Indian National Building Code, Indian Factories Act, Local Municipal Rules, etc.
2. Operation & Maintenance Requirement	
a) Adequate floor space shall be kept to permit dismantling, temporary storing and in-situ maintenance of plant & equipment parts, satisfying the clear space requirements stated above. A separate unloading bay for such purpose is required.	Yes
b) Floors or fixed/portable platforms with stairs/ ladders shall be provided for easy approach to any plant item, including valves, instruments, etc. to be operated, observed and/or to be frequently (more than once a month) maintained.	Yes
3. Plinth level of all buildings, above the finished grade level	500 mm
4. Minimum access opening required (with rolling shutter) for transportation, wherever entry of truck for material handling is envisaged	3.5M wide x 4M high or, more depending upon the equipment size to be handled.

ITEM	SPECIFICATION REQUIREMENT
C. Other Maintenance Requirement	
1. Generator stator handling In case the Generator stator cannot be handled by the turbine house crane, all provisions for its overhauling, including the arrangement to slide the stator on the turbine house floor, the foundation work for stator jacking /lowering assembly, dismantling of building end walls/structures etc. shall be kept.	Yes
2. Maintenance of the internals/impellers of all important equipment, like boiler feed pumps, feed water heaters, Surface Condenser, fans of the boiler draft plant, Intake and circulating water pumps, cooling water pumps, coal mills, compressors, blowers, heat exchangers, fuel oil pumps, filters etc.	Shall be possible without disconnecting or dismantling any piping/ducting.
3. Overhauling and handling of the casings for the above items	Shall be possible without disturbing/dismantling any piping/ducting not directly connected to them.
4. Crane Approach Wherever required the unobstructed approach of the crane hook/other hoisting equipment hook to various plant & equipment shall be possible.	Yes
D. Central Control Room All electronic equipment other than those directly associated with control, operation or presentation of displays shall be mounted external to the control room in air conditioned control equipment room.	Yes
The bidder shall describe in his bid the proposed layout philosophy of the Central Control Room and Control Equipment Room and the arrangement of equipment best suited for the system offered by him and as per good ergonomically consideration. However, as a guide line, following features are given :	
a) False ceiling and false flooring shall be provided.	
b) Uniform height, colouring schemes for cabinets etc. shall be available.	

ITEM	SPECIFICATION REQUIREMENT
c) The total area of floor space covered by Control Consoles/Panels in the Control Room shall not exceed 15% of floor area.	
d) No opening shall be provided from Boiler side.	
e) Two double leaf doors, suitably located for entering the Control room shall be provided with opening towards the turbine floor.	
f) Cable entry for the panels/consoles shall be from bottom and suitable openings shall be provided.	
g) The Control Room lighting shall be designed to provide a glare free uniform illumination. The level of illumination shall be minimum 400 LUX.	
h) Necessary Air Conditioning shall be provided for Central Control room, Control Equipment Room and SWAS room etc.	
i) Basic amenities like toilet, Tiffin rooms, wash basins, rest rooms etc. shall be provided near the Control Room.	
E. Toilet and drinking water facility	Required in all buildings and on all floors wherever operating personnel are to be deployed.

PROJECT MANAGEMENT AND SITE SERVICES

CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	PROJECT MANAGEMENT SERVICES
2.00.00	SITE SERVICES
3.00.00	PROJECT INFORMATION AND MANAGEMENT SYSTEM, INCLUDING DCOUMENT MANAGMENT SERVER (DMS)

PROJECT MANAGEMENT AND SITE SERVICES

1.00.00 PROJECT MANAGEMENT SERVICES

1.01.00 Responsibility

The Bidder shall identify a separate and independent project management team headed by a Project Manager for the execution of this project. Responsibilities of this project Management team shall cover the areas listed below :

- a) Planning and Monitoring
- b) Engineering Management
- c) Contracts Management
- d) Project Safety Management
- e) Quality Assurance, Inspection & Expediting
- f) Construction Management
- g) Spares Management
- h) Erection & Commissioning Management

Detailed responsibilities in the above areas are discussed below :

1.02.00 Organisation

1.02.01 Headquarters

The headquarters of the project management team shall be headed by a senior level executive designated as the Project Manager who shall be responsible to Owner for the execution of the project. He should have adequate financial power and authority to give decision.

Separately, designated leaders shall be identified for each of the areas mentioned under 1.01.00, who, in turn, will report to the Project Manager for all matters relative to this contract.

1.02.02 Central Co-ordination Cell

The central coordination cell shall have sufficient technical personnel to coordinate technical matters and to quickly resolve day to day queries or

	references made by Owner and his Consultants without having the need to refer to his headquarters each time.
1.02.03	Site Organisation The site should have a competent construction manager for all site operations with adequate financial power and sufficient level of authority to take site decisions. The organisation chart for site should indicate the various levels of experts to be posted for supervision in the various fields in civil construction, erection, commissioning etc.
1.02.04	Organisation Chart The Bidder shall furnish a detailed organisation chart for the project management team, clearly identifying the key personnel in each of the areas mentioned at 1.01.00 above. The expected number of executives at different levels shall also be indicated, separately for headquarters, central coordination cell and site organisation.
1.03.00	Implementation Schedule The schedule for the completion of the Project would be as follows : As per project specific special condition of contract. To achieve these targets, the Contractor shall furnish to the Owner, various schedules as defined below:
1.03.01	Engineering Schedules These schedules shall cover various design submissions indicating different engineering activities to be performed. Such schedules shall be furnished by the Bidder for each and every plant/systems/ equipment item covered in the scope of this specification.
1.03.02	Manufacturing Schedule The Contractor shall submit to the Engineer his manufacturing and delivery schedules for all equipment within thirty (30) days from the date of issue of the Letter of Intent (LOI). Such schedules shall be in line with the detailed network for all phases of the work of the Contractor. Such schedules shall be reviewed, updated and submitted to the Engineer, once in every two months thereafter, by the Contractor. Schedules shall also include the materials and equipment purchased from outside suppliers.

1.03.03 Erection Schedules

In order to achieve the overall completion schedule, the Contractor shall provide the Owner all the information covering erection sequence, testing and commissioning activities. These schedules may be based on the recommended erection procedures and will be subject to discussions/agreements with the Owner subsequent to the award of contract.

1.03.04 The successful Bidder shall have to provide all the above schedules (i.e. 1.03.01, 1.03.02 & 1.03.03) in a tabular form in addition to that in the form of L2 & L3 networks and these shall necessarily include information not limited to the earliest and latest dates for various activities/submissions and also any related constraints. However, the Bidder shall include in his proposal a Level-1 (L-1) network showing the major activities and various milestones to achieve the above mentioned completion schedule.

1.03.05 The Contractor shall provide the Owner the original disc/software for all such schedules alongwith requisite no. of copies (as required by the Owner) within an agreed time schedule. This time schedule will be agreed between Owner/Bidder at the time of award of contract. The Contractor's project management software shall be compatible with that of the Owner and the input data shall be furnished to the Owner in a manner compatible with Owner's project management software, SAP.

1.04.00 Detailed Responsibilities

1.04.01 Planning & Monitoring

a) Planning

The Bidder shall prepare a Master Network Schedule in the form of PERT network.

The network shall be prepared on a Work Breakdown Structure for the project which sub-divides the project into a set of manageable systems/sub-systems. The master network will identify milestones of key events for each system/package in the areas of engineering, procurement, manufacture and despatch and erection and commissioning. The master network shall represent the Level-I plan and will form the basis for development of detailed second and third tier execution plans. The master network shall conform to the overall schedule prescribed by Owner.

The master network should be submitted along with the bid which would be mutually discussed and finalised before the Award of Contract. This master network would clearly indicate the responsibility of the Bidder and project management team. This master network would form a part of the contract. The master network shall also identify a complete list of inputs to be furnished by the Owner which may be required for proper interfacing and tie-up. Scheduled dates for providing such inputs shall also be indicated, which will be mutually discussed and finalised.

b) Monitoring & Progress Reporting

The progress reports would be emanated every month, one from the head office of the Contractor and another from the site office. The progress report emanating from the head office should necessarily include the following sections:

- i) Report on key milestones.
- ii) Management summary indicating critical areas with details of actions initiated and effect of any on the project.
- iii) Action needing attention of the Owner/Consultant.
- iv) Detailed packagewise status of engineering submissions, quality plan submissions and approval, procurement manufacture and despatch.

The monthly report generated from the site office should necessarily include:

- i) Report on key milestones.
- ii) Management summary indicating critical areas with details of actions initiated and effect if any on the project.
- iii) Action needing attention of the Owner/Consultant.
- iv) This report would also cover the areas pertaining to the receipt of the equipment at the port, port clearance, transport, receipt at site, erection and commissioning.

In addition to the above, as the project execution progresses, the Contractor shall also be responsible for generating more frequent reports in the form of fax/e-mail information on progress in critical areas so that actions can be expedited. The exact format of the progress report shall be finalised after award of Contract.

1.04.02 Engineering Management

Based on the master network for the project (L-1) the Contractor will prepare an exhaustive list of engineering activities for the equipment/systems covered in his scope and a detailed programme of accomplishing the same within the time frame specified in the master network. This schedule will form the Level-2 (L-2) network for engineering activities.

Based on (L-2) network, the Contractor shall further develop the Level-3 (L-3) network for engineering activities which will indicate schedule for data availability, drawing release date and document submission dates.

Detailed (L-2) and (L-3) networks would be submitted sequentially by the Contractor within two months from the date of issue of Letter of Intent and finalised within one (1) month thereafter.

All such networks shall be provided in MS PROJECT software as well as in other format / software suitable to Owner.

The engineering management team should also co-ordinate all interface engineering activity between the Contractor and the equipment sub-vendors so as to ensure the correctness and completeness of related engineering documentation before the same is submitted to the Owner.

TSGENCO is implementing SAP ERP. Hence the bidder apart from submission of the hard copies shall upload all the documents, drawings etc. in soft format in the relevant C- folder environment (web based) and comply with the additional requirements, if any.

1.04.03 Contracts Management

Based on the master network, the Contractor shall submit L-2 programmes of manufacture and despatch. In addition, the master network shall also include periods considered for site activities viz. erection, commissioning etc. These L-2 programmes would be submitted in 2 months time from the date of award of contract and finalised within one (1) month thereafter. The Contractor will also submit site mobilisation plan. This programme would be submitted at the time of finalisation of award of contract and agreed immediately thereafter so that immediate development of the various activities at site could take place.

The Contractor should also submit L-3 programmes for the manufacturing, despatch of the various items. These networks shall also show the customer hold points (CHP) which have to be cleared by Owner or their authorised representative(s) before further manufacture can take place. These L-3 programmes for the manufacture and despatch would clearly identify responsibilities of the Contractor, sub-Contractor and Owner. These networks shall be submitted within one (1) month of the date of finalisation of the various sub-contracts by the Contractor.

In case all the manufacture is being done by the Contractor then the L-2 programmes would be themselves amplified to cover details of the manufacture, inspection, clearance by Owner and despatch.

The Contractor shall also submit the programme for procurement of boughtout items, detailed shipping schedule and cash flow statement for Owner's approval.

1.04.04 Quality Assurance, Inspection and Expediting

The Contractor shall submit the list of manufacturers/sub-vendors from whom the equipment are expected to be procured and the quality assurance plans thereof for the manufacture shall be approved by the QA group of Owner before the manufacture is commenced. The list of major suppliers would be submitted along with the bid and this shall be mutually discussed and approval will be given by the Owner during contract negotiation meeting prior

to placement of Letter of Intent. This approved list will be binding to the bidder. In the said list, Owner reserves the right to include reputed/reliable vendors of his own choice. Regarding the various other sub-vendors, the list would be submitted within six (6) months of the award of the contract that shall be scrutinized by the Owner to accord approval. In such list Owner reserves the right to include vendors of his own choice. No further vendor approval will be given after twelve (12) months. On the quality plans, the customer hold points will also be identified based on which Owner would give clearance for the manufacture to proceed further.

Quality assurance/Inspection group of Owner or its representative would issue a material despatch clearance certificate (MDCC) after the inspection clearance which will enable the Contractor to despatch the equipment and claim the payment. In the despatch programme, the Contractor shall indicate a schedule of estimated programme, tonnages specifically identifying various oversize dimensioned consignments (ODC). Further the Contractor will also be required to ensure at all stages of shipment that packing of all shipments despatched are suitable for ocean freight to India, handling at the port of entry, inland transportation and preservation at site upto erection. All despatch details & item lists shall be made available to both Owner & site immediately after shipping.

The Contractor shall also expedite all despatches from their own works/works of their sub-vendors, so as to match with the various activities mentioned at 1.04.03 above.

1.04.05 Construction Management

Based on the L-1 Master Network Programme, within two (2) months of the issue of Letter of Intent, the Contractor shall submit a programme of construction/ erection/ commissioning, either in continuation with the manufacture and despatch or separately for the implementation. These programmes would be amplified showing when the civil drawings shall be released by him and construction of civil works shall be completed by him to facilitate start of erection and subsequent activities and shall form the basis for site execution and detailed monitoring. The three monthly rolling programme with the first month's programme being tentative based on the site conditions would be prepared based on these L-3 programmes. The Contractor shall also be involved along with the Owner to tie up detailed resource mobilisation plan over the period of time of the contract matching with the performance targets.

The L-3 programme would be jointly finalised by the site in charge of the Contractor with the Owner's project coordinator as well as the site planning representative. The erection programme will also identify the sequential erectable tonnages that are required for various equipment which should be taken care of in the despatch programmes.

Erection and commissioning of the equipment shall also be done under the supervision of experts from the respective equipment/ system supplier.

1.04.06 Spares Management

Alongwith the proposal for the plant and equipment, the Contractor shall also submit proposals/schedule for the following:

- a) Mandatory spares
- b) Recommended spares

While the award for mandatory spares will be finalised at the time of the award of contract, recommended spares will be finalised thereafter.

1.05.00 **Project Progress Review Meetings**

Keeping in mind the overall responsibility of the Contractor it is intended that periodic progress reviews on the entire activities of execution of the project will be held initially at least once in two (2) months at Hyderabad/site/ at the discretion of the Owner.. During peak period it may be held once in a month. These meetings will be attended by reasonably higher officials of the Contractor and their leading sub- contractors and will be used as a forum for discussing all areas where progress needs to be speeded up. Actions will be placed on the concerned agencies and decisions will be taken to expedite/speed up the progress. Minutes of such meetings will be issued reflecting the major discussions and decisions taken and circulated to all concerned for reference and action. The Contractor shall be further responsible for ensuring that suitable steps are taken to meet various targets decided upon such meetings.

In addition to the above, and to streamline the construction and erection at site, a suitable frequency and forum of periodic meetings between the Contractor and the Owner will be decided upon as part of erection coordination procedure. Site co-ordination meeting may be held on weekly basis.

1.06.00 **Owner's Consultant**

The Owner would appoint a consultant to assist him in some of the areas mentioned at 1.01.00 above. The details of interaction and procedures for coordination between Owner / Owner's Consultant and Contractor/ Contractor's project management team shall be finalised during contract negotiations.

1.07.00 **Commissioning Management**

1.07.01 For commissioning of the various equipment/system covered under the scope of contract, Owner will form an organisation structure which may consist of the following committees. The Contractor shall nominate his representative on one or more of the committee as decided by the Owner:

- a) Steering Committee
- b) Commissioning Panel.
- c) Working Parties
- d) Testing Teams.

1.07.02 Commissioning documents shall be prepared by the Contractor in the

following manner and submitted for Owner's approval :

a) Field Quality Plan

This document shall be prepared for the various equipment/ systems under commissioning and shall have the following objectives to fulfill and shall be submitted for Owner's approval at least six (6) months before their actual commissioning :

- i) Establish design data against which Plant Performance will be compared.
- ii) Set-out the testing objectives and proposals.
- iii) Define the documentation required.

b) Testing/Commissioning Schedule

These shall be prepared for the various equipment/systems under consideration and shall contain sections like detailed testing method, programme, safety, individual responsibility and results.

c) Standard Check Lists

Standard check lists are intended for use at the completion of erection to ensure correct erection, testing and to a limited extent operation for repetitive items.

1.07.03 Test Reports

After the completion of commissioning activity of equipment/ systems, the Contractor shall prepare the test reports which shall include all the relevant information related to various commissioning checks, tests carried out, any deviations/commissions noticed with respect to the intended design requirements, sequence of various commissioning activities as actually adopted vis-a-vis as recommended in the procedures, programme schedules achieved and any other such information as required. These test reports shall be submitted in requisite number of copies to the Owner and this should be duly signed jointly by the Owner/Consultant and the Contractor/Equipment supplier, who are involved during the commissioning activities.

2.00.00 **SITE SERVICES**

These services shall be rendered by the Bidder as part of the overall project management service. The services shall broadly include but not be limited to the following :

2.01.00 Arranging material despatch from the shop by rail/road and/or sea as applicable.

2.02.00 Monitoring movement of materials & follow-up as necessary with Railways, road transport, port clearance etc. from the time of despatch F.O.R. works/ F.O.B. port of shipment by Contractor till receipt of the same at site.

- 2.03.00 Unloading of materials at Railway Station/Railway Siding inside project area/ Road Transportation, transportation to site store, assessment of lost/damaged items in transit and arranging insurance claims and replacement of lost/damaged items. The Contractor shall submit to the Engineer a report detailing all the receipts during the week as well as storing, preservation of material at site.
- 2.04.00 Issuing materials from site store/open yard from time to time for erection as per the construction programme. The Contractor shall be the custodian of all the materials issued till the plant is officially taken over by the Owner after complete erection and successful trial run & commissioning.
- 2.05.00 Transportation of materials to their respective places of erection and erection of the complete plant & equipment as supplied under this specification.
- 2.06.00 Trial run and commissioning of individual equipment/sub-systems and the plant as a whole to the satisfaction of the Owner, including supply of temporary equipment & services for chemical cleaning, steam blowing as well as performance guarantee tests.

Apart from Boiler, proper chemical cleaning shall be carried out in following pipe lines/equipment before commissioning

- a) Deaerator
- b) Boiler feed suction, recirculation leak-off lines
- c) Boiler Feed discharge line by passing heaters
- d) Attenuation lines
- e) Condensate suction & discharge piping upto deaerator by passing the feed water heaters.
- f) Fuel oil lines.

Provision for preservation of individual equipment after trial run and commissioning e.g. Nitrogen blanketing etc. as necessary shall also be in the scope of the Bidder.

Safe disposal of effluent after chemical cleaning shall be done by the contractor.

- 2.07.00 Supply and application of the final paints and first fill lubricants on all the equipment to be erected under this specification. Supply of chemicals, lub oils and other consumables upto COD.
- 2.08.00 For the purpose of erection and commissioning the Contractor's scope of work shall include but not be limited to the following :
- 2.08.01 Deployment of all skilled and unskilled manpower required for erection, supervision of erection, watch & ward, commissioning and other services to

	be rendered under this specification.
2.08.02	Deployment of all erection tools & tackle, construction machinery, transportation vehicles and all other implements in adequate number and size, appropriate for the erection work to be handled under the scope of this specification.
2.08.03	Supply of all consumables, e.g. welding electrodes, cleaning agents, diesel oil, grease, lubricant etc. as well as materials required for temporary supports, scaffolding etc. as necessary for such erection work except those listed under exclusion elsewhere in this specification.
2.08.04	Construction of all civil/structural/architectural works, including construction of foundation for all equipment supplied as required, grouting of equipment on foundation after alignment, and all other incidental civil activities as detailed elsewhere.
2.08.05	All structural steel fabrication and erection work as detailed elsewhere in the specification.
2.08.06	Providing support services for the Contractor's erection staff e.g. construction of site offices, temporary stores, residential accommodation and transport to work site for erection personnel, insurance cover, watch & ward for security and safety of the materials under the Contractor's custody etc. as required.
2.08.07	Maintaining proper documentation of all the site activities undertaken by the Contractor as per the proforma mutually agreed with the Owner; submitting monthly progress reports as also any such document as and when desired by the Owner; taking approval of all statutory authorities e.g. Boiler Inspector, Factory Inspector, Inspector of Explosives, Electrical Inspector etc. for respective portions of work under the jurisdiction of such statutes or laws.
2.08.08	The Contractor shall provide 'Industrial Relations' unit and 'Medical' unit to take care of his erection staff and the Owner shall have no obligation in the regard.
2.08.09	The successful Bidder shall arrange for Tower cranes of adequate capacity for speedy erection activities.
2.09.00	Site Organisation The Contractor shall maintain a site organisation of adequate strength in respect of manpower, construction machinery and other implements at all times for smooth execution of the contract. This organisation shall be reinforced from time to time, as required, to make up for slippages from the schedule without any commercial implication to the Owner. The site organisation shall be headed by a competent construction manager having sufficient authority to take decisions at site.

On award of contract, the Contractor shall submit to the Owner a site organisation chart indicating the various levels of experts to be deployed on the job. The Owner reserves the right to reject or approve the list of personnel

proposed by the Contractor. The persons, whose bio-data have been approved by the Owner, will have to be posted at site and deviations in this regard will not generally be permitted.

The Contractor shall also submit to the Owner for approval a list of construction equipment, erection tools, tackle etc. prior to commencement of site activities. These tools & tackle shall not be removed from site without written permission of the Owner.

2.10.00 General Guidelines for Field Activities

2.10.01 The Contractor shall execute the works in a professional manner so as to achieve the target schedule without any sacrifice on quality and maintaining highest standards of safety and cleanliness.

2.10.02 The Contractor shall co-operate with the Owner and other Contractors working in site and arrange to perform his work in a manner so as to minimise interference with other Contractors' works. The Owner's engineer shall be notified promptly of any defect in other Contractor's works that could affect the Contractor's work. If rescheduling of Contractor's work is requested by the Owner's engineer in the interest of overall site activities, the same shall be complied with by the Contractor. In all cases of controversy, the decision of the Owner shall be final and binding on the Contractor without any commercial implication.

2.10.03 The Engineer shall hold weekly meetings of all the Contractors working at Site at a time and a place to be designated by the Engineer. The Contractor shall attend such meetings and take notes of discussions during the meeting and the decisions of the Engineer and shall strictly adhere to those decisions in performing his Work. In addition to the above weekly meeting, Engineer may call for other meetings either with individual contractors or with selected number of contractors and in such a case the Contractor, if called will also attend such meetings.

2.10.04 Time is the essence of the Contract and the Contractor shall be responsible for performance of his Work in accordance with the specified construction schedule. If at any time the Contractor is falling behind the schedule, he shall take necessary action to make good of such delays by increasing his work force or by working overtime or otherwise accelerate the progress of the work to comply with the schedule and shall communicate such action in writing to the Engineer, satisfying that his action will compensate for the delay. The Contractor shall not be allowed any extra compensation for such action.

2.10.05 The Engineer shall however not be responsible for provision of additional labour and or materials or supply or any other services to the Contractor except for the co-ordination work between various Contractors as set out earlier.

2.10.06 The works under execution shall be open to inspection & supervision by the Owner's engineer at all times. The Contractor shall give reasonable notice to the Owner before covering up or otherwise placing beyond the reach of inspection any work in order that same may be verified, if so desired by the Owner.

- 2.10.07 Every effort shall be made to maintain the highest quality of workmanship by stringent supervision and inspection at every stage of execution. Manufacturer's instruction manual and guidelines on sequence of erection and precautions shall be strictly followed. Should any error or ambiguity be discovered in such documents, the same shall be brought to the notice of the Owner's engineer. Manufacturer's interpretation in such cases shall be binding on the Contractor.
- 2.10.08 The Contractor shall comply with all the rules and regulations of the local authorities, all statutory laws including Minimum Wages, Workmen Compensation etc. All registration and statutory inspection fees, if any, in respect of the work executed by the Contractor shall be to his account.
- 2.10.09 All the works such as cleaning, checking, leveling, blue matching, aligning, assembling, temporary erection for alignment, opening, dismantling of certain equipments for checking and cleaning, surface preparation, edge preparation, fabrication of tubes and pipes as per general engineering practice at site, cutting grinding, straightening, chamfering, filling, chipping, drilling, reaming, scrapping, shaping, fitting-up bolting/welding, etc., as may be applicable in such erection and are necessary to complete the work satisfactorily, are to be treated as incidental and the same shall be carried out by the Contractor as part of the work.
- 2.10.10 In case of any class of work for which there is no such specification as laid down in the contract such as, blue matching, welding of stainless steel parts, etc., the work shall be carried out in accordance with the instructions and requirements of the Engineer and as per the Standards.
- 2.10.11 It may sometimes be necessary to remove some of the erected structural members to facilitate erection of bigger/pre-assembled equipment. In such cases, the removal and re-erection of such members, which are essential, and if so agreed by the Engineer, will have to be done by the Contractor.
- 2.10.12 Attachment welding of necessary instrumentation tapping points, thermocouple pads, root valves, condensing vessels, flow nozzles and control valves etc., both for regular measurement and performance testing to be provided on equipment, its auxiliaries or pipelines covered within the scope of this tender, will also be the responsibility of the Contractor and the same will be done as per the instructions of Engineer. The erection and welding of all above items will be the Contractor's responsibility, even if :
- a) Product groups under which these items are re-leased are not covered in the scope of this tender.
 - b) Items are supplied by an agency other than the Contractor.
- 2.10.13 Preservation of all materials/equipment under custody of the Contractor during storage, pre-assembly & erection, commissioning etc., shall be the responsibility of the Contractor. All necessary preservatives and consumables like paints, etc., shall be arranged by the Contractor. Necessary touch up painting, periodic application of preservatives/paints on pressure parts/other equipment even after erection until completion of work shall be carried out by

the Contractor. The Contractor shall fabricate piping, install lub oil systems and carry out the acid cleaning of fabricated piping. The Contractor shall also service the lub. oil system, carryout the hydraulic test of oil coolers, etc.

- 2.10.14 It is responsibility of the Contractor to do the alignment etc. if necessary, repeatedly to satisfy Engineer, with all the necessary tools & tackle, manpower, etc. The alignment will be complete only when jointly certified so, by the Contractor's Engineer & Owner. Also the Contractor should ensure that the alignment is not disturbed afterwards.
- 2.10.15 Additional platforms for approaching different equipment as per site requirement, which may not be indicated in drawings, shall be fabricated and erected by the Contractor. The materials required for these works shall be supplied by the Contractor and he will have to fabricate them to suit the requirement.
- 2.10.16 Equipment and material which are wrongly installed shall be removed and reinstalled to comply with the design requirement at the Contractor's expense, to the satisfaction of the Owner/ Consultant.
- 2.10.17 Before erection of any equipment on a foundation, the Contractor shall check and undertake if necessary rectification of foundation bolts, reaming of holes, drilling of dowels, matching of bolts and nuts, making new dowel pin, etc.
- 2.10.18 Assistance for calibrating/testing the power cylinders, valves, gauges, instruments, etc., and setting of actuators coming under various groups shall be provided by Contractor.
- 2.10.19 It shall be the responsibility of the Contractor to provide ladders on columns for initial works till such time stairways are completed. For this, the ladder should not be welded on the column and should be prefabricated clamping type. No temporary welding on any structural member is permitted except under special circumstances with the approval of Owner.
- 2.10.20 Structural materials required for the supporting/operating platforms required for the valves at various levels for the same operation of valves will be arranged by the Contractor.

2.11.00 **Safety**

Safety and overall cleanliness of work site shall be given top priority.

- 2.11.01 The Contractor shall ensure the safety of all workmen, materials and equipment either belonging to him or to others working at site. He shall observe safety rules & codes applied by the Owner at site without exception.
- 2.11.02 The Contractor shall notify the Owner of his intention to bring to site any equipment or material which may create hazard. The Owner shall have the right to prescribe the conditions under which such equipment or material may be

handled and the Contractor shall adhere to such instructions. The Owner may prohibit the use of any construction machinery, which according to him is unsafe. No claim for compensation due to such prohibition will be entertained by the Owner.

- 2.11.03 Storage of petroleum products & explosives for construction work shall be as per rules and regulation laid down in Petroleum Act, Explosive Act and Petroleum and Carbide of Calcium Manual. Approvals as necessary from Chief Inspector of Explosives or other statutory authorities shall be the responsibility of the Contractor.
- 2.11.04 The Contractor shall be responsible for safe storage of his and his sub-contractor's radioactive sources.
- 2.11.05 All requisite tests & inspection of handling equipment, lifting tools & tackle shall be done by the Contractor and certified copies shall be supplied to the Owner. Defective equipment shall be removed from service. Any equipment shall not be loaded in excess of its recommended safe working load.
- 2.11.06 All combustible waste and rubbish shall be collected and removed from the worksite at least once each day. Use of undercoated canvas paper, corrugated paper, fabricated carton, plastic or other flammable materials shall be restricted to the minimum and promptly removed.
- 2.11.07 The Contractor shall provide adequate number of fire protection equipment of the required types for his stores, office, temporary structures, labour colony etc. Personnel trained for fire-fighting shall be made available by the Contractor at site during the entire period of the Contract.
- 2.11.08 All electrical appliances used in the work shall be in good working condition and shall be properly earthed. No maintenance work shall be carried out on live equipment. The Contractor shall maintain adequate number of qualified electricians to maintain his temporary electrical installation.
- 2.11.09 All workmen of the Contractor working in construction site shall wear safety helmets, safety boots and safety belts. The Contractor shall take appropriate insurance cover against accidents for his workmen as well as third party.
- 2.11.10 All the worksites shall be provided with adequate lighting facilities e.g. flood lighting, hand lamps, area lighting etc. by the Contractor for proper working environment during night times.
- 2.11.11 All safety precautions shall be taken for welding and cutting operations as per IS-818.
- 2.11.12 All safety precautions shall be taken for foundation and other excavation marks as per IS-3764.
- 2.12.00 **Taking Delivery & Storage**
- 2.12.01 The Contractor shall arrange issue of all equipment and materials to be erected under the contract from the stores/open yard at site by signing on standard indent forms. After completion of work, detailed auditing of the

materials so issued shall be submitted to the Owner.

- 2.12.02 The Contractor shall arrange for proper and safe storage of materials till the same are taken over by the Owner as per terms of the contract. Manufacturer's instructions for preservation shall be strictly followed.
- 2.12.03 All empty containers, packing materials, gunny bags, transport frames and also surplus and unused materials reconciliation prior to completion of contract shall be the property of the Owner and returned to the Owner by the Contractor.
- 2.13.00 **Site Welding & Heat Treatment**
- 2.13.01 Welding shall be done in accordance with IS-813, IS-816, IS-9595 & other relevant IS/International standards and as per instructions of Contractor. Only those welders, who are qualified as per IS-817 for ordinary welds and as per IBR/ASME Section-IX for high pressure welds, shall be employed in the job.
- 2.13.02 All welders shall be tested and approved by Engineer before they are actually engaged on the work even though they may possess the requisite certificates. The Owner reserves the right to reject any welder without assigning any reason. The welder identification code as approved by the Engineer shall be stamped by the welder on each joint done by them. The Contractor will be responsible for the periodic renewal, re-testing of the welders as demanded by Owner.
- 2.13.03 The Engineer is entitled to stop Contractor's any welder from his work if his work is unsatisfactory for any technical reason or there is a high percentage of the rejection of joints welded by him, which in the opinion of Engineer will adversely affect the quality of welding even though the welder has earlier passed the tests. The welders having passed the tests do not relieve the Contractor from his contractual obligations, to check the performance of the welders.
- 2.13.04 All charges for testing of welders including destructive and non- destructive tests if conducted by Owner or by the inspection authority at site shall have to be borne by the Contractor. The necessary test materials and consumables will have to be arranged by the Contractor and all testing facility made available, as required.
- 2.13.05 All welded joints shall be subject to acceptance by Engineer. Inspection of welds shall be in accordance with IS-822 or equivalent code.
- 2.13.06 Preheating/post heating and stress relieving after welding are part of fabrication and erection work and shall be performed by the Contractor in accordance with the instruction of Engineer. Contractor shall arrange to supply heating equipment with automatic recording devices. Also the Contractor shall have to arrange for the labour, heating elements, thermocouples, compensating cables, insulation materials like mineral wools, asbestos cloth, ceramic beads, asbestos rope, etc. required for the heat-treatment and stress relieving works. During pre- heat/stress relieving operations, the temperature shall be measured at one or more points as required by attaching thermocouples and recorded on a continuous printing

type recorder. All the record graphs for the heat treatment works carried out shall be got signed by the Engineer prior to the commencement of each cycle and handed over to Engineer on completion. The graphs will be the property of Owner. The Contractor has to provide thermo-chalks temperature recorders, thermocouple attachments, units, graph sheets, etc. required for the job and maintain them in good condition.

- 2.13.07 All electrodes shall be baked and dried in the electric/electrode drying oven to the required temperature and for the period specified by the Engineer before they are used in erection work. The electrodes used shall be as per IS-814, IS-815, IS-1442, IS-7280 and other codes as applicable, and shall be of approved reputed manufacture. The electrodes shall meet the requirement of the pipe material. No electrode manufactured more than 12 months ago and the type covered under certificate issued after conducting tests more than 6 months ago shall be used. All electrodes shall be preserved at works and at site as per manufacturer's recommendations.
- 2.13.08 Oxy-acetylene flame or Exothermic chemical heating for stress relieving is not permitted. Heating shall be by means, of electric induction coil or electric resistance coil.
- 2.13.09 It may become necessary to adopt inter layer radiography/MPT/UT depending upon the site/technical requirement necessitating interruptions in continuation of the work and making necessary arrangement for carrying out the above work.
- 2.13.10 Gas tungsten arc welding process (TIG) shall be adopted for all root pass welds except for structural works until 4.75 mm thickness is deposited. Subsequent welding after root pass can be carried out by manual metal arc welding with coated electrodes. For pipes of thickness less than 6 mm the entire welding has to be carried out by TIG welding.
- Fillet weld shall be made by shielded metal arc process as per applicable codes.
- However, the Engineer will have the option of changing the method of welding as per site requirement. The method adopted for manual arc welding shall be weaving technique and the width of weaving shall not exceed 1.5 times of the dia. of the electrode.
- In case of deviation from welding process and electrodes, the Contractor shall take approval of the Owner prior to adoption of same.
- 2.13.11 The root pass for butt joints shall be such as to achieve full penetration with complete fusion of root edges.
- 2.13.12 Each pass shall be cleared and freed of slag before the next pass is deposited.
- 2.13.13 On completion of each run, craters, weld irregularities, slag etc. shall be removed by grinding or chipping.
- 2.13.14 Each layer of welding shall have an even and smooth appearance.

- 2.13.15 Welding sequence shall be adjusted in such a way that distortion due to welding shrinkage is minimised. Further any movement, shock or vibration during welding shall be avoided to prevent weld cracks.
- 2.13.16 Proper protection of welders and the work shall be taken during periods of rain. No welding shall be carried out when surface to be welded are wet from any cause.
- 2.13.17 Following will be stages of inspection during welding :
- a) Two pieces to be joined shall be individually checked for the weld edge preparation and profile dimensionally and to the template. Dye penetrant check shall be carried out on edge prepared surfaces at random. The percentage will depend upon on criticality as specified by Engineer.
 - b) Joint fit up will be a stage of inspection. Misalignment after fit up may vary from 0.3 mm to 1.6 mm depending on outside diameter and thickness.
 - c) All joints shall be offered for visual inspection after root run. Subsequent welding should be made only after the approval of root run.
- 2.13.18 All welded joints shall be painted with anti-corrosive paint immediately on completion of radiography and stress-relieving.

3.00.00 **PROJECT INFORMATION AND MANAGEMENT SYSTEM, INCLUDING DCOUMENT MANAGMENT SERVER (DMS)**

3.01.00 Contractor shall submit as part of its Work Scope detailed documentation as outlined in this section and / or required by the Technical Requirements. The content and format of the documentation to be submitted are subject to Owner's approval.

3.02.00 Contractor shall utilise a computer based system for control and management of project documentation. The system must be capable of producing customized reports and information on demand. This control system should have been successfully applied to similar projects and be familiar to the project control personnel selected. Contractor's detailed project documentation plan shall identify all documentation requirements for the project, the party responsible for production of the document, the basic content of the document and the required timing for issue. This plan shall include, but not be limited to the details of all Drawings to be produced, plant specification / definition documentation, equipment orders and manuals. The documentation identified shall be entered into the computer based control system The database thus created shall be capable of being sorted and

ordered on a variety of selected parameters such as document type, subject description, responsible party, start date and finish date, to enable review and update to be conducted only on those documents which are relevant.

3.03.00 Regular documentation control progress reports shall be prepared by the Contractor to record the status of documentation. In the event either Party or Engineer expresses concern with the content of such progress reports, the accuracy of progress reports, status of documentation production and other such matters, the concern will be identified to the Project Manager. Within five days of notification of this concern, the Project Manager will attend a meeting with relevant Owner Representatives and provide details of specific actions to be initiated to satisfactorily overcome the difficulties identified. It will be the Project Manager's responsibility to initiate whatever action is necessary to ensure that the production of documentation is completely in accordance with Project Information Management System (PIMS).

3.04.00 Within 90 days after Effective Date of Contract, the Contractor shall establish an integrated PIMS which will support the needs of Project and management, detail design and engineering, procurement, construction and operation, and maintenance.

PIMS shall utilise software which links various software and database programs to form a composite system. The typical scope of PIMS shall include, but not be limited to, the following:

- (a) Power plant systems and equipment data, from which Project specific flow diagrams, data sheets and other integrated data are derived. The Power plant systems and equipment data, from which Project specific flow diagrams, data sheets and other integrated data are derived. This data shall include, but not be limited to, the following:
 - (i) System descriptions and design requirements and design criteria
 - (ii) Equipment and material technical specifications for all engineering disciplines
- (b) Detail engineering data to create flow diagrams, plant arrangements, piping configurations, equipment layout and design, electrical and instrumentation systems, structures, and other systems. The software tool used shall be capable of manipulation and storage of plant layout and design information. The 3D model of the plant shall also contain details of the various components like pipe, structural steel work, etc., and relevant information shall be available on-line from relevant data base. Software shall be multi-user, multi-access nature allowing the designers of Contractor and major Sub-Contractors, if required, to work in interactive real time environment and software shall be capable of interference checking. The software shall allow access to different types of information held in the database. It shall estimate the type and quantity of materials required to build the plant and it shall be possible for such data to be taken off the system at any time.

(c) Construction data to monitor and manage site activities, including material control, scheduling and progress, quality control, start-up and testing, operation, maintenance, training, and all other site functions.

(d) Plant design and construction records to provide data for safe and efficient maintenance and operation. Records to include may be maintenance schedule, man power tracking, tools, spare parts, and test equipment inventory, equipment list, drawing, control, technical specifications, and equipment instruction manuals.

3.05.00 The PIMS shall be installed in a distributed processing array system and operated through personal computer work stations at the Contractor's site office. A complete integrated system shall be implemented. This system shall be utilised by Contractor during the Project execution.

ENGINEERING SERVICES

CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	GENERAL
2.00.00	DESIGN COORDINATION MEETING
3.00.00	CO-OPERATION WITH OTHER CONTRACTORS AND CONSULTING ENGINEERS
4.00.00	GUIDELINES FOR ENGINEERING SERVICES
5.00.00	OPERATING MANUALS AND MAINTENANCE INSTRUCTIONS
6.00.00	PLANT HANDBOOK
7.00.00	CONTRACT STAGE DOCUMENT SUBMISSION AND APPROVAL PROCEDURE
8.00.00	TENDER STAGE DOCUMENT SUBMISSION

ATTACHMENTS

ANNEXURE-1	DISTRIBUTION SCHEDULE

ENGINEERING SERVICES

1.00.00 GENERAL

1.01.00 As part of the overall project management activity, the Contractor shall be responsible for proper engineering and co-ordination of activities during various phases of execution of the contract. The Contractor shall identify a person, designated as Project Manager, with whom the Owner, the Consulting Engineer or the Review Consultant shall interact on matters related to engineering as well as execution of the contract. The Project Manager shall be the single-point contact person on behalf of the Contractor and shall be responsible for all 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 Contractor or on matters involving the Contractor, 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 contractors. However such interaction will not, under any circumstance, dilute the responsibility of the Contractor to provide a fully engineered and co-ordinated package under this contract.

1.02.00 On finalization of the contract, a procedure for exchange of engineering information will be mutually agreed and finalized between the Owner and the Contractor.

2.00.00 DESIGN COORDINATION MEETING

The Contractor and his sub-vendors will be called upon to attend design co-ordination meetings with the Engineer, other Contractors and the Consultants of the Owner during the period of execution of contract. The Contractor including his sub-vendors shall attend such meetings at their own cost at Owner's 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 CONTRACTORS AND CONSULTING ENGINEERS

The Contractor shall agree to cooperate with the Owner's other Contractors and Consulting 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 Engineer shall be provided with copies of all correspondences addressed by the Contractor to other Sub- contractors and Consulting Engineers in respect of such exchange of technical information.

4.00.00 **GUIDELINES FOR ENGINEERING SERVICES**

- 4.01.00 Prior to commencement of the 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 engineering work.
- 4.02.00 Engineering work shall be performed on modern and proven concepts and internationally accepted good engineering practices but fully compatible with the Indian environments. Owner shall have the right to review and approve the engineering work by themselves and/or through consultant and ask for any clarifications and changes/modifications to the work performed by Contractor.
- 4.03.00 At any stage during the performance of assignment, the Contractor may be required to make certain changes/modification/improvements in design/drawing/other documents which are applicable to 800 MW Unit, which in the opinion of the Owner could result in better improved design, layout, operability, plant availability, maintainability, reliability or economy of the plant 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 Contractor.
- 4.04.00 During the course of review of detailed 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 engineering, it may be essential in Owner's opinion to obtain data and information on similar equipment and plants 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 engineering work to be carried out by Contractor, however, all engineering work required for the satisfactory completion of the plant/systems as specified shall be carried out by the Contractor. 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 (plant 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 Contractor 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-contractors.
 - 4.06.03 Review of sub-contractor'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, Terminal Points & 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 power plant.
 - 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 plant 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 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.
 - 4.06.12 For all bought out item packages, the Contractor shall provide complete material / component list along with detail specification, drawings, component part no. etc. during detail engineering stage prior to final approval. Such approved drawing/document shall be made available at site in adequate number prior to commencement of work. Moreover, such document/drawing shall be provided in soft form (CD)
 - 4.06.13 Preparation of necessary documentation, design calculations etc. required for submission to statutory authorities like IBR, Chief Electric Inspector, Factory Inspector etc.
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5.00.00 **OPERATING MANUALS AND MAINTENANCE INSTRUCTIONS**

5.01.00 The Contractor shall provide at least six (6) months before the time of commissioning and before taking over of the plant and equipment, all necessary maintenance manuals and operating instructions. The instruction manual shall be submitted in the form of one (1) soft copy in CD and 15 hard copies as per distribution schedule (Annexure-1).

5.02.00 The information provided, which shall be contained in loose leaf stiff backed covers, shall include :

- a) A complete inventory of all main items of plant, with identification details.
- b) Service manuals for all plant and equipment giving full descriptions of the main items and auxiliary items such as power packs, hydraulic equipment, actuators, lubricating pumps, etc.
- c) A separate electrical manual covering items such as switchgear, cabling, instrumentation, controls, cabling layouts and wiring diagrams.
- d) A schedule of recommendations for routine maintenance of all electrical and mechanical equipment, recommended inspection point, information on detection, cause and rectifications of troubles & faults.
- e) A lubrication schedule with all necessary drawings diagrams to identify the lubrication points.
- f) Manufacturer's literature.

5.03.00 The instruction manual shall be subject to the approval of Owner.

6.00.00 **PLANT HANDBOOK**

The Contractor shall submit to the Engineer, a preliminary plant handbook preferably in A-4 size sheets which shall contain the design and performance data of various plant, equipment and systems covering the complete project including single line flow diagrams, within twenty four (24) months from the date of his acceptance of the Letter of Intent. The final plant handbook complete in all respects shall be submitted by the Contractor six (6) months before start-up and commissioning activities. The plant handbook shall be submitted as per distribution schedule.

7.00.00 **CONTRACT STAGE DOCUMENT SUBMISSION AND APPROVAL PROCEDURE**

7.01.00 Within fifteen (15) days to one month of issue of Letter of Intent (LOI) by the Owner, the Contractor shall furnish a schedule of drawings and design

document to be submitted by him to the Owner/Engineer indicating dates against each document.

The documents shall be divided into two categories : a) for approval and b) for information/further engineering and co-ordination by the Owner.

In preparing this schedule, the Contractor shall allow two (2) weeks from date of receipt for review and comments by the Owner/Engineer for each submission of a document.

This document submission schedule shall require approval by the Owner/Engineer.

7.02.00 All contract documents shall be marked, without fail, 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.

7.03.00 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/Engineer.

7.04.00 Unless specified otherwise, the following categories of documents/drawings would require approval of the Owner/Engineer:

- a) List of sub-vendors (from Owner only)
- b) System scheme and instrumentation diagrams
- c) Design basis justifying selection of equipment & process parameters where not specified in the Contract
- d) Equipment data sheets and general arrangement drawings
- e) Materials of construction
- f) Layout drawings.
- g) Operation logic diagrams.
- h) Typical control circuit.
- i) Drawings of Instrumentation and control.

7.05.00 Unless specified otherwise, the following categories of documents/ drawings would be treated for information/further engineering by the Owner/Engineer. The Contractor shall, however, incorporate all additional information and clarifications in these documents / drawings as and when desired by the Owner/Engineer.

- 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) Cable schedule and interconnection chart.
- j) Drive/feederwise control scheme showing all external interfaces.

In essence, the Contractor is solely responsible for corrections and adequacy of design & engineering for documents under this category.

7.06.00

Upon review, the Owner/Engineer shall put his remarks and one of the following action stamps on the drawing/document:

- a) A - Drawing submitted as approved, proceed with fabrication
- b) B - Drawing approved subject to comments noted, proceed with fabrication, considering our comments. Correct as necessary and resubmit for record.
- c) C - See attached memo.
- d) D - Correct your original drawing incorporating our comments and resubmit for approval.
- e) E - Information furnished is noted.
- f) F - Prints not enclosed

For action stamps in category (c) & (d), documents must be resubmitted for review by the Owner/Engineer. For action stamp in category (b), further review by Owner/Engineer would not be necessary provided the Contractor agrees & incorporates the comments made on the document.

Except for action stamp under category (c) & (d), the Contractor can proceed with manufacturing and other sequential activities for those areas of a drawing/document which do not have any review comment by the Owner/Engineer.

The Owner/Engineer may accord approval in category (c) or (d) in more than one submission of a document till he is satisfied that the intent of the specification has been fully complied with. The Contractor shall be responsible for delay in such cases and no extension of time shall ordinarily be allowed on such grounds. Approval of contract documents by the Owner/Engineer shall not relieve the Contractor of his responsibility for any errors and fulfillment of contract requirements.

The Contractor's work shall be in strict accordance with the finally approved drawings and no deviation shall be permitted without written approval of the Owner/Engineer.

- 7.07.00 Except key plan/general yard plan, any layout drawing requiring scrutiny shall not be drawn to a scale less than 1:50.
- 7.08.00 For review by the Consulting Engineer, the Contractor shall furnish soft copies of drawings & documents and three (3) prints of each drawing/document. Two (2) prints of such submission shall also be sent to the Owner. After review, comment/approval will be sent to the Contractor. Upon action under category (a) or (e), the Contractor shall directly distribute the documents to the various offices of the Owner and other agencies in number of copies as specified in the contract document. Such distribution copies shall be marked with the reference and date of the letter by which the Owner/Engineer has accorded his final approval. Penal action shall be taken against the Contractor for any unauthorised revision in the drawings so distributed from the drawings approved by the Owner/Engineer. The contractor shall furnish three (3) CDs of all as built/final drawings for Owner/Consultant site.
- 7.09.00 In case of contradiction between the stipulations above and those stated elsewhere in the specification, the stipulations herein shall prevail.

ANNEXURE-1

DISTRIBUTION SCHEDULE

S. No	Description	TSGENCO										Consultant			Equipment Vendor	Remarks
		Director Projects	Director Technical	CE/Civil Thermal Projects Hyd.	CE/ TPC-I, Hyd	CE/ O&M/	SE/ Civil	SE/E&M /	DE Constr.		HYD	BTPS				
A	Letter Of Intent or Contract Documents	1	1	1	S	1	2	2	1	1	1	1	2			
B	Vendor Drawings															
1.	Preliminary	1	1	1	2	1	1	2	2	12	1	-	S			
2.	Return preliminary with comments	-	-	1	2	1	1	1	1	S	1	-	1			
3.	Final and any revision thereof															
	a. Civil	1	1	6+1T	1	1	6+1T	1	-	2+1T	1	1	S			
	b. E&M	1	1	1	6+1T	1	1	6+1T	1	2+1T	1	1	S			
C.	Design Drawings															
1.	Preliminary															
	a. Civil	1	1	2	1	1	2	1	1	4	1	1	S			
	b. E&M	1	1	1	2	1	1	2	1	4	1	1	S			
2.	Released for construction															
	a. Civil	1	1	2	1	1	6	1	1	1	1	2	S			
	b. E&M	1	1	1	1	2	1	6	1	1	1	2	S			
3.	Return marked 'As built'															
	a. Civil	-	-	1	-	-	1	-	-	1	1	S	1			
	b. E&M	-	-	-	1	-	-	1	1	1	1	S	1			
4.	As built drawings															
	a. Civil	-	-	1+1T	-	2+1T	5+1T	-	1	1+1T	-	1	S			
	b. E&M	-	-	1	2+1T	2+1T	-	5+1T	1+1T	1+1T	-	1	S			

S. No	Description	TSGENCO										Consultant		Equipment Vendor	Remarks
		Director Projects	Director Technical	CE/Civil Thermal Projects Hyd.	CE/ TPC-I, Hyd	CE/ O&M/	SE/ Civil	SE/E&M /	DE Constr.						
D	Progress Report Monthly														
1.	Equipment vendor	1	1	1	2	1	1	2	1	1	1	1	1	S	
2.	Consultant	1	1	2	2	1	1	2	1	S	1	1	1	Nil	
E	Test & Inspection Reports														
1.	Equipment manufacturer														
	a. Civil	1	1	1	2	1	1	1	-	11	1	1	1	S	
s	b. E&M	1	1	-	2	1	-	1	1	11	1	1	1	S	
2.	Consultant	1	1	-	2	1	-	1	1	S	-	1	1	-	
F	Instruction Manuals/Data Books														
1.	Equipment manufacturer														
	a. Civil	1	1	1+1T	1	1	6+1T	1	1	2+1T	1	1	1	S	
	b. E&M	1	1	-	3+1T	1	-	6+1T	2	3+1T	1	1	1	S	
2.	Consultant	1	1	-	10+1T	1	-	15+1T	-	S	1	1	1	Nil	
G	Consultant	1	1	1	8+1T	1	1	2	1	1	1	1	1	S	
H	Design Calculations	1	1	1	8+1T	1	1	2	1	1	1	1	1	S	
I	Final consulting Engineering Report	1	1	1	10	1	1	2	1	S	1	1	1	Nil	

S – Source, T – Transparency & Soft Copy on CD,

TSGENCO

: Telangana State Power Generation Corporation Limited

Director, Projects, Hyd

: Director/ Projects, TSGENCO, Vidut Soudha, Hyderabad – 500 082

QUALITY ASSURANCE REQUIREMENTS

CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	QUALITY ASSURANCE PROGRAMME
2.00.00	GENERAL REQUIREMENTS QUALITY ASSURANCE
3.00.00	QUALITY ASSURANCE DOCUMENTS
4.00.00	INSPECTION, TESTING & INSPECTION CERTIFICATES

ATTACHMENTS

ANNEXURE-I	FORMAT OF QUALITY ASSURANCE PROGRAMME
ANNEXURE-II	FIELD WELDING SCHEDULE

QUALITY ASSURANCE REQUIREMENTS

1.00.00 QUALITY ASSURANCE PROGRAMME

1.01.00 To ensure that the equipment and services under the scope of Contract whether manufactured or performed within the Contractor's works or at his Sub-contractor's premises or at the Owner's site or at any other place or work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points, as necessary. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Owner/Authorised representative after discussions before the award of contract. A quality assurance programme of the Contractor shall generally cover the following :

- a) His organisation structure for the management and implementation of the proposed quality assurance programme.
- b) Documentation control system.
- c) Qualification data for Bidder's key personnel.
- d) The procedure for purchase of materials, parts, components and selection of Sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.
- e) System for shop manufacturing and site erection control including process controls and fabrication and assembly controls.
- f) Control of non-conforming items and system for corrective actions.
- g) Inspection and test procedure both for manufacture and all site related works.
- h) Control of calibration and testing of measuring and testing equipments.
- i) System for quality audit.
- j) System for indication and appraisal of inspection status.
- k) System for authorising release of manufactured product to the Owner.
- l) System for handling storage and delivery.
- m) System for maintenance of records.

- n) Furnishing of quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component as per format enclosed at Annexure-I to this section for Owners approval
- o) Internal standards, if referred in the quality plans shall generally be compatible with National / International standards and shall be mentioned in the quality plans. Alternatively bidder shall furnish extracts of the internal standards detailing out acceptance norm for the product / material.

2.00.00 **GENERAL REQUIREMENTS - QUALITY ASSURANCE**

2.01.00 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the Contractor for some of the major items is given in the respective technical specification. This is however, not intended to form a comprehensive programme as it is the Contractor's responsibility to draw up and implement such programme duly approved by the Owner/Consultant. The detailed Quality Plans for manufacturing and field activities should be drawn up by the Bidder, separately in the format attached at Annexure-I and will be submitted to Owner/Authorised representative for approval. Schedule of finalisation of such quality plans will be finalised before award.

Contractor shall furnish list of Manufacturing Quality Plans of major equipments indicating proposed inspection categorisation indicating items that will be offered for Owner's inspection etc and the Field Quality Plans

2.02.00 Manufacturing Quality Plan for all the major equipment will detail out their respective important components, their in-process various tests/inspection & final inspection / tests, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's Quality Control organization. The relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing are to be comprehensibly documented by Contractor.

Manufacturing Quality Plan for all major equipments/ items will be approved by owner. In these approved quality plans, Owner / Authorised representative shall identify customer hold points (CHP), test / checks which shall be carried out in presence of the Owners Engineer or his authorised representative and beyond which the work shall not proceed without consent of Owner / Authorised representative in writing. Inspection/ Test reports are to be submitted to owner as specified in final approved Manufacturing Quality Plans.

2.03.00 Field Quality Plans / Procedures for all field activities shall be submitted to

	owner for review / approval. These Quality Plans / procedures will detail out, for all equipment, the quality practices and procedures etc. to be followed by the Contractor's site Quality Control organisation, during various stages of site activities from receipt of materials/ equipment at site.
2.04.00	The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality plans and reference documents/standards etc. will be subject to Owner's approval without which manufacture shall not proceed. These approved documents shall form a part of the contract. In these approved quality plans, Owner/Authorised representative shall identify customer hold points (CHP), test/checks which shall be carried out in presence of the Owners Engineer or his authorised representative and beyond which the work will not proceed without consent of Owner/Authorised representative in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and major deviations in the form of Non Conformity Report shall be referred to Owner/Authorised representative for approval and dispositioning.
2.05.00	No material shall be despatched from the manufacturer's works before the same is accepted subsequent to pre-despatch final inspection including verification of records of all previous tests/inspections by Owner's Engineer/ Authorised representative for "CHP" and "W" points marked in quality plans , and duly authorised for despatch by issuance of Material Despatch Clearance Certificate (MDCC). For items which is not under owner's inspection the contractor shall apply for despatch clearance (MDCC) from owner by submitting their internal inspection reports and quality records
2.06.00	All materials used or supplied shall be accompanied by valid and approved materials certificates and tests and inspection report. These certificates and reports shall indicate the sheet serial numbers or other such acceptable identification numbers of the material. The material certified shall also have the identification details stamped on it.
2.07.00	Castings and forgings used for construction shall be of tested quality. Details of results of chemical analysis, heat treatment record, mechanical property test results shall be furnished.
2.08.00	All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section - IX (latest edition) or other International equivalent standard acceptable to the Owner.
	All brazers, welders etc. employed on any part of the contract at Contractor's/ Sub-Contractor's works or at site shall be qualified as per ASME Section-IX (latest edition) or equivalent international standard approved by the Owner. Such qualification tests shall be conducted in presence of Owner / his authorised representative or owner approved Third Party Inspection Agency(TPIA). Previously qualified WPS & PQR shall be acceptable if witnessed by owner's approved TPIA.
	For welding of pressure parts and high pressure piping coming under IBR purview, the requirements of IBR shall also be complied with.

2.09.00	All non-destructive examination (NDT) shall be carried out in accordance with LIST OF STANDARDS FOR REFERENCE as given below in this section. The NDT operator shall be qualified as per SNT-TC-IA (of American Society of non- destructive examination). Results of NDT for the list major equipments / items identified for owner's inspection shall be properly recorded and submitted for review and approval. Other items not covered under owner's inspection, contractor shall review and approve the NDT results and such reports shall be submitted to owner in the final documentation of the items / equipments
2.10.00	All the sub-vendors proposed by the Contractor for procurement of major bought out items including castings, forgings, semi-finished and finished components/equipment list of which shall be drawn up by the Contractor and finalised with the Owner shall be subject to Owner's approval. Quality Plans of the successful vendors shall be discussed, finalised and approved by the Owner/Authorised representative and form part of the Purchase Order between the Contractor and the Vendor.
2.11.00	All the purchase specifications for the major bought-out items, list of which shall be drawn up by the Contractor and finalised with the Owner shall be furnished to the Owner for comments and subsequent approval before orders are placed. Owner reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub-vendor's quality management and control activities. The Contractor shall provide all necessary assistance to enable the Owner carry out such audit and surveillance. Quality audit/approval of the results of tests and inspection will not prejudice the right of the Owner to reject equipment not giving the desired performance after erection and shall not in no way limit the liabilities and responsibilities of the Contractor in earning satisfactory performance of equipment as per specification.
2.12.00	Quality requirements for main equipment shall equally apply for spares and replacement items.
2.13.00	Repair/rectification procedures to be adopted to make any job acceptable shall be subject to the approval of the Owner.
2.14.00	For quality assurance of all civil works refer to the specifications for civil works.
3.00.00	QUALITY ASSURANCE DOCUMENTS
3.01.00	The Contractor shall be required to submit two (2) copies and two (2) sets of microfilms / CDs of the following Quality Assurance documents within three (3) weeks after despatch of the equipment: a) Material mill test reports on components as specified by the specification.

- b) The inspection plan with verification, inspection plan check points, verification sketches, if used and methods used to verify that the inspection and testing points in the inspection plan were performed satisfactorily.
- c) Non-destructive examination results /reports including radiography interpretation reports.
- d) Factory tests results for testing required as per applicable codes and standards referred in the specification.
- e) Welder identification list listing welder's and welding operator's qualification procedure and welding identification symbols.
- f) Sketches and drawings used for indicating the method of traceability of the radiographs to the location on the equipment.
- g) Stress relief time temperature charts.
- h) Inspection reports duly signed by QA personnel of the Owner and Contractor for the agreed inspection hold points. During the course of inspection, the following will also be recorded :
 - i) When some important repair work is involved to make the job acceptable.
 - ii) The repair work remains part of the accepted product quality.
- i) Letter of conformity certifying that the requirement is in compliance with finalised specification requirements.

4.00.00 **INSPECTION, TESTING AND INSPECTION CERTIFICATES**

4.01.00 The Owner's Engineer, or his duly authorised representative and/or an outside inspection agency acting on behalf of the Owner shall have access inside the workshops, test labs, establishments at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain for the Owner's Engineer and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.

4.02.00 The Contractor shall give the Owner's Engineer/ Authorized Inspector twenty one (21) days written notice for "CHP" / "W" points of any material being ready for testing by owner' engineer / Authorized inspector. Such tests shall be to the Contractor's account except for the expenses of the Inspector. The Engineer/ Inspector, unless the witnessing of the tests is virtually waived, will attend such tests within fifteen (15) days of the date on which the equipment is notified as being ready for test/inspection. If owner's Engineer / Authorised Inspector fail to attend the inspection, next mutually convenient date for test shall be agreed with Contractor. Contractor shall, in

-
- no case proceed with the test without owner or his authorized inspectors, unless the witnessing is officially waived and advised Contractor to proceed with the test. Contractor shall forthwith forward duly certified completed test report and a product quality certificate in six (6) copies to owner upon completion of such test.
- 4.03.00 The Engineer or Inspector shall within fifteen (15) days from the date of Inspection as defined herein give notice in writing to the Contractor, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract / QAP or other approved quality documents. The Contractor shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall confirm in writing to the Engineer/Inspector giving reasons therein, that no modifications are necessary to comply with the contract / QAP or other approved quality documents.
- 4.04.00 When the factory tests have been completed at the Contractor's or sub-contractor's works, the Engineer/Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests excluding the test completion date subject to submission of all certified documents related to the test, If the tests are not witnessed by the Engineer/Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Engineer/Inspector. Failure of the owner's Engineer/Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests, or the issue of the certificates shall not bind the Owner to accept the equipment should it, on further tests after erection be found not to comply with the contract / QAP or other approved quality documents.
- 4.05.00 In all cases where the contract provides for tests whether at the premises or works of the Contractor or any sub-contractor, the Contractor, except where otherwise specified shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the owner's Engineer/Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Contract / QAP or other approved quality documents. Contractor and shall give facilities to the owner's Engineer/ Inspector or to his authorised representative to accomplish testing.
- 4.06.00 To facilitate advance planning of inspection in addition to giving inspection notice as per Clause 4.02.00, the Contractor shall furnish quarterly inspection programme indicating proposed schedule dates of inspection at customer hold point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.

LIST OF STANDARDS FOR REFERENCE

- a) International Standards Organisation (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) Power Test Code for Steam Turbines (PTC).
- u) Applicable German Standards (DIN).
- v) Applicable British Standards (BS).
- w) Applicable Japanese Standards (JIS).
- x) Electric Power Research Institute (EPRI).
- y) Standards of Manufacturer's Standardization Society (MSS)

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- 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) Emission regulation of Central Pollution Control Board (CPCB).
 - gg) Pollution Control regulations of Dept. of Environment, Govt. of India
 - hh) Central Board of Irrigation and Power (CBIP) Publications

ANNEXURE-I
FORMAT OF QUALITY ASSURANCE PROGRAMME

VENDOR'S LOGO , NAME & ADDRESS		MANUFACTURING QUALITY ASSURANCE PLAN										DOC NO: XXXXX-CAL-QAP-M-0001	
		ITEM : -										REV NO : 0 1 2 3 4	
												DATE :	
CLIENT :		LOCATION :											
PROJECT :		REFERENCE PURCHASE ORDER NO. & DT :											
VENDOR :		REFERENCE APPROVED DATA SHEET :											
SUB VENDOR :		REFERENCE APPROVED DRAWING. NO. :											
ABBREVIATIONS :												GENERAL REMARKS 1 THE ITEMS WHICH ARE FALLING UNDER ANY STATUTORY AUTHORITY'S (LIKE I.B.R. ETC.) SCOPE SHALL BE SUBJECTED TO THAT STATUTORY AUTHORITY'S INSPECTION CLEARANCE.	
QAP - QUALITY ASSURANCE PLAN,		MATL - MATERIAL,		1 - PROJECT AUTHORITY									
CR - CRITICAL,		APP - APPROVED,		2 - SUPPLIER									
MA - MAJOR,		DWG - DRAWING,		3 - SUB-SUPPLIER									
MI - MINOR		SUPL - SUPPLIER,		4 - MANUFACTURER									
SPEC - SPECIFICATION,		PROC - PROCEDURE		5 - THIRD PARTY INSPECTION AGENCY									
TC - TEST CERTIFICATES													
P - PERFORM													
W - WITNESS													
V - VERIFY													
CHP - CUSTOMER HOLD POINT													
NOTES:													
1. EXACT MATERIAL / PROCESS / INSPECTION / TESTS FOLLOWED BY THE MANUFACTURER SHALL BE SPECIFIED													
2. EXACT REFERENCE DOCUMENT/ACCEPTANCE STANDARD SHALL BE SPECIFIED													
3. IN CASE SPECIFIED ACCEPTANCE STANDARD / NORMS IS OTHER THAN NATIONAL / INTERNATIONAL STANDARDS													
. STANDARD / COPY OF THE ACCEPTANCE NORMS FOLLOWED BY THE MANUFACTURER SHALL BE SUBMITTED FOR REVIEW RECORD													
4 FINAL INSPECTION DOSSIER SHALL BE PREPARED BY MANUFACTURER & SHALL BE ENDORSED BY INSPECTION AGENCY													
Prepared by				Checked by				Approved By					
Revision		R0		R1		R2		R0		R1		R2	
DATE													

[illegible]

ANNEXURE-II

FIELD WELDING SCHEDULE

PROJECT : FWS NO :
 CONTRACTOR : REV NO. :
 PACKAGE : FIELD WELDING CODE :
 SYSTEM : PAGE NO. :

Sl No.	Drawing No. for Weld Locations & Identification mark	Description of parts to be welded	Material specification	Dimensions	Process of Welding	Type of Weld	Electrode Filler Specification	WPS No.	Minimum Pre-heat Temperature	Heat Treatment Temperature [Holding Time in secs]	NDT Method	NDT Specification Number	Acceptance Norm Ref.	Remarks

The Field Welding Schedule should be submitted for :

- o Pressure Parts
- o Tanks/Vessels
- o Piping
- o Heavy/Important Structural Steel
- o Heat Exchangers
- o Bus Ducts

**REQUIREMENTS OF SPARES, TOOLS & TACKLE,
LUBRICANTS/OIL/CONSUMABLES**

CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	TOOLS AND TACKLE
2.00.00	SPARES
	ATTACHMENT
ANNEXURE-I	MANDATORY SPARE LIST

REQUIREMENTS OF SPARES, TOOLS & TACKLE, LUBRICANTS/OIL/CONSUMABLES

1.00.00 TOOLS & TACKLE

The Contractor shall supply with the equipment one complete set of special tools and tackle as required for the erection, assembly, dismantling & maintenance of the equipment. These special tools will also include special material handling equipment, jigs & fixtures for maintenance and calibration/readjustment, checking & measurement aids etc. A list of such tools & tackle shall be submitted by the Bidder along with the offer. Detailed description of each tools/tackle, its function along with the equipment/part for which it is meant for and the price of each tools/tackle shall also be indicated in the offer. These tools & tackle shall be separately packed and sent to site before the first unit commissioning. The Bidder shall also ensure that these tools are not used for erection purpose.

2.00.00 SPARES

2.01.00 General

The Bidder shall indicate and include in his scope of supply all the necessary start-up, commissioning and recommended spares in addition to mandatory spares as specified elsewhere in the specification. The Owner reserves the right to buy any or all mandatory and recommended spares. The Contractor shall also state for each item of spares both mandatory and recommended, the normal expected service life.

2.01.01 All spares supplied under this contract shall be strictly interchangeable with the parts for which they are intended to replace. 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 bags with dessicator packs as necessary.

2.01.02 Each spare part shall be clearly marked or labelled on the outside of the packing with the description. When more than one spare part is packed in a single case, a general description of the contents shall be shown on the outside and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purposes of identification.

2.01.03 All cases, containers or other packages are liable to be opened for examination as may be considered necessary by the Engineer.

2.01.04 All mandatory spares shall be delivered to site within one to three months prior to the scheduled date of the trial operation of the plant. However, they shall not be despatched before the despatch of the associated main equipment.

2.01.05 The Bidder shall also guarantee supply of spare parts, which will be made, based on manufacturer's drawings on special order from the Purchaser for 30 years after commissioning of the plant.

2.02.00 **Recommended Spares**

2.02.01 The Contractor shall provide a list of recommended spares giving unit prices and total prices for 2 years of normal operation of the plant for spares of indigenous origin, and for 5 years of normal operation for spares of non-indigenous origin. This list shall take into consideration the mandatory spares specified elsewhere in the specification and should be a separate list.

2.02.02 The price of recommended spares will not be used for the evaluation of bids. The price of these spares shall remain valid for a period as specified elsewhere in the specification from the date of Award of the Contract. Where the recommended spares are the same as mandatory spares, the prices shall be the same. The prices of any recommended spares, which are not common with mandatory spares, shall be subject to review by the Owner, and shall be finalised after mutual discussion.

2.03.00 **Start-up Commissioning Spares**

2.03.01 Start-up commissioning spares are those spares which may be required during the start-up and commissioning of the equipment/system. All spares used until the plant is handed over to the Owner shall come under this category. Said spares, properly marked, shall be supplied together with the main equipment and shall be used by the Contractor, if needed, during erection & commissioning stage. All such spares which remain unused till issuance of Taking Over Certificate by the Owner, along with an equipment-wise quantitative consumption report shall be returned to the Owner during time of handover. The list of commissioning spares to be brought by the Contractor to ensure smooth commissioning of the plant shall be subject to the Engineer's approval.

2.03.02 The Contractor shall submit a complete BBU list inclusive of recommended, mandatory, initial start-up and commissioning spares. Costs of the above spares, which are consumed before the handing-over of the plant, shall be deemed to have been included in the lump sum proposal price of the package, and the Contractor shall have no claim on this account to the Owner.

2.04.00 **Mandatory Spare Parts**

2.04.01 The Owner considers some of the spares are essential for running the equipment irrespective of whether they are included in the list of recommended spares by the Bidder as mentioned above.

Since the components involved can not be foreseen at the bidding stage, only

broad requirements of the Owner in this respect are outlined hereinafter. The bidder shall include his proposal, on the basis of this guideline, an item-wise list of all components and the quantity, unit prices & total price thereof, offered as mandatory spares for each and every equipment. This list shall be separate from the list of recommended spares and shall be used for bid evaluation purposes. Any clarification in this respect may be obtained by the Bidder at the pre-bidding stage.

- 2.04.02 The mandatory spares should be supplied to the Owner at least one month before the trial run. The despatch programme is subject to approval of the Owner/Consultant after award of contract.

ANNEXURE - VI
PAINTING

TECHNICAL SPECIFICATION

FOR

PROTECTIVE LINING 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 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 / : Near White Blast Cleaning
- b) SSPC PA 2 : Measurement of dry film Coating Thickness with magnetic gauges.
- c) ASTM D 4541 : 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 on 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 C222-2000 : Polyurethane Coating for the Interior and Exterior of Steel Water Pipe and Fittings.
- j) IS 13213 : 2000 : Polyurethane Full Gloss Enamel (Two pack)

3.00.00 GENERAL REQUIREMENTS

- 3.01.00** The steel surface preparation prior to actual commencement of coating shall conform to SSPC SP 10 / NACE 2 / Sa2½ (near white metal) with sand blasting.
- 3.02.00** The contractor 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.
- 3.03.00** The contractor shall also provide copies of test reports from NABL approved laboratory (like National Test House, Kolkata) in support of the paint/primer materials to be used shall conform to the specification requirement.
- 3.04.00** The contractor 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.
- 3.05.00** 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.

- 3.06.00 Applied coating shall be tested for dry film thickness, holiday (electrical inspection for continuity) and adhesion as per relevant standard such as SSPC PA 2, NACE RP 0274 and ASTM D 4541.
- 3.07.00 If necessary, the material may be heated and applied by airless spray / plural component spray system.
- 3.08.00 Manufacturer's specific recommendation, if any, shall be followed during application of lining / paints.
- 3.09.00 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.
- 3.10.00 The colour scheme of the entire Plant, covered under this specification shall be approved by the Purchaser in advance before application.
- 3.11.00 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.
- 3.12.00 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.
- 3.13.00 For vessels / tanks requiring lining and epoxy painting all inside surface shall be blast cleaned using non-siliceous abrasive after usual wire brushing.
- 3.14.00 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.
- 3.15.00 Surface hardness of rubber lining shall be 65 +/- 5 deg. A (shore).
- 3.16.00 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.

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

3.18.00 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.

3.19.00 All insulated piping shall have aluminium sheet jacketing.

4.00.00 EQUIPMENT, MATERIAL AND SERVICES TO BE FURNISHED BY THE BIDDER

4.01.00 After erection at site, the outside surfaces of all equipment having a shop coat shall be given further priming coat and finished coats of paint as detailed in following clauses. However, if the painting system is such that the shop coat and primer coat to be applied at site are not compatible, then shop coat has to be removed from the surface of equipment before application of primer coat with prior blasting.

All factory finished paints shall be touched up at site as required.

All uninsulated piping shall be finished with final paintings after use of proper wash primer and primer. Aluminium sheet jacketed piping need not be painted. Colour bands of Purchaser's approved shade shall however be applied on jacketed piping near walls or partitions, at all junctions, near valves and all other places as instructed by the Purchaser. All structures shall be painted with approved paint.

4.02.00 Surface Preparation

4.02.01 Unless mentioned otherwise, all rust and mill scale shall be removed by blasting to Sa 2-1/2 Swiss Standard before applying the primer.

4.02.02 Special care shall be taken to remove grease and oil by means of suitable solvents like Trichloroethylene or Carbon Tetrachloride.

4.02.03 The minimum degree of surface preparations for all equipment, piping, fittings, valves, structures etc. shall be "Near White" according to Steel Structure, Painting Council-SSPC-SP-10 before application of any primer/paint.

4.03.00 Painting

- 4.03.01 Specification for application of paints for external surfaces protection of vessels / tanks / equipment / piping / fittings / valves etc. to be installed indoor shall be as follows :
- a) Surface preparation shall be done either manually or by any other approved method.
 - b) Primer Coat shall consist of one coat (minimum DFT of 50 microns) of chlorinated rubber based zinc phosphate.
 - c) Intermediate Coat (or Under Coat) shall consist of one coat (minimum DFT of 50 microns) of chlorinated rubber based paint pigmented with Titanium Dioxide.
 - d) Top Coat shall consist of one coat (minimum DFT of 50 microns) of chlorinated rubber paint of approved shade and colour with glossy finish.
 - e) Total DFT of paint system shall not be less than 150 microns.
- 4.03.02 Specification for application of paints for external surfaces protection of vessels / tanks / equipment / piping / fittings / valves etc to be installed **outdoor** shall be as follows :
- a) Surface preparation shall be done by means of sand blasting, which shall conform to Sa 2-1/2 Swiss Standard.
 - b) Primer Coat shall consist of one coat (minimum DFT of 100 microns) of epoxy resin based zinc phosphate primer.
 - c) Intermediate Coat (or Under Coat) shall consist of one coat (minimum DFT of 100 microns) epoxy resin based paint pigmented with Titanium Dioxide.
 - d) Top Coat shall consist of one coat (minimum DFT of 75 microns) of epoxy paint of approved shade and colour with glossy finish. Additional one coat (minimum DFT of 25 microns) of Finish Coat of polyurethane shall be provided.
 - e) Total DFT of paint system shall not be less than 300 microns.
- 4.03.03 Specification for application of paints for external surfaces protection of steel pipes and fittings which are **buried underground / laid inside a huge pipe & or submerged Under Water and laid under Pipe Trenches** (in road/rail/pipe or trench crossings) shall be as follows :

The no. of coats and DFT specified above is minimum. However to achieve above specified DFT, no of coats can be increased as per paint manufacture's recommendation.

External surface of the pipe, fittings, specialties etc. handling raw water/clarified water/filter water shall be painted with one coat of two part chemically cured polyurethane primer of min 50 micron dry film thickness followed by three or maximum four coats of two part solvent less polyurethane to build up coating of dry film thickness of 2000 micron including primer coat.

- 4.03.04 Specification for application of paints for **internal surface protection of large diameter pipes** (sizes above 600 mm NB and above) if any, shall be as follows :
- a) All Internal surfaces of steel pipes, fittings, specialties etc. buried underground or located within pipe trenches shall be given epoxy coating to protect them from (except for drinking water service, where the compatible painting shall be so selected to meet relevant quality standards) corrosion.
 - b) Internal surface of the pipe should be coated with one coat of two part epoxy primer with not less than 50 micron DFT (dry film thickness) followed by two part polyamide cured solvent less epoxy.
 - c) The minimum dry film thickness (DFT) of internal lining shall be 600 micron.
- 4.03.05 Specification for application of paints for protection of **internal surfaces of DM Water Storage Tank(s)** shall be as follows :
- a) Primer - One coat of epoxy primer containing high level of Zinc Phosphate anticorrosive pigment. Total Dry Film Thickness (DFT) of primer shall not be less than 125 microns.
 - b) Finish Paint - Three (3) coats Polyamine HB Epoxy Paint. Total Dry Film Thickness (DFT) of finish paint shall not be less than 125 microns per coat.
 - c) Total thickness of primer and paint should not be less than 500 microns.
- 4.03.06 All motors, local push button stations, cable racks, structures used for supports etc. are to be painted with acid proof paint.
- 4.03.07 The following surfaces shall not be painted - stainless steel, galvanized steel, aluminum, copper, brass, bronze and other nonferrous materials.
- 4.03.08 No painting or filler shall be applied until all repairs, hydrostatic tests and final shop inspection are completed.

The no. of coats and DFT specified above is minimum. However to achieve above specified DFT, no of coats can be increased as per paint manufacture's recommendation.

4.03.09 All machined surfaces shall have two (2) coats of water repellant grease after thorough cleaning.

5.00.00 COATING PROCEDURE AND APPLICATION

5.01.00 Surface Preparation :

Pipe shall be blast cleaned by sand. The cleanliness achieved prior to application shall be in accordance with the requirement of SSPC SP 10 / NACE 2 / Sa2½ of ISO 8501 (near white metal)

- a) The blast pattern or profile depth shall be 40 to 100 micron and shall be measured by dial micrometer.
- b) Before sand blasting is started or during blasting or coating, temperature of the pipe surface should be more than 3°C above dew point temperature. Blast cleaned surface should be primed within 4 hours and shall be protected from rainfall or surface moisture and shall not be allowed to flash rust. If the rust occurs, the surface again to be prepared by sand blasting or wire brushing.

5.02.00 Application of Epoxy Coating

- a) Coating shall be applied when
 - i) When the pipe surface temperature shall be atleast 3°C above dew point temperature.
 - ii) The temperature of mixed coating material and the pipe at the time of application shall not be lower than 10°C or greater than 50°C.
- b) Material preparation shall be in accordance with manufacturer's recommendations.
- c) Application of epoxy coating system :

The epoxy coating system shall be applied as per recommendation of the manufacturer and shall be applied by airless spray / plural component spray machine. For more than one coat, the second shall be applied with the time limits as recommended by the manufacturer.

5.03.00 Application of PU Coating

- a) PU coating shall be applied when the pipe surface temperature atleast 3°C above dew point temperature (when R.H is more than 85%).
- b) Material preparation and application shall be done as per manufacturer recommendation.

6.00.00 TEST REQUIREMENTS :

6.01.00 Measurement of dry film thickness

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

6.01.01 Apparatus / Instrument:-

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

6.01.02 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.

6.02.00 Electrical Inspection (Holiday) Test

- 6.02.01 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.
- 6.02.02 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.
- 6.02.03 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 $V = 7900 \sqrt{T} \pm 10$ percent where T is the average coating thickness in mm.
- 6.02.04 Any audio visual sound or spark leads to indicate pinhole, break or conductive particle.
- 6.03.00 Adhesion Pull off Test :**
- After holiday the coated surface is subjected to adhesion pull off test as per ASTM D 4541.
- 6.03.01 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.
- 6.03.02 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.
- 6.03.03 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.

6.03.04 Select an adhesive:

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

6.03.05 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, then apply tape across the head of the dolly.

6.03.06 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 handwheel 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.

6.04.00 Coating Repair

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

6.04.01 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.

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

6.04.03 Coating Application :

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

6.04.04 Repair Inspection :

Repaired portion shall be electrically inspected using a holiday detector.

6.05.00 Welded Field Joints

6.05.01 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.

6.05.02 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.

7.00.00

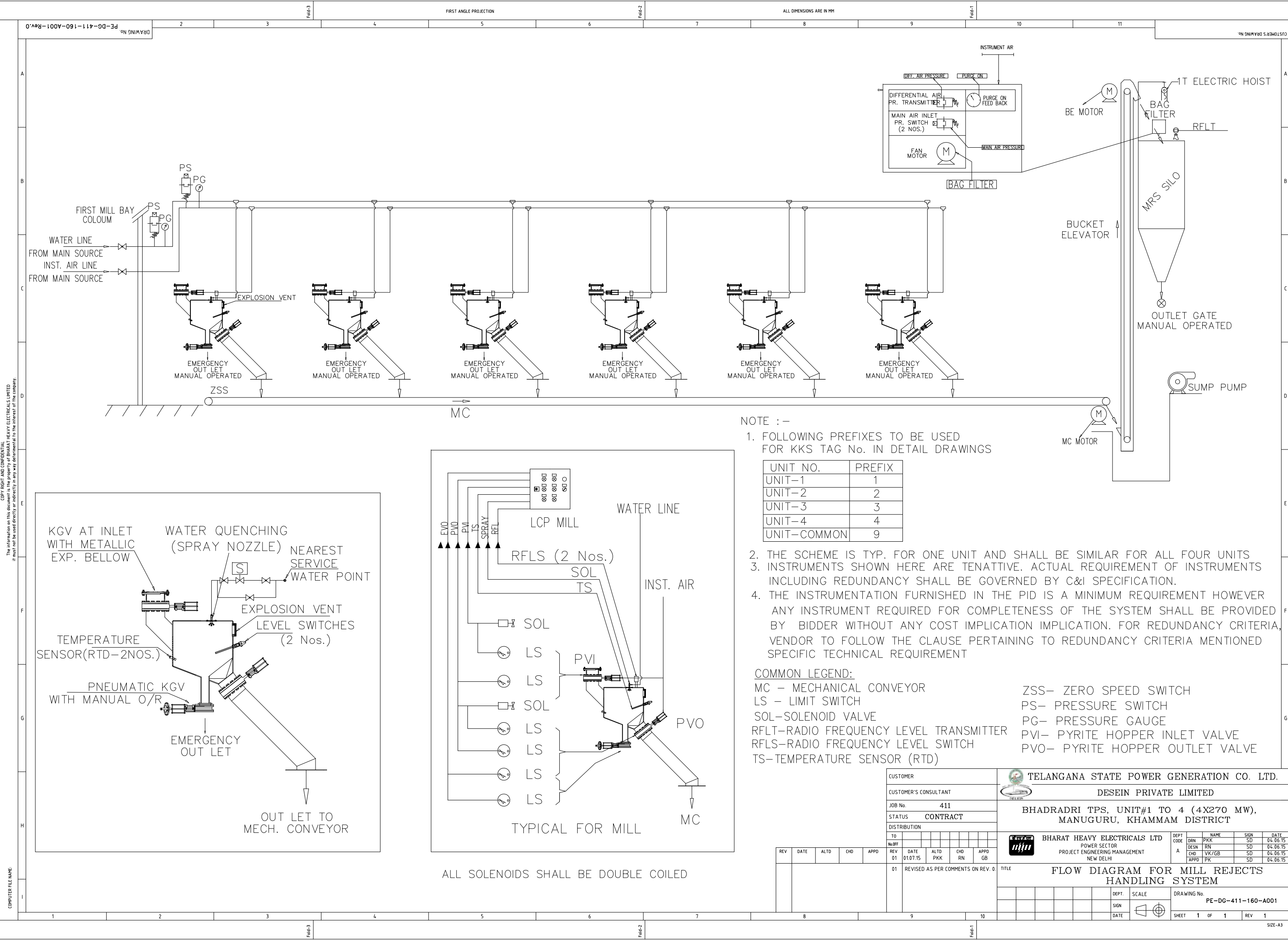
INFORMATION/DATA REQUIRED

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.

	TITLE 4 x 270 MW BHADRADRI TPS MILL REJECT SYSTEM (CONVEYOR TYPE) SPECIFIC TECHNICAL REQUIREMENTS	SPECIFICATION NO. PE-TS-411-160-A002	
		SECTION - I	
		REV 01	
		Sub Section -IA	Date 7/4/17
		Page 1 of 1	

ANNEXURE – VIII

INPUT DRAWINGS



NOTE :-
1. FOLLOWING PREFIXES TO BE USED FOR KKS TAG No. IN DETAIL DRAWINGS

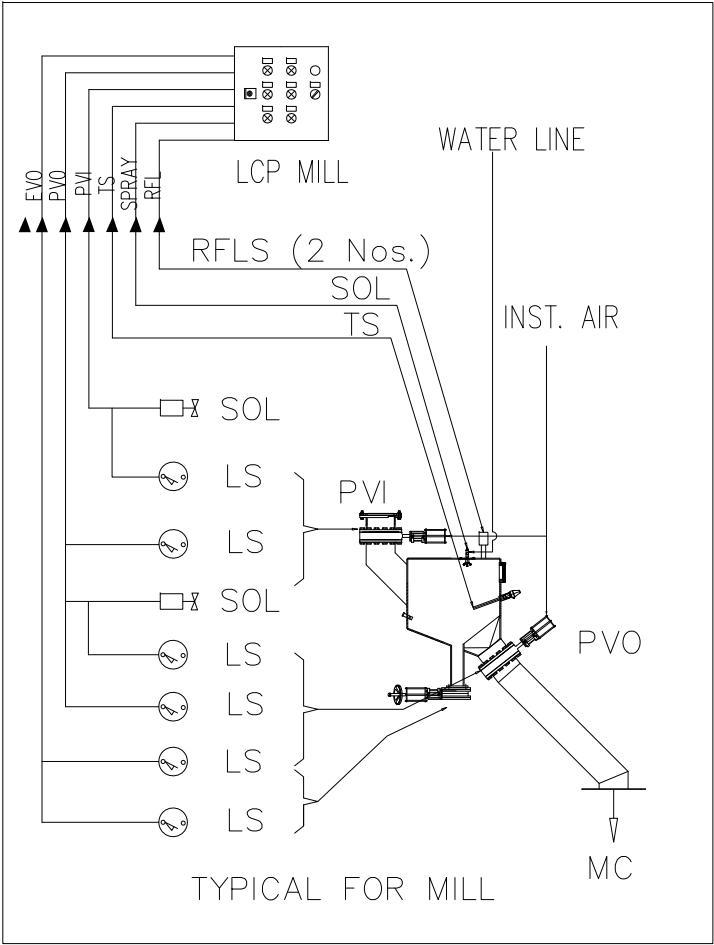
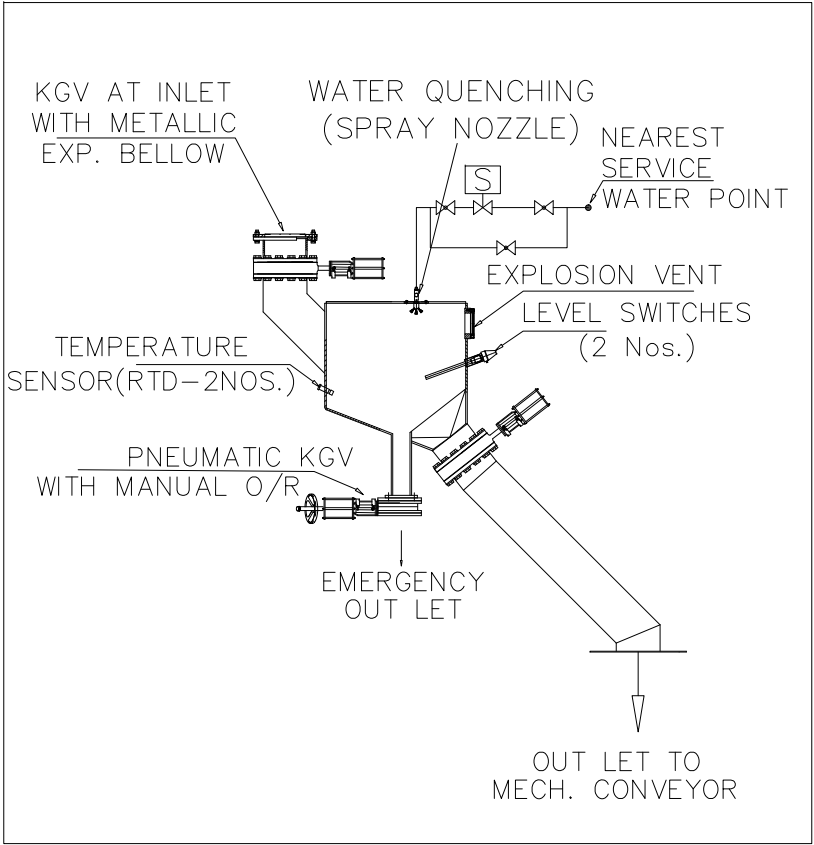
UNIT NO.	PREFIX
UNIT-1	1
UNIT-2	2
UNIT-3	3
UNIT-4	4
UNIT-COMMON	9

2. THE SCHEME IS TYP. FOR ONE UNIT AND SHALL BE SIMILAR FOR ALL FOUR UNITS
3. INSTRUMENTS SHOWN HERE ARE TENATIVE. ACTUAL REQUIREMENT OF INSTRUMENTS INCLUDING REDUNDANCY SHALL BE GOVERNED BY C&I SPECIFICATION.
4. THE INSTRUMENTATION FURNISHED IN THE PID IS A MINIMUM REQUIREMENT HOWEVER ANY INSTRUMENT REQUIRED FOR COMPLETENESS OF THE SYSTEM SHALL BE PROVIDED BY BIDDER WITHOUT ANY COST IMPLICATION IMPLICATION. FOR REDUNDANCY CRITERIA, VENDOR TO FOLLOW THE CLAUSE PERTAINING TO REDUNDANCY CRITERIA MENTIONED SPECIFIC TECHNICAL REQUIREMENT

COMMON LEGEND:

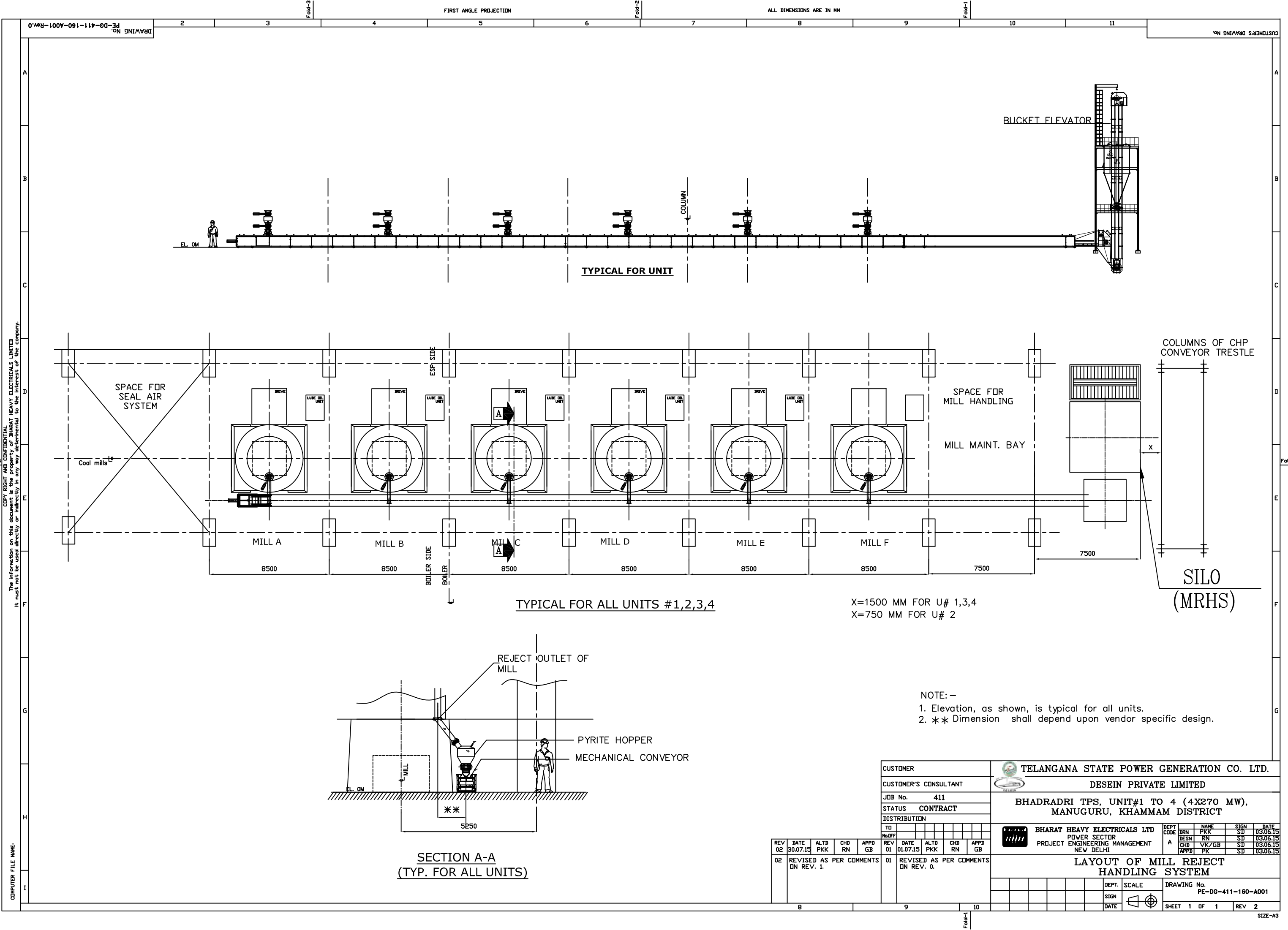
MC – MECHANICAL CONVEYOR
LS – LIMIT SWITCH
SOL-SOLENOID VALVE
RFLT-RADIO FREQUENCY LEVEL TRANSMITTER
RFLS-RADIO FREQUENCY LEVEL SWITCH
TS-TEMPERATURE SENSOR (RTD)

ZSS- ZERO SPEED SWITCH
PS- PRESSURE SWITCH
PG- PRESSURE GAUGE
PVI- PYRITE HOPPER INLET VALVE
PVO- PYRITE HOPPER OUTLET VALVE



ALL SOLENOIDS SHALL BE DOUBLE COILED

CUSTOMER		TELANGANA STATE POWER GENERATION CO. LTD.	
CUSTOMER'S CONSULTANT		DESEIN PRIVATE LIMITED	
JOB No. 411		BHADRADRI TPS, UNIT#1 TO 4 (4X270 MW), MANUGURU, KHAMMAM DISTRICT	
STATUS CONTRACT			
DISTRIBUTION			
TO			
No OFF			
REV 01		01	
DATE 01.07.15		ALTD PKK	
CHD RN		APPD GB	
REVISED AS PER COMMENTS ON REV. 0.		TITLE	
		FLOW DIAGRAM FOR MILL REJECTS HANDLING SYSTEM	
		DEPT. SCALE	
		SIGN	
		DATE	
		DRAWING No. PE-DG-411-160-A001	
		SHEET 1 OF 1 REV 1	



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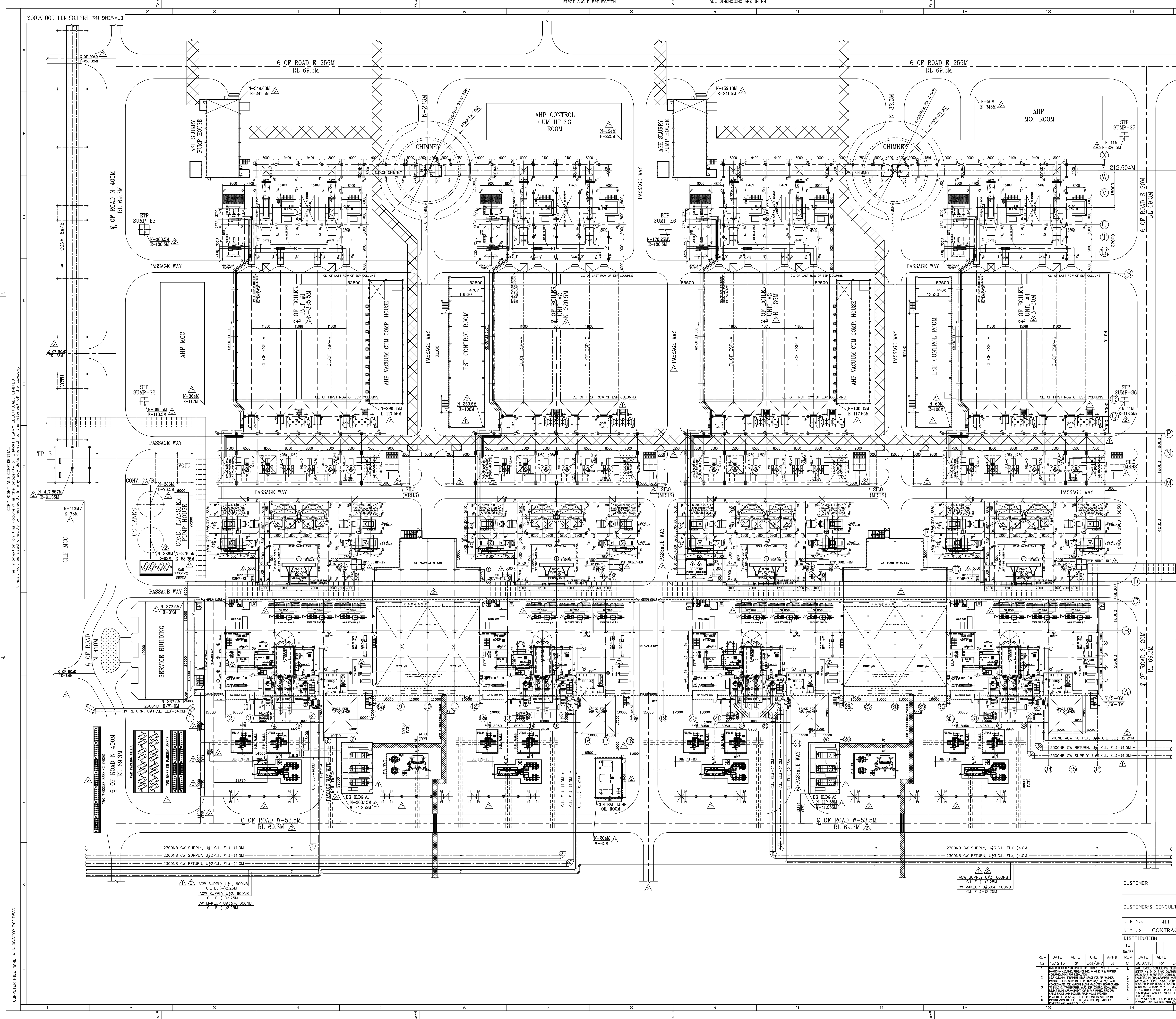
COMPUTER FILE NAME:

Fold-3
2 3 4 5 6 7 8 9 10 11
FOLD-1
CUSTOMER'S DRAWING No.

A
B
C
D
E
F
G
H
I

A
B
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I

SIZE-A3



- NOTES:-**
- 1. ALL DIMENSIONS AND CO-ORDINATES ARE IN METRES UNLESS NOTED OTHERWISE.
 - 2. THE FINISHED FLOOR LEVEL (FFL) OF POWER HOUSE BUILDING GROUND FLOOR IS EL. 0.00M WHICH CORRESPONDS TO RL 69.5M I.E. 0.5M ABOVE FGL.
 - 3. BOILER AREA FINISHED FLOOR LEVEL IS 200MM BELOW 0.0M I.E. RL 69.3M.
 - 4. TRANSFORMER YARD FINISHED FLOOR LEVEL IS 100MM BELOW 0.0M I.E. RL 69.4M.
 - 5. MILL BAY FINISHED FLOOR LEVEL IS SAME AS POWER HOUSE BUILDING I.E. EL. 0.00M (RL 69.5M).
 - 6. THE PIPE RACK SHOWN IS INDICATIVE ONLY.
 - 7. FOR DETAILS OF ROADS/PASSAGEWAYS, CIVIL DRG. TO BE REFERRED.
 - 8. PASSAGEWAYS LEVEL IN TRANSFORMER YARD AREA IS 0.0M I.E. RL69.5M & FROM C-ROW TO CHIMNEY IS (-)0.2M I.E. RL69.3M.
 - 9. FOUNDATION OF STATOR LIFTING STRUCTURE WILL BE UPDATED AFTER FINALIZATION OF INPUTS.
- REFERENCE DRGS:-**
- 1. PLOT PLAN PE-DG-411-100-M001 (PEM)
 - 2. T.G. EQUIPMENT LAYOUT PLAN AT GROUND (EL.0.0M) FLOOR PE-DG-411-100-M003 (PEM)
 - 3. LAYOUT OF TRANSFORMER YARD PE-DG-411-100-E001 (PEM)
 - 4. ELECTRICAL EQUIPMENT & CABLING LAYOUT IN ESP CONTROL ROOM PE-DG-411-100-E001 (PEM)
 - 5. KEY PLAN OF BOILERS 0-00-020-76765 (TRY)
 - 6. GA AND LOAD DATA OF BCN-6A/B IS-1-GA-691-101-M013 (ISG)
 - 7. GA AND LOAD DATA OF BCN-7A/B IS-1-GA-691-101-M014 (ISG)
 - 8. GA OF ASH SLURRY PUMP HOUSE IS-1-GA-691-305-M005 (ISG)
 - 9. EQUIPMENT LAYOUT OF BOOSTER PUMP HOUSE 1-36316-00254 (HYD)

- LEGENDS:**
- PIPE CUM CABLE RACK (PEM)
 - PIPE CUM CABLE RACK (ISG)
 - RAILWAY TRACK

TELANGANA STATE POWER GENERATION CO. LTD.

DESEIN PRIVATE LIMITED

BHADRADRI TPS, UNITS # 1 TO 4 (2X270 MW), MANUGURU, KHAMMAM DISTRICT

POWER SECTOR PROJECT ENGINEERING MANAGEMENT

DEPT. NAME SIGN DATE

CHD LKJ/SPV M 25.05.15

APPD JJ 25.05.15

MAIN EQUIPMENT LAYOUT PLAN

MPL C HSE I MAX E SEPT. SCALE 1:500 DRAWING No. PE-DG-411-100-M002

CUSTOMER

CUSTOMER'S CONSULTANT

JOB No. 411

STATUS CONTRACT

DISTRIBUTION

TO

REV

DATE

ALTD

CHD

APPD

02

15.12.15

RK

LKJ/SPV

JJ

01

30.07.15

RK

LKJ/SPV

JJ

1. THE REVIEW CONSIDERING DESIGN COMMENTS AND LETTERS TO THE ENGINEER FOR CONSTRUCTION OF THE FACILITIES IN TRANSFORMER YARD, POWER HOUSE AND MILL BAY ARE LOCATED NEAR BOILERS. THE BUILDING, TRANSFORMER YARD, MILL BAY AND BOILER ARE LOCATED NEAR BOILERS. THE BUILDING, TRANSFORMER YARD, MILL BAY AND BOILER ARE LOCATED NEAR BOILERS. THE BUILDING, TRANSFORMER YARD, MILL BAY AND BOILER ARE LOCATED NEAR BOILERS.

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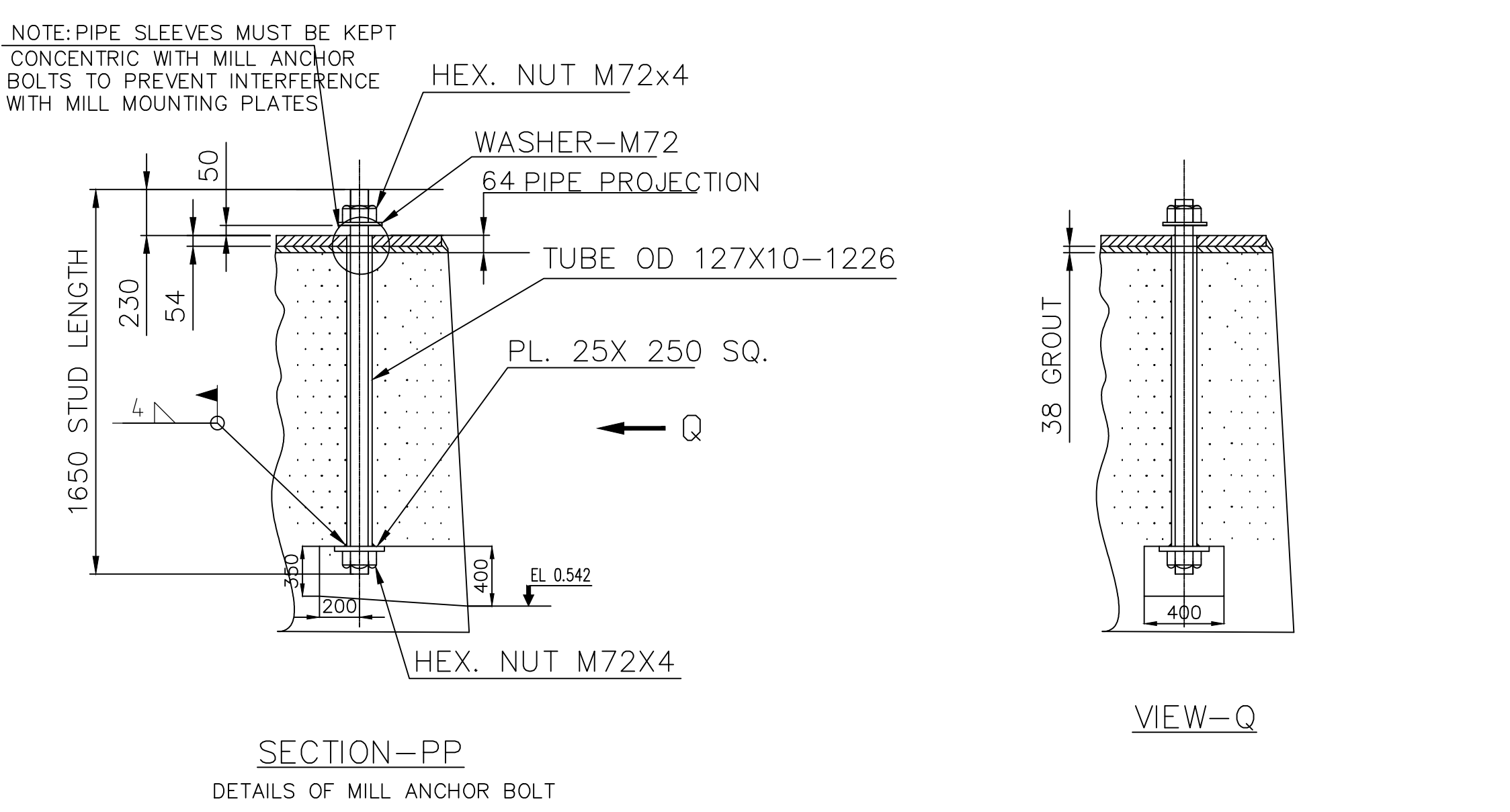
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COMPUTER FILE NAME: 411-100-M002-BUILDING

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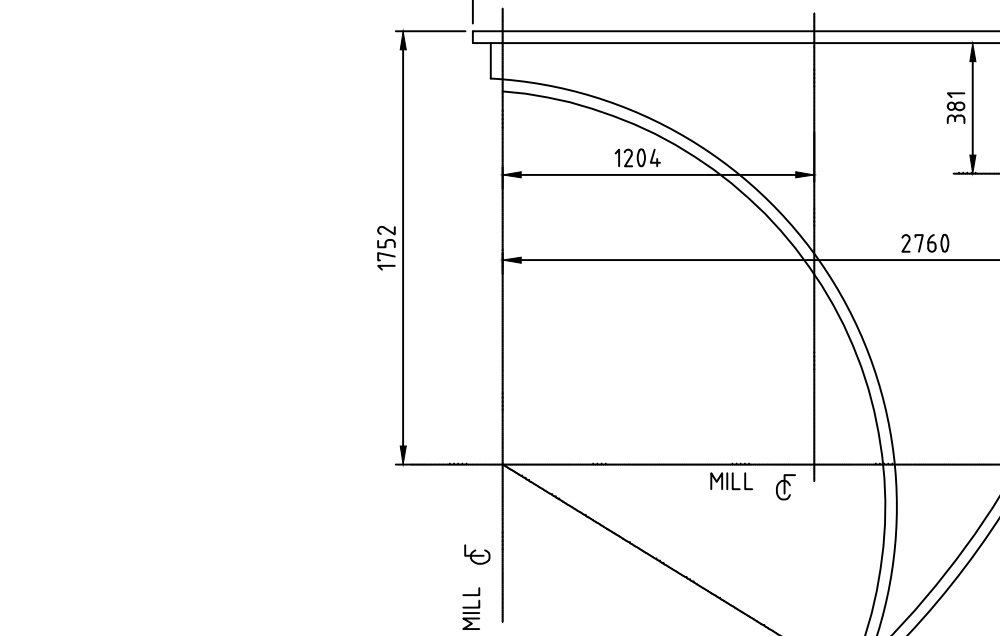
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01. FOUNDATION TO BE MADE OF WELL REINFORCED CONCRETE.
02. TOTAL CIVIL FOUNDATION IS NOT IN THE SCOPE OF BHEL-HYD.
03. ALL ANCHOR BOLTS TO BE SET IN PIPE SLEEVES. ALL ANCHOR BOLTS TO BE THREADED AT BOTH ENDS. DO NOT FILL PIPE SLEEVES OF ANCHOR BOLTS. KEEP PIPE SLEEVES FREE OF DEBRIS AND WATER.
04. BOWL MILL FOUNDATION BOLT PIPE SLEEVES ASSY. SHOULD BE POSITIONED, PREFERABLY, USING TEMPLATE, SO AS TO MAINTAIN FOUNDATION BOLTS CENTRE LINE DISTANCE WITHIN $\pm 2\text{mm}$ AND TO BE IN LINE WITH MILL BASE BOLT HOLES.
05. THIS DRAWING REPRESENTS A SUGGESTED FOUNDATION ARRANGEMENT ONLY.
06. FOR OTHER DETAILS OF BOWL MILLS, REFER BOWL MILL GENERAL ARRANGEMENT DRG.
07. SLEEVE TUBE AND ANCHOR BOLTS FOR MILL FOUNDATION ARE IN THE SCOPE OF BHEL (HYD)
08. MOTOR MOUNTING PLATE, FOUNDATION BOLTS, PACKERS ETC., ARE IN THE MOTOR SUPPLIER (BHEL BHOPAL) SCOPE.
09. REFER DRG No. 0-00-620-87042 FOR GENERAL ARRANGEMENT OF MILL.
10. WEIGHT OF CONCRETE, MAKING FOUNDATION SHOULD BE ATLEAST 2 1/2 TIMES THE WEIGHT OF PULVERISER.
11. MILL FFL IS EL.0.000M IS SAME AS TG HALL FINISHED FLOOR LEVEL AS EL.0.000M WHICH CORRESPONDS TO RL (+) ---M.

<u>MILL DATA</u>		<u>MOTOR DATA</u> - (TO BE CONFIRMED)	
1. MILL SPEED	: 985 RPM	SUPPLIER	: BHEL - BHOPAL
2. SPEED OF PULVERIZER	: 44.7 RPM	RATING	: 450 KW
3. TOTAL WT. OF MILL (INCLUDING MOTOR)	: 121 TONNES.	SPEED	: 985 RPM
4. TYPE OF LOAD	: MODERATE SHOCK LOAD.	FULL LOAD AMP STATOR	: 55 AMP
		VOLTAGE 3 PHASE 50 Hz	: 6600 VOLTS
		APPROX. WEIGHT OF MOTOR	: 5.75 TONNE
		APPROX. WEIGHT OF ROTOR	: 1200 Kgs
		GD ² OF ROTOR	: 156 Kgm ²
		MAX. FOUNDATION LOADING-P	: 65KN UPWARDS
		(ALTERNATING)PER MOTOR	
		LONGITUDINAL SIDE	:121KN DOWNWARDS
		DIRECTION OF ROTATION	: BI-DIRECTIONAL
		VIEWED FROM DRIVE END	

[illegible]



	TITLE 4 x 270 MW BHADRADRI TPS MILL REJECT SYSTEM (CONVEYOR TYPE) SPECIFIC TECHNICAL REQUIREMENTS	SPECIFICATION NO. PE-TS-411-160-A002	
		SECTION: I	
		REV 01	
		Sub-Section: IB	Date 4/7/17
		Page 1 of 2	

SUB-SECTION – IB

SPECIFIC TECHNICAL REQUIREMENTS (ELECTRICAL)

	TITLE 4 x 270 MW BHADRADRI TPS MILL REJECT SYSTEM (CONVEYOR TYPE) SPECIFIC TECHNICAL REQUIREMENTS	SPECIFICATION NO. PE-TS-411-160-A002	
		SECTION: I	
		REV 01	
		Sub-Section: IB	Date 4/7/17
		Page 2 of 2	

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 MILL REJECT SYSTEM
- 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.
- j) Cable BOQ worked out based on routing of cable listing provided by the vendor for “both end equipment in vendor’s scope” shall be binding to the vendor with +10 % margin to take care of slight variation in routing length & wastages.

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 (Annexure –I)
- b) Standard Technical specification for motors.
- c) Datasheets (A & C) & quality plan for motors.
- d) Electrical Load data format (Annexure –II)
- e) BHEL cable Schedule format (Annexure –III)
- f) Explanatory notes for cable routing

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGES: MRS (MILL REJECT SYSTEM)

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT: 4 X 270MW BHADRADRI TPS LOCATED AT MANUGURU

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	BHEL	BHEL	415 V AC (3 PHASE 4 WIRE) supply 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, optical fibre etc.	Vendor	Vendor	Refer C&I portion of specification for scope of fibre Optical cables if used between PLC/ microprocessor & DCS.
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. Main cable trays in mill bay area shall be at El. 8.0M to 9.5M.
7	Cable glands ,lugs and bimetallic strip 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 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	
10	Equipment grounding (including electronic earthing) & lightning protection	BHEL	BHEL	Refer note no. 4 for electronic earthing

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGES: MRS (MILL REJECT SYSTEM)

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT: 4 X 270MW BHADRADRI TPS LOCATED AT MANUGURU

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
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	-	For ensuring cabling requirements are met, vendor shall furnish Electrical equipment layout & cable tray layout drawings (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipment requiring cabling, and shall incorporate cable trays routing details marked on the drawing as per PEM interface comments. Cabling arrangement of the same (wherever overhead cable trays, trenches, cable ducts, conduits etc.) shall be decided during contract stage. Electrical equipment layout & cable tray layout drawing shall be subjected to BHEL/ customer approval without any commercial implications to BHEL.
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.
4. Vendor shall indicate location of Electronic Earth pit in their Civil assignment drawing.



TITLE :
GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO. PE-SS-999-506-E101
VOLUME NO. : II-B
SECTION : D
REV NO. : 00 DATE : 29/08/2005
SHEET : 1 OF 1

GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO.: PE-SS-999-506-E101 Rev 00

बी एच ई एल 	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
		VOLUME NO. : II-B
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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 machines
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.

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		VOLUME NO. : II-B
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		SHEET : 2 OF 4
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 minimum 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: 4691 and 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.		

	TITLE : GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	SPECIFICATION NO. PE-SS-999-506-E101
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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	

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		SHEET : 4 OF 4
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.		

	TITLE LV MOTORS DATA SHEET-A 4 X 270 MW BHADRADRI TPS	SPECIFICATION NO.	
		VOLUME	II B
		SECTION	D
		REV. NO.	DATE 18.12.14
		SHEET 1	OF 2

1.0	Design ambient temperature	:	50 °C
2.0	Maximum acceptable kW rating of LV motor	:	160KW *
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 + 3 % 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		
o	110 kW and above (Breaker Controlled)	:	50 KA for 0.20 sec..
o	Below 110 kW (Contactor Controlled)	:	50 KA protected by HRC fuse
f)	LV System grounding	:	Solidly
5.0	Class of insulation	:	Class 'F', with temp rise limited to class B.
6.0	Minimum voltage for starting (As percentage of rated voltage)	:	(a) 85% below 110KW (b) 80% from 110KW to 160KW (c) 85% above 160KW to 1000KW (d) 80% from 1001 KW to 4000KW (e) 75% > 4000KW
7.0	Power cables data	:	Shall be given during detailed engg.
8.0	Earth Conductor Size & Material	:	As per attached Datasheet of Earthing.
9.0	Space heater supply	:	240 V, 1ϕ, 50 Hz (for motors above 30 Kw)
10.0	Rating up to which Single phase motor	:	Acceptable below 0.20 kW
11.0	Locked rotor current		
a)	Limit as percentage of FLC	:	As per IS 12615*
12.0	Flame-proof motor		
a)	Enclosure suitable (As per IS: 2148)	:	As per requirement
b)	Classification of Hazardous area (As per IS: 5572 part-I)	:	As per requirement
13.0	Makes	:	BHEL/ Customer approval
14.0	Paint shade	:	Shall be given during detailed engg
15.0	Degree Of protection for motor/ terminal box	:	IP 54/ IP 55



TITLE

LV MOTORS**DATA SHEET-A****4 X 270 MW TSGENCO MANUGURU TPS**

SPECIFICATION NO.

VOLUME II B

SECTION D

REV NO. DATE 18.12.14

SHEET 1 OF 2

* Continuous duty LT motors up to 160 KW Output rating (at 50 deg.C ambient temperature), shall be High efficiency (IE2) as per IEC: 60034-30/ IS:12615

16.0 TESTING**16.1 Type Tests**

For LT Motors above 55kW, type test reports for type tests as per IS: 325/ IS: 12615 conducted on equipment similar to those proposed to be supplied and carried out within last five years from the date of bid opening shall be submitted. However, if such reports are not available, one motor of each type shall be subjected to type tests for free of cost.

16.2 Routine Tests

All motors shall be subjected to routine tests as per IS: 325/ IS: 12615 in the presence of customer or customer representative.

	TITLE MOTOR DATA SHEET - C	SPECIFICATION NO. PE-TS-411-160-A002
		SECTION I
		SUB SECTION IB
		REV NO. 01 DATE April 17
		SHEET 1 OF 2

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		

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

	TITLE MOTOR DATA SHEET - C	SPECIFICATION NO. PE-TS-411-160-A002
		SECTION I
		SUB SECTION IB
		REV NO. 01 DATE April 17
		SHEET 2 OF 2

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 $\geq 55\text{KW}$)	
	a) Torque speed characteristic	
	b) Thermal withstand characteristic	
	c) Current vs time	
	d) Speed vs time	

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

		QUALITY PLAN		CUSTOMER :		PROJECT: 4x270 MW Bhadradi TPS located at Manugur			SPECIFICATION :			
				BIDDER/ :		TITLE			NUMBER :			
				VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION TITLE			
SHEET 1 OF 2		SYSTEM		ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION			VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	10	11	12	13
1.0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	MANUF'S SPEC	MANUF'S SPEC	-DO-	2	-	-	
		2.DIMENSIONS	MA	-DO-	-DO-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	-DO-	2	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	MFG.SPEC./ RELEVANT IS	MFG.SPEC. RELEVANT IS	-DO-	2	-	-	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUFR'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	IS-325/ BHEL SPEC./ DATA SHEET	SAME AS COL.7	TEST REPORT	2	1		
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2	1	-	NOTE -1 & NOTE-3
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									

		QUALITY PLAN		CUSTOMER :		PROJECT: 4x270 MW Bhadradri TPS located at Manugur		SPECIFICATION :				
				BIDDER/ :		TITLE		NUMBER :				
		SHEET 2 OF 2		VENDOR		SYSTEM		QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01		SPECIFICATION : TITLE :		
						ITEM AC ELECT. MOTORS BELOW 55KW (LV)		SECTION		VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1	-	
NOTES: 1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON 2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. 3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY. <u>Legends for Inspection agency</u> 1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER) P. PERFORM W. WITNESS V. VERIFY												
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

CABLE SCHEDULE FORMAT

ANNEXURE III

[illegible]

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

1. For the purpose of clarity, it may please be noted that the information given in regard to the cables to be routed through WinPath as per the system elaborated below is called "Cable List", while the term "Cable Schedule" applies to the cable list with routing information added after routing has been carried out.
2. The cable list shall be entered as an MS Excel file in the format as per enclosed template EXT_CAB_SCH_FORMAT.XLS. No blank lines, special characters, header, footer, lines, etc. shall be introduced in the file. No changes shall be made in the title line (first line) of the template.
3. The field properties shall be as under:
 - a. UNIT CABLE NO: A/N, up to sixteen (16) characters; each cable shall have its own unique, unduplicated cable number. In case this rule is violated, the cable cannot be taken up for routing.
 - b. FROM: A/N, up to sixty (60) characters; the "From" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - c. TO: A/N, up to sixty (60) characters; the "To" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - d. PURPOSE: A/N, up to sixty (60) characters; the purpose (i.e. power cable/ indication/ measurement, etc.) to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - e. REMARKS: A/N, up to forty (40) characters; Any information pertinent to routing to be specified here (e.g., cable number of the cable redundant to the cable number being entered). Information in excess of 40 characters will be truncated after 40 characters.
 - f. CABLESIZE: A/N, 7 characters exactly as per the codes indicated below shall be specified here. The program cannot route cables described in any other way/ format.
 - g. PATHCABLENO: Field reserved for utilization by the program. User shall not enter any information here.
4. One list shall be prepared for each system/ equipment (i.e., separate and unique cable lists shall be prepared for each system).
5. The cables shall be described as per the scheme listed below:

A	NN	A	NNN
Cable	No. of cores	Cable code	Cable size
Voltage	(e.g. 01,03,3H, 07)	(See C below)	(e.g. 035,185,2.5, 0.5)
Code (see B below)			

(A) SYSTEM VOLTAGE CODES:

(ac) A = 11KV, B = 6.6KV, C = 3.3KV, D = 415V, E = 240V, F = 110V

(dc) G = 220V, H = 110V, J = 48V, K = +24V, L = -24V

(B) CABLE VOLTAGE CODES:

A = 11KV (Power cables)

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

B = 6.6KV (Power cables)
C = 3.3KV (Power cables)
D = 1.1KV (LV & DC system power & control cables)
E = 0.6KV (0.5 sq. mm. Control cables)

(C) CABLE CODES

PVC Copper

A = Armoured FRLS	B = Armoured Non-FRLS
C = unarmoured FRLS	D = Unarmoured Non-FRLS

PVC Aluminium

E = Armoured FRLS	F = Armoured Non-FRLS
G = unarmoured FRLS	H = Unarmoured Non-FRLS

XLPE Copper

J = Armoured FRLS	K = Armoured Non-FRLS
L = unarmoured FRLS	M = Unarmoured Non-FRLS

XLPE Aluminium

N = Armoured FRLS	P = Armoured Non-FRLS
Q = unarmoured FRLS	R = Unarmoured Non-FRLS

S = FIRE SURVIVAL CABLES
T = TOUGH RUBBER SHEATH
U = OVERALL SCREENED
V = PAIRED OVERALL SCREENED
W = PAIRED INDIVIDUAL SCREENED
Y = COMPENSATING CABLES
I = PRE-FABRICATED CABLES
Z = JELLY FILLED CABLES



TITLE
4 x 270 MW BHADRADRI TPS
MILL REJECT SYSTEM (CONVEYOR TYPE)
SPECIFIC TECHNICAL REQUIREMENTS

SPECIFICATION NO. PE-TS-411-160-A002
SECTION: I
REV 01
Sub-Section: IC
Date 4/7/17
Page 1 of 1

SUB-SECTION – IC

SPECIFIC TECHNICAL REQUIREMENTS (C&I)



Technical specification for
Mill Reject Handling System

4 X 270 MW BHADRADRI TPP, TELANGANA

REV. NO. 00 DATE : 24.03.2015

C&I TECHNICAL SPECIFICATION FOR MILL REJECT HANDLING SYSTEM



Technical specification for
Mill Reject Handling System

4 X 270 MW BHADRADRI TPP, TELANGANA

REV. NO. 00 DATE : 24.03.2015

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Technical specification for
Mill Reject Handling System

4 X 270 MW BHADRADRI TPP, TELANGANA

SECTION C

REV. NO.

00

DATE : 24.03.2015

SECTION -C

SPECIFIC TECHNICAL REQUIREMENT

	Telangana State Power Generation Corporation Ltd. 4X270 MW Bhadradri TPS	
	SPECIFIC TECHNICAL REQUIREMENTS (C&I) MILL REJECT HANDLING SYSTEM	
Specific Technical Requirements (C&I): 1.0 Mill Reject Handling System shall be operated from plant DCS (DCS-BHEL Scope of supply) through operator work stations located in CCR. 2.0 Bidder to provide local control panel for each pyrite hoppers. This local panel will act as interface between the DCS and the field devices for commands & feedbacks. 3.0 Bidder to supply all the instruments (PG, PS, PT, LS and RTD etc.) required for the package along with necessary fittings, accessories and valve manifold etc. 4.0 The solenoid operated valves/ damper/gates shall have limit switches for open/ close feedback. Solenoid valve shall be rated for 24 V DC only. 5.0 The junction boxes/LIEs for termination of instruments /solenoid valve limit switches etc are in bidder's scope. 6.0 BHEL shall provide 230V AC UPS supply feeder at a single point. Further distribution to various instruments shall be in Bidder's scope. Bidder to include necessary power distribution board in his scope. Any power supply other than the above, if required by any instrument/device, has to be derived by the Bidder and all necessary hardware/software for the same shall be in bidder's scope. Bidder to furnish UPS power requirement along with the bid. 7.0 Power supply derived for Transmitters, contact interrogation, interposing relay and solenoid shall generally be ungrounded 24V D.C only. 8.0 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 or repetition of clauses in the specification, the more stringent requirements among them are to be complied with. 9.0 Vendor representative shall be available for 3-4 days at BHEL EDN B'lore during testing of DCS.		

	Telangana State Power Generation Corporation Ltd. 4X270 MW Bhadradri TPS	
	SPECIFIC TECHNICAL REQUIREMENTS (C&I) MILL REJECT HANDLING SYSTEM	
10.0	Participation of bidder's personnel and experts as well as experts from their collaborator in discussion with Owner / consultant and other equipment vendors during various stages of contract implementation as required by the Owner to achieve desired C&I system configuration and performance is in Bidder's scope.	
11.0	Mandatory spares has to be supplied by bidder.	
12.0	The design, manufacture, inspection, testing, site calibration and installation of all C&I equipment and systems covered under this specification shall conform to the latest editions of applicable codes and standards as specified in Section-D, 1.10.	
13.0	The scope of cable shall be referred in Electrical scope split sheet in Electrical portion of the specification.	
14.0	Bidder shall provide Cable Schedule in BHEL excel format provided in Electrical portion of the specification. Also, cable interconnections details for complete system shall be in Bidders' scope.	
15.0	All pneumatic operated regulating control valves shall be envisaged with smart positioner.	
16.0	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 / analyzers & JBs/Racks should be protruding on the walkway.	
17.0	Instrument installation and accessories required and same shall be in Bidder's scope and shall be subject to customer/BHEL approval during detailed engineering.	
18.0	Bidder to provide erection hardware including junction boxes, canopies, structural steel as required.	
19.0	Every panel-mounted instrument, requiring power supply, shall be provided with a pair of easily replaceable glass cartridge fuses of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus.	
20.0	Provision for separate Terminal block/wiring diagram for power and control blocks of control panel to be ensured.	
21.0	The make of all the items shall be from approved sub-vendor list.	

	Telangana State Power Generation Corporation Ltd. 4X270 MW Bhadradri TPS	
	SPECIFIC TECHNICAL REQUIREMENTS (C&I) MILL REJECT HANDLING SYSTEM	
22.0	Editable & pdf copy of Drawings/Documents and data to be furnished after award of the contract: • Control & operational write-up for the system • Recommended control scheme/ logic diagram • Process manuscript for implementation in DCS • List of Drives (Solenoid valves etc) • I/O list (DCS) • GA & wiring diagram of local panel. • Power requirement. • Local control panel and field instruments quality plan. • Local control panel & instruments data sheet. • JB grouping document. • Cable schedule and cable interconnection drawing. • Instrument schedule • Alarm Schedule • SOE schedule • Instrument hook-up diagram. • Mandatory spare BOQ • UPS load list • Any other document decided during detailed engineering. • Note:- 1. All equipment items shall be of latest design with proven on track record. 2. 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. 3. 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.	



SPECIFIC TECHNICAL REQUIREMENT ANNEXURE

SPEC NO.:

VOLUME II -B

SECTION

REV. NO. 00

DATE : 24.03.2017

SHEET 1 OF 1

SPECIFIC TECHNICAL REQUIREMENTS

SENSOR REDUNDANCY

Following redundancy criteria shall be met:

1. Two out of three measurements philosophy shall be adopted for all CLCS (Closed Loop Control System) and Protection for reliability of operation. The control system shall select the median value for the normal control purpose. In case of deviation of one transmitter output from the other two, the same shall be automatically isolated and average output of the remaining transmitters shall be fed to the control and measurement system and the control loop in this case shall be maintained on auto, with an alarm on the operator's work station as well as on the engineer's station. In case of failure of the two remaining transmitters in circuit, deviation of one transmitter output is more than the pre-set limit compared to the other transmitter, there shall be automatic bump less transfer to manual and Changeovers shall have suitable alarms in the operator's work station as well as engineer's station.
2. For signal compensations, separate signals from separate transmitters other than used for measurement & control shall be used.
3. For OLCS (Open Loop Control System) all sensors used for the protection shall be triple redundant All sensors for permissive and interlock shall be dual redundant.

GENERAL POINTS:

1. The Instrumentation furnished in the PID is a minimum requirement however any instrument required for completeness of the system shall be provided by bidder without any cost implication. The requirement shall be decided during detailed engineering.
2. Solenoid Valves shall be mounted in Pneumatic Junction Boxes only and Pneumatic Junction box shall be in the scope of bidder. (Typical photo of Pneumatic Junction Box is attached for ready reference)
3. LIE/LIR shall be provided for mounting of the instrument and LIE/LIR shall be in the scope of bidder.





Technical specification for
CONTROL & INSTRUMENTATION

4 X 270 MW BHADRADRI TPP, TELANGANA

SECTION D

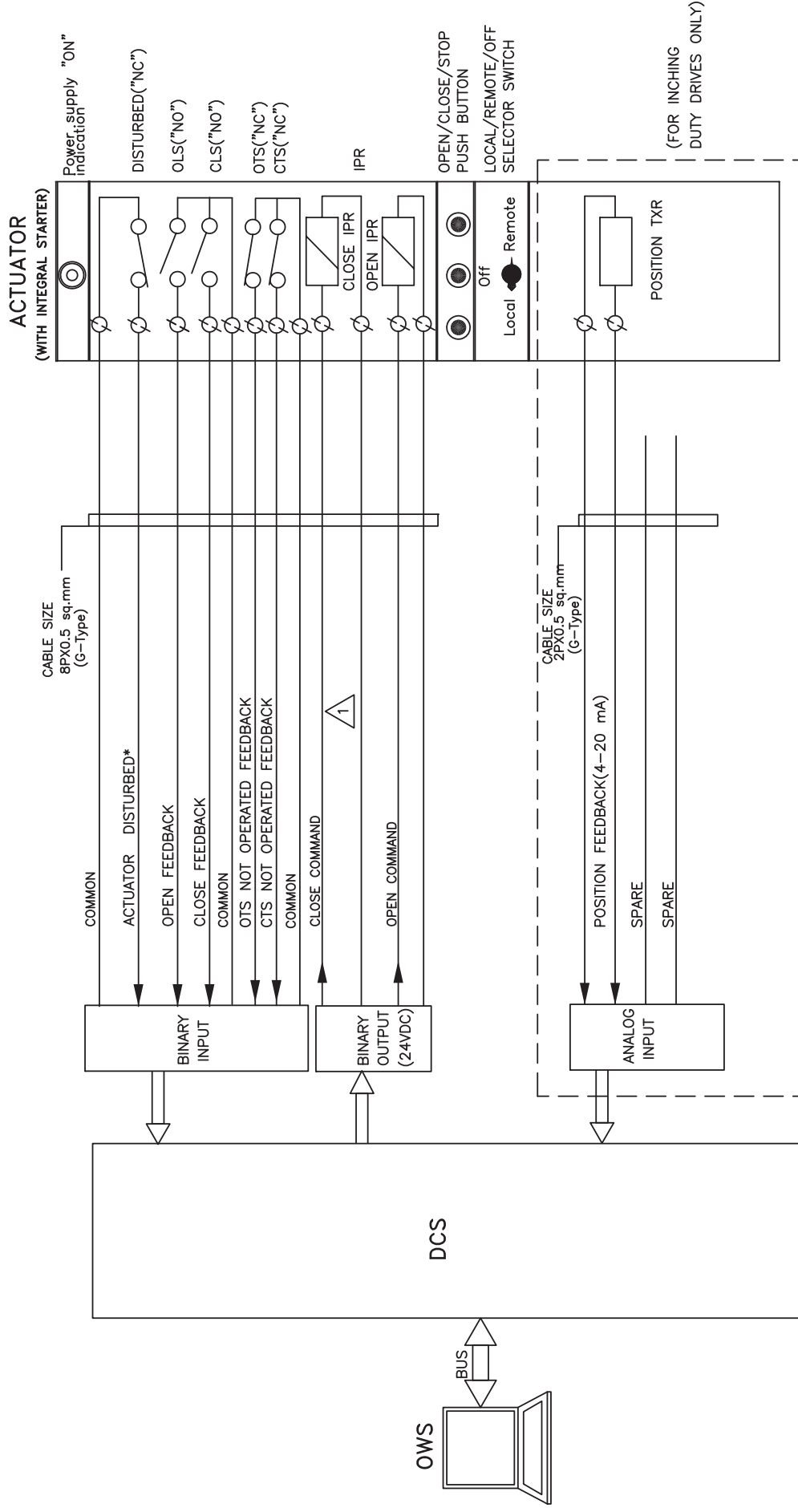
REV. NO. 00

DATE : 24.03.2015

SECTION - D

DRIVE CONTROL PHILOSOPHY

DCS INTERFACE FOR BIDIRECTIONAL DRIVE(WITH INTEGRAL STARTER)



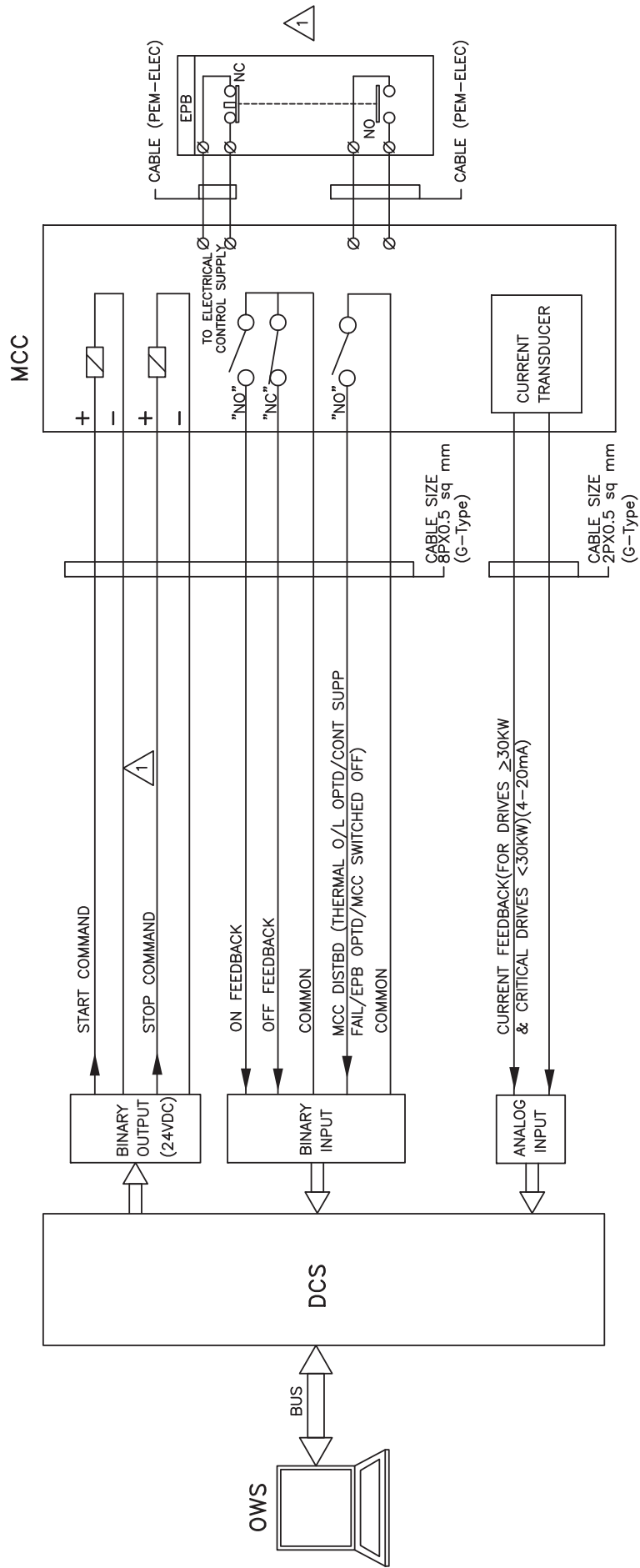
NOTE:

- * DISTURBED= Loss of Power supply (1 Phase/3 Phase)/
- Loss of control supply/ Motor thermostat trip/
- Thermal over load/
- Local/Off/Remote Sel. switch in local or off mode/
- Stop PB optd.



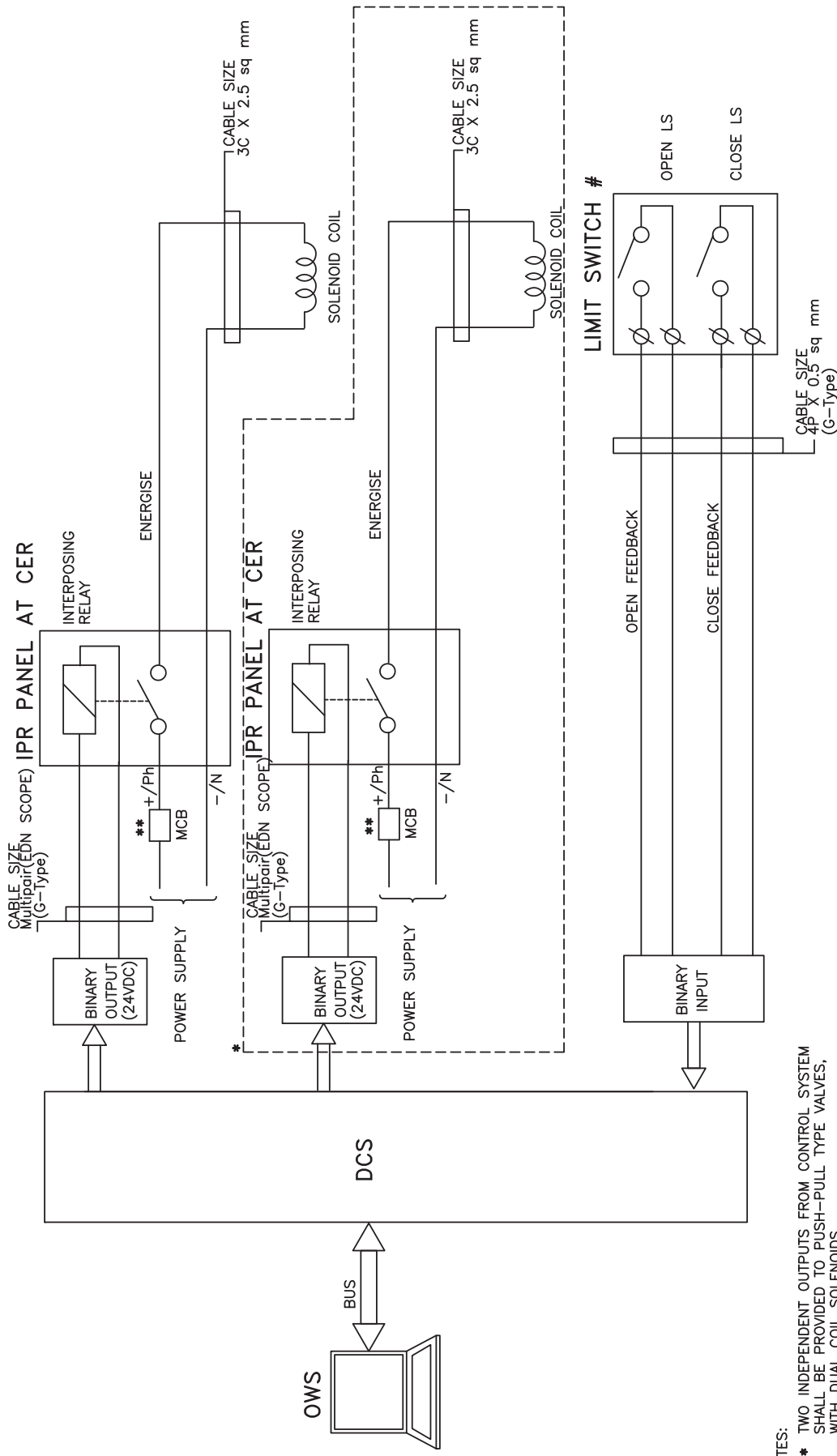
PROJECT: 4 X 270 MW BHADRADRI TPS		DRG.NO.	PE-DM-411-145-1002	
TITLE		DATE	06.02.2015	
DDCMS INTERFACE FOR BIDIRECTIONAL DRIVE		REV.NO.	01	
		SHT	7	OF 11

DCS INTERFACE FOR UNIDIRECTIONAL LT DRIVE



	PROJECT: 4 X 270 MW BHADRADRI TPS		DRG.NO.	PE-DM-411-145-1002	
	TITLE		DATE	06.02.2015	
	DDCMIS INTERFACE FOR UNIDIRECTIONAL LT DRIVE		REV.NO.	01	
			SHT	8	OF 11

DCS INTERFACE FOR SOLENOID DRIVE (24V DC / 240V AC UPS)



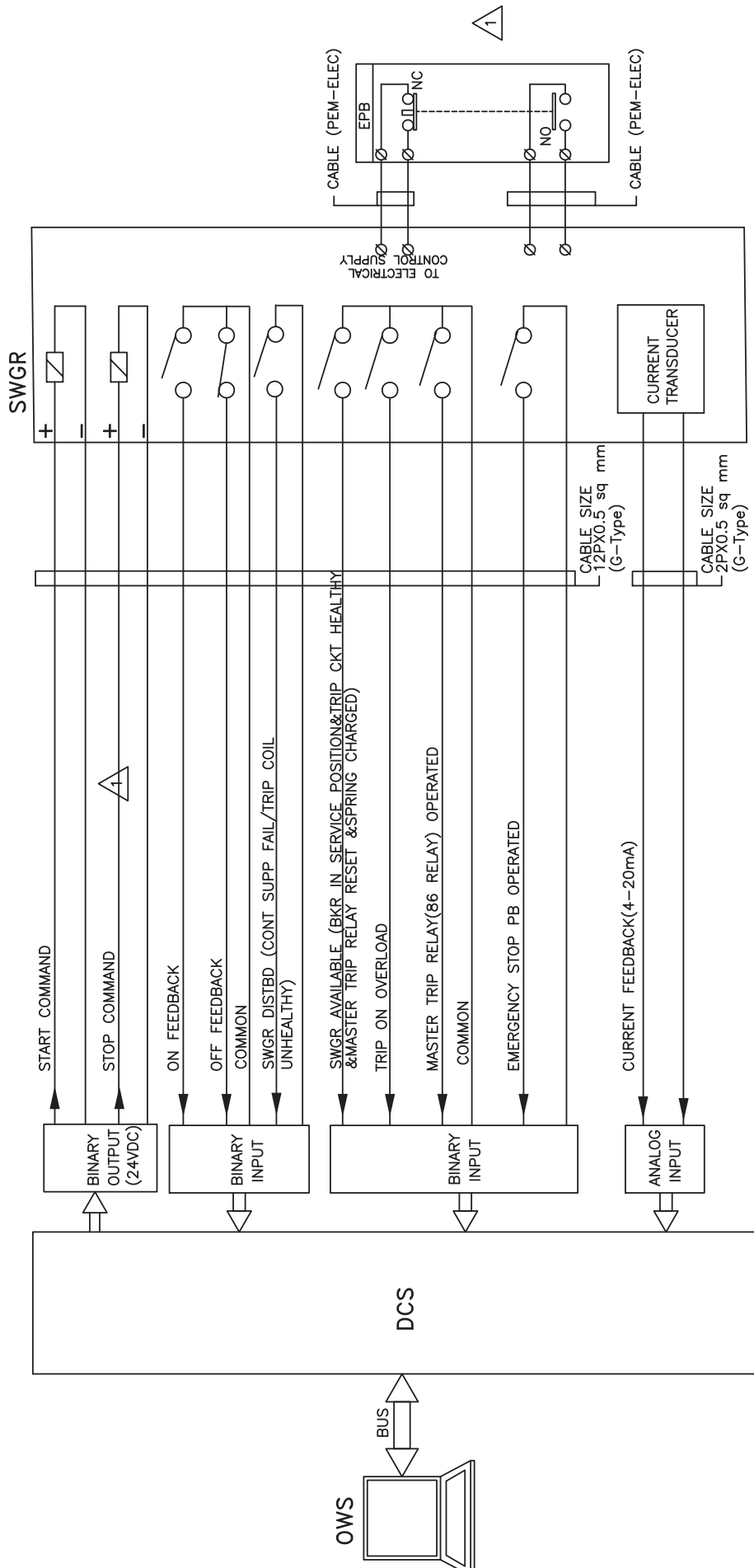
- NOTES:
- * TWO INDEPENDENT OUTPUTS FROM CONTROL SYSTEM SHALL BE PROVIDED TO PUSH-PULL TYPE VALVES, WITH DUAL COIL SOLENOIDS.
 - ** MCB SHALL BE PROVIDED FOR EACH SOLENOID
 - # FOR ON/OFF TYPE, SOLENOID ACTUATED CONTROL VALVE.



PROJECT: 4 X 270 MW BHADRADRI TPS
TITLE DDCMIS INTERFACE FOR SOLENOID DRIVE

DRG.NO.	PE-DM-411-145-1002
DATE	18.11.2014
REV.NO.	00
SHT	9 OF 11

DCS INTERFACE FOR HT/LT UNIDIRECTIONAL DRIVES(BREAKER OPERATED)



PROJECT: 4 X 270 MW BHADRADRI TPS
TITLE DDCMIS INTERFACE FOR UNIDIRECTIONAL HT DRIVE

DRG.NO.	PE-DM-411-145-1002
DATE	06.02.2015
REV.NO.	01
SHT	10 OF 11



Technical specification for
CONTROL & INSTRUMENTATION

4 X 270 MW BHADRADRI TPP, TELANGANA

SECTION D

REV. NO. 00

DATE : 24.03.2015

INSTRUMENTATION DATA SHEET

1.00.00 **SPECIFICATION FOR ELECTRONIC TRANSMITTERS**

1.01.00 PRESSURE TRANSMITTER

1. Working Principle : Smart (HART Compatible)
2. Type : Microprocessor based, 2 – Wire
3. Output Signal : 4-20 mA DC along with superimposed digital signal
4. Measuring Element : Capsule / Diaphragm
5. Element material : SS-316 (Stainless Steel) or better
6. Static Pressure : 150 % of maximum span continuously, without affecting the calibration
7. Turn-down ratio : 100: 1
8. Span and Zero : Continuous, tamper proof, remote as well locally adjustable with zero elevation and suppression by 100% of span
9. Enclosure Class : IP-65 (Explosion proof for NEC Class-1, Division 1 area)
10. Output Indicator : LCD (Integral indicator of 5 digit display)
11. Nameplate : Tag number, service engraved in SS tag plate
12. Body : SS
13. Operating Voltage : 24V DC
14. Load : 600 Ohms (min.) at 24 Volts D.C.
15. Ambient Temperature : 0 - 50 °C
16. Performance: :
 - i. Accuracy : $\pm 0.075\%$ of Span or better

-
ii.	Repeatability	± 0.05% of Span or better
-
17.	Sealing/Isolation	: Extended diaphragm (Silicon oil/Fluorolub filled) with 5 meters SS armoured capillary for corrosive/viscous/solid bearing or slurry type fluid applications
18.	Accessories	: a. Universal mounting bracket suitable for 2" pipe mounting b. High tensile carbon steel U-bolts c. Siphon for steam and hot water services d. ½" NPT 2-valve stainless steel manifold, constructed from SS316 bar stock e. Companion flange with nuts, bolts and gaskets f. ½" NPT cable gland g. Handheld calibrator
19.	Adjustment/Calibration/ Maintenance	: From handheld calibrator/ HART management system

Notes: For primary air/ secondary air/ flue gas applications, DP type transmitters shall be provided for pressure measurement.
LVDT type is not acceptable.

1.02.00 DIFFERENTIAL PRESSURE TRANSMITTER / FLOW TRANSMITTER

1.	Working Principle	: Smart (HART Compatible)
2.	Type	: Microprocessor based, 2 – Wire
3.	Output Signal	: 4-20 mA DC along with superimposed digital signal
4.	Measuring Element	: Capsule / Diaphragm

-
5.	Element material	:	SS-316 (Stainless Steel) or better
6.	Static Pressure	:	150 % of maximum span continuously, without affecting the calibration
7.	Turn-down ratio	:	100: 1
8.	Span and Zero	:	Continuous, tamper proof, remote as well locally adjustable with zero elevation and suppression by 100% of span
9.	Enclosure Class	:	IP-65 (Explosion proof for NEC Class-1, Division 1 area)
10.	Output Indicator	:	LCD (Integral indicator of 5 digit display)
11.	Nameplate	:	Tag number, service engraved in SS tag plate
12.	Body	:	SS
13.	Operating Voltage	:	24V DC
14.	Load	:	600 Ohms (min.) at 24 Volts D.C.
15.	Ambient Temperature	:	0 - 50 °C
16.	Performance:		
	i. Accuracy	:	± 0.075% of Span or better
	ii. Repeatability	:	± 0.05% of Span or better
17.	Sealing/Isolation	:	Extended diaphragm (Silicon oil/ Fluorolub filled) with 5 meters SS armoured capillary for corrosive/viscous/solid bearing or slurry type fluid applications
18.	Accessories	:	a. Universal mounting bracket suitable for 2" pipe mounting b. High tensile carbon steel U-bolts

-
- c. Siphon for steam and hot water services
 - d. ½" NPT 5-valve stainless steel manifold, constructed from SS316 bar stock
 - e. Companion flange with nuts, bolts and gaskets
 - f. ½" NPT cable gland
 - g. Handheld calibrator

19. Adjustment/Calibration/ Maintenance : From handheld calibrator/ HART management system

1.03.00 Displacer Type Level Transmitters

- 1. Type : Smart (HART Compatible)
- 2. Stages of operation : Continuous
- 3. Material :
- 4. i. Displacer SS-316
- 5. ii. Suspension wire SS-316
- 6. iii. Torque tube housing SS
- 7. iv. Torque tube Inconel
- 8. v. Displacer chamber SS
- 9. vi. Transmitter Housing SS
- 10. Operating Voltage : 24 V DC
- 11. Transmission : Microprocessor based, 2-wire
- 12. Output Signal : 4-20 mA DC along with superimposed digital signal
- 13. Static / overload : Maximum static pressure without

	pressure		permanent deformation or loss of accuracy
14.	Turn-down ratio	:	10 : 1 or better
15.	Zero & Span	:	Continuous, tamper proof, remote as well locally adjustable with zero elevation and suppression by 100% of span
16.	Enclosure Class	:	IP-65
17.	Output Indicator	:	LCD type (Integral indicator of 5 digit display)
18.	Nameplate	:	Tag number and Service engraved in stainless steel tag plate
19.	Ambient Temperature	:	0 - 50 °C
20.	Load Impedance	:	600 Ohms at 24 Volts (minimum)
21.	Process Connection	:	2" Flanged
22.	Performance - Accuracy	:	± 0.075 % of span or better
23.	Accessories	:	a) Counter Flange, nuts, bolts, gaskets etc b) Weights for 5 point calibration of instruments c) Vent and drain plugs d) ½" NPT Glands e) Handheld calibrator
24.	Preferred Features	:	a) Test plug connection and cutout terminals physically separated from other electronics b) Electronic Damping facility (adjustable)
25.	Adjustment/Calibration/ Maintenance	:	From handheld calibrator/ HART management system

	26. Applications	: During detail engineering on Owner's approval
1.04.00	MASS FLOW METER	
1.04.01	SENSOR	
	1. Measuring Principle	: Coriolis Mass flow
	2. Primary Element	: Flow Tube of 316SS or better
	3. Heating Arrangement	: Integral
	4. Temperature Control	: For heavy fuel oil application
	5. Process Connection	: Flanged of rating as per process requirement
	6. Drain	: Self-draining facility
	7. Enclosure	: Stainless steel
	8. Accessories	: Counter flanges, Mounting nuts, bolts, gaskets etc.
1.04.02	TRANSMITTER	
	1. Measured quantities	: Mass Flow rate, Total Mass Flow, Density
	2. Input Signal Processing	: Smart (HART compatible)
	3. Display	: LCD
	4. Output	: 2 nos. isolated output of 4-20mA DC selectable from four measured quantities
	5. Load	: < 750 ohms
	6. Power supply	: 240V AC, 50 Hz

-
7.	Turn Down	:	100:1
8.	Accuracy	:	± 0.2 % of measured value
9.	Housing	:	IP 65 (Explosion proof)
10.	Nameplate	:	Tag number, service engraved in stainless steel tag plate
11.	Accessories	:	a) Handheld calibrator b) Mounting U-bolts, nuts, bolts, prefab cable etc c) $\frac{1}{2}$ "NPT cable gland
12.	Adjustment/Calibration/ /Maintenance	:	From handheld calibrator/ HART management system
13.	Applications	:	Fuel Oil service

1.05.00 RADAR TYPE LEVEL MEASUREMENT

1.	Type	:	Smart (HART Compatible)
2.	Antenna	:	Co axial / guided wave radar / Overspill protection
3.	Principle	:	TDR (Time Domain Reflectometry)
4.	Communication	:	Two wire 4-20mA DC with HART
5.	Environmental temperature	:	0 – 50 °C
6.	Enclosure	:	IP-65 (Explosion proof for NEC Class-1, Division 1 area)
7.	Calibration	:	a) Self calibration with internal reference b) Zero & Span calibration
8.	Process Connection	:	External cage mounting Flanged /screwed
9.	Electronic Housing	:	Epoxy painted Die-Cast aluminium

	alloy	
10. Antenna / Flange assembly	:	316 SS or Hest alloy (as required)
11. Power supply	:	24 V DC
12. Output Indicator	:	LCD
13. Accuracy	:	5 mm or 0.1% of probe length
14. Accessories	:	a) Handheld calibrator
	:	b) Counter Flange, nuts, bolts, gaskets etc
	:	c) ½"NPT cable gland
	:	d) SS Nameplate
15. Adjustment/Calibration/ /Maintenance	:	From handheld calibrator/ HART management system
16. Applications	:	Vessels under vacuum or low pressure applications, solid levels

1.06.00 ULTRASONIC LEVEL TRANSMITTER

1. Type	:	Microprocessor based, 2-wire, Smart (HART Compatible)
2. Operating Principle	:	Detection of reflected ultrasonic pulse
3. Output Signal	:	4-20 mA DC along with superimposed digital signal
4. Operating frequency	:	10 KHz to 50 KHz (typical)
5. Display	:	LCD
6. Temperature Compensation	:	Built in –Programmable
7. Power supply	:	24 V DC
8. Enclosure	:	SS, IP-65 (Explosion proof for NEC Class-1, Division 1 area)

-
9. Zero & Span	:	Continuous, tamper proof, remote as well locally adjustable. It shall be possible to calibrate the instrument without any level in the sump/ tank
10. Accuracy & Repeatability	:	0.15 % of span or better
11. Resolution	:	0.1 % of span
12. Operating temp.	:	Transmitter- 500 C and Sensor - 800 C
13. MOC Sensor	:	SS-316/Body- PVC and Face – Polyurethane
14. Mounting	:	4" Flanged/ 2" NPT for sensor and Transmitter on panel
15. Accessories	:	a) Handheld calibrator b) Weather canopy for protection from direct sunlight and direct rain c) ½"NPT cable gland d) All mounting hardware (SS-316), Prefab cable e) SS Nameplate
16. Diagnosis	:	On-line
17. Status Indication	:	Power On, HI, HI-HI, Lo, LO-LO, Fault
18. Output Contacts	:	2 SPDT, 230V, 5A
19. Adjustment/Calibration/ Maintenance	:	From handheld calibrator/ HART management system
20. Applications	:	Coal Bunker, Water Service etc.

1.07.00 ULTRASONIC FLOW TRANSMITTER

1. Type	:	Ultrasonic – Clamp On					
2. Accuracy	:	+/- 1 % of reading					
3. Repeatability	:	+/- 0.3 % of reading					
4. Rangeability	:	400 : 1					
5. Output Signal	:	4-20 mA DC with HART					
6. Measured Parameter	:	Volumetric flow, Totalized flow and flow Velocity					
7. Display	:	LCD with internal Key Pad (Flow rate & Totalization)					
8. Power Supply	:	24 V DC (2 Wire)					
9. Enclosure	:	SS (IP- 68 – Submersible)					
10. Mounting	:	SS Chain or Strap					
11. Accessories		<table border="0"><tr><td>1. Handheld calibrator</td></tr><tr><td>2. ½"NPT cable gland</td></tr><tr><td>3. Transducer cable</td></tr><tr><td>4. All mounting hardware (SS-316)</td></tr><tr><td>5. SS Nameplate</td></tr></table>	1. Handheld calibrator	2. ½"NPT cable gland	3. Transducer cable	4. All mounting hardware (SS-316)	5. SS Nameplate
1. Handheld calibrator							
2. ½"NPT cable gland							
3. Transducer cable							
4. All mounting hardware (SS-316)							
5. SS Nameplate							
12. Adjustment/Calibration/ /Maintenance	:	From handheld calibrator/ HART management system					
13. Applications	:	Plant water service					

Note: Multi-path insertion type (minimum 4 path) Ultrasonic Flow meter shall be provided for Raw water/ Cooling Water flow measurements.

2.00.00 ~~HART HAND HELD CALIBRATOR~~

~~Hand held calibrators (5 nos. for each type) shall be provided for adjustment/ calibration/maintenance of the HART compatible~~

~~transmitters. The hand held calibrator shall be suitable for all types of transmitters supplied in the package. If one type of hand held type calibrator is not suitable for communicating with all types of transmitters then separate hand held calibrator will be provided.~~

3.00.00 PROCESS ACTUATED SWITCHES

3.01.00 PRESSURE SWITCH

1.	Type	:	i. Piston for high pressure application
			ii. Bellow / Diaphragm for low pressure application
2.	Sensing element material	:	SS-316. All other wetted part SS316
3.	Case Material	:	SS $\frac{1}{2}$
4.	Setter Scale	:	Black graduation on white linear scale. Graduation 0-100% with red pointer for set points
5.	Over range	:	150 % of maximum pressure
6.	Adjustments	:	a) Internal Set Point
		:	b) Differential adjustment
7.	End Connection	:	1/2" NPT bottom connected
8.	Switch configuration	:	Two SPDT (240V, 5A AC/220V, 0.5A DC)
9.	Switch Type	:	Snap acting, shock & vibration proof
10.	Terminal Block	:	Suitable for full ring lugs
11.	Enclosure Class	:	IP-65 (Explosion proof for NEC Class-1, Division 1 area)
12.	Performance	:	a) Repeat accuracy $\pm 1.0\%$
		:	b) Accuracy of Setting Indication of $\pm 1.5\%$
13.	Ambient temperature	:	0 – 50 Deg.C

-
14. Nameplate	:	Tag number, service engraved in SS tag plate
15. Accessories	:	a) Silicon oil/ Fluorolub filled Remote diaphragm seal with SS-316 capillary for corrosive/ viscous/ solid bearing or slurry type fluid applications b) Snubbers for pulsating fluid applications c) Siphons for steam and hot water services d) Retention ring and screws for surface mounting e) 1/2" NPT 2 Valve SS-316 barstock manifold f) 1/2" NPT cable gland
16. Applications	:	During Detail Engineering on Owner's approval

3.02.00 DIFFERENTIAL PRESSURE SWITCH

1. Type	:	i. Piston for high pressure application ii. Bellow / Diaphragm for low pressure application
2. Sensing element material	:	SS-316. All other wetted part SS316
3. Case Material	:	SS
4. Setter Scale	:	Black graduation on white linear scale. Graduation 0-100% with red pointer for set points
5. Over range	:	150 % of maximum pressure

-
6. Adjustments	:	a) Internal Set Point
	:	b) Differential adjustment
7. End Connection	:	1/2" NPT bottom/ back connected
8. Switch configuration	:	Two SPDT (240V, 5A AC/220V, 0.5A DC)
9. Switch Type	:	Snap acting, shock & vibration proof
10. Terminal Block	:	Suitable for full ring lugs
11. Enclosure Class	:	IP-65 (Explosion proof for NEC Class-1, Division 1 area)
12. Performance	:	a) Repeat accuracy $\pm 1.0\%$
		b) Accuracy of Setting Indication of $\pm 1.5\%$
13. Ambient temperature	:	0 – 50 Deg.C
14. Nameplate	:	Tag number, service engraved in SS tag plate
15. Accessories	:	a) Silicon oil/ Fluorolub filled Remote diaphragm seal with SS-316 capillary Diaphragm seals for corrosive/ viscous/ solid bearing or slurry type fluid applications
		b) Snubbers for pulsating fluid applications
		c) Siphons for steam and hot water services
		d) Retention ring and screws for surface mounting
		e) 1/2" NPT 5 Valve SS-316 barstock manifold
		f) 1/2" NPT cable gland
16. Applications	:	During Detail Engineering on Owner's

approval

3.03.00 LEVEL SWITCH

3.03.01 FLOAT OPERATED

1. Float material : SS-316
2. Wetted parts : SS-316
3. Float chamber : Stainless steel/Carbon steel,
construction welded
4. Float chamber : Side mounted
mounting
5. Fluid connection : Side – Side
6. Fluid connection size : 1" ANSI RF Flange (rubber line, if
required)
7. Drain : ½ inch NPT with Plug
8. Pressure rating of
chamber : Minimum 1.5 times of design pressure
9. Repeatability : +/- 1.5 mm or better
10. Switch housing : Stainless Steel
11. Switch housing type : IP- 65
12. Type of switch : Snap acting magnetically operated
hermetically sealed
13. Switch configuration : 2 SPDT (5A, 240 V AC, 0.5A, 220V DC)
14. Accessories :
 - a) Counter flange, nuts
& bolts, suitable
gasket etc.
 - b) Steel globe type
drain valve
 - c) ½"NPT cable gland

		d)	Stainless steel nameplate with alpha-numeric engraved for service and tag
	15. Application	:	During Detail Engineering on Owner's approval
3.04.00	FLOW SWITCH		
	1. Type	:	Paddle /Piston/Disk
	2. Wetted part material	:	Stainless steel or Hastelloy for acidic application
	3. End connection	:	a) Threaded upto 1" line size with integral Tee
		:	b) Flanged for line size > 1 ½"
	4. Enclosure material	:	Stainless Steel
	5. Enclosure class	:	IP 65
	6. Switch configuration	:	2 SPDT (5A, 240 V AC, 0.5A, 220V DC)
	7. Repeatability	:	2%
	8. Cable connection	:	½"NPTF
	9. Accessories	:	a) Tee, Counter flange, nuts & bolts, suitable gasket etc
			b) ½"NPT cable gland
			c) Stainless steel nameplate with alpha-numeric engraved for service and tag
3.05.00	RF LEVEL SWITCH		

-
1. Type	:	RADIO FREQUENCY
Sensing probe		
2. Material	:	SS-316
3. Mounting	:	Threaded
Application		
4. Temperature	:	250°C (Max.)
Electronic Controller		
5. Input Supply Voltage	:	240V AC ±10%, 50 Hz.
6. Relay Output	:	2 SPDT (240V AC, 5A)
7. Ambient Temperature	:	50 °C
8. Enclosure Protection	:	IP-66
9. Enclosure Housing	:	SS
		Normal Level
		Power On
10. Local LED Indication	:	Alarm Level
		Probe Healthy
11. Switching Repeatability	:	±0.5%
		Co-axial cable for probe connection to controller
12. Accessories	:	SS Tag plate
		½" NPT Cable Glands
13. Application	:	Solid level

3.06.00 CONDUCTIVITY TYPE LEVEL SWITCH

1. Type	:	Conductivity discrimination
2. Probe MOC	:	SS-316
3. Mounting	:	Flanged on external cage
Application		
4. Temperature	:	250°C (Max.)
5. Test Pressure	:	Two times rated pressure

-
6. Input Supply Voltage	:	240V AC $\pm$ 10%, 50 Hz.
7. Input	:	Four independent channel with selectable switching threshold for water conductivity
8. Relay Output	:	2 SPDT (240V AC, 5A)
9. Ambient Temperature	:	50 °C
10. Enclosure Protection	:	IP-65 (Explosion proof for NEC Class-1, Division-1 area)
11. Enclosure Housing	:	SS HI,LO, HIGH-HIGH, LOW-LOW
12. Local LED Indication	:	Power Fault
13. Accessories	:	a) Interconnecting cable from probe to electronics b) Mounting accessories c) External cage d) Washer & Gasket e) ½" NPT Cable Glands f) SS Tag Plate
14. Application	:	During Detail Engineering on Owner's approval

3.07.00 TEMPERATURE SWITCH

1. Type	:	Bimetallic or gas filled
2. Sensing Element Material	:	SS-316
3. Bulb Material	:	SS-316
4. Capillary	:	Stainless Steel armored

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5.	Movement Material	:	Stainless Steel
6.	Case material	:	Stainless Steel with neoprene gasket and clear glass where applicable cover conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).
7..	Scale	:	Black graduation on white linear scale. Graduation 0-100% with red pointer for set points
8.	Over range Protection	:	120 %
9.	Instrument connection	:	Bottom
10.	Switch configuration	:	Two SPDT (240V, 5A AC/220V, 0.5A DC)
11.	Switch type	:	Snap acting, shock and vibration-proof
12.	Adjustability	:	Internal Set point adjustable over span range
13.	Compensation	:	a) Capillary compensation with invar wire throughout the capillary length b) Case compensation
14.	Performance		
	a) Scale Accuracy	:	±1.0 % of full scale
	b) Repeatability	:	< 0.5 % of full range
	c) Response time	:	Less than 40 seconds with thermowell
15.	Capillary length	:	5 meters (minimum) for local mounting/15 meters for local panel mounting
16.	Nameplate	:	Tag number, service engraved in stainless steel tag plate
17.	Accessories	:	Mounting accessories, ½" NPT cable gland
18.	Applications	:	During Detail Engineering on Owner's

approval

4.00.00 **LOCAL INSTRUMENTS**

4.01.00 PRESSURE GAUGE AND DIFFERENTIAL PRESSURE GAUGE

1. Type	:	Bourdon/Bellows/Diaphragm
2. Sensing & Socket	:	SS-316
3. Movement Material	:	SS-316
4. Case Material	:	Stainless steel. IP-65 (Explosion proof for NEC Class-1, Division 1 area)
5. Dial Size	:	Generally 150 mm
6. Scale	:	Black lettering on white in 270 O arc.
7. Window	:	Shatterproof glass
8. Range Selection	:	Normal process pressure: 50~70 % of range
9. Over-range Protection	:	125% of maximum range by internal stop. External stop at zero For Zero adjustment (Micrometer screw external)
10. Adjustment	:	For Range adjustment (Micrometer screw internal).
11. Element Connection	:	Argon welding
12. Process Connection	:	1/2" NPT (M) Bottom for local, back for panel mounting
13. Performance	:	Accuracy of ± 1.0 % of span or better
14. Operating ambient	:	0 - 50 °C
15. Safety Feature	:	Blow out disc /diaphragm at the back
16. Accessories	:	a) Snubbers for pulsating fluid application.discharge b) Stainless steel Diaphragm seals

		for corrosive/ viscous/ solid bearing or slurry type fluid applications
	c)	3-Way SS316 Gauge cock for pressure gauges
		5-valve SS316 manifold from
	d)	barstock for differential pressure gauge
	e)	Siphons for steam and hot water services
17. Nameplate	:	Tag number, service engraved in stainless steel tag plate
4.02.00	LEVEL INDICATOR (FLOAT & BOARD TYPE)	
1. Type	:	Float and Board
2. Float Material	:	SS-316
3. Float Cable	:	SS-316
4. Indicator Assembly	:	Epoxy painted Aluminium
5. Guide wire spring assembly	:	SS-316 (2 Nos.)
6. Guide Wire Anchor	:	SS-316
		Anodized Aluminium with engraved marking (Minimum graduation 10mm),
7. Scale Board	:	mounting brackets and suitable hardware required as per tank height
8. Elbow Assembly	:	Anodized Aluminium
9. Flanges	:	RF , ANSI 150 , SS (3 Nos.)
10. Accuracy	:	± 10 mm or better
11. Accessories	:	All mounting accessories including counter flange, nuts & bolts, suitable

gasket etc. as applicable, SS Tag plate

4.03.00 GAUGE GLASS

1. Type : Reflex /Transparent
2. Material :
 - Glass : Toughened borosilicate resistant to thermal shock
 - Body Material : ~~Carbon Steel~~ Stainless Steel
 - Enclosure : IP-65 (Explosion proof for NEC Class-1, Division 1 area)
3. Integral cocks & valves/Fittings :
 - i. SS 316
 - Rubber lined corrosion resistant
4. :
 - ii. stainless steel (for DM/RO service)
5. Vessel Connection : ANSI Flanged SS316
6. Accessories :
 - i. Integral cocks
 - ii. Drain Valves
 - iii. Companion Flanges, Bolts, nuts, gaskets, SS Tag plate
 - iv. Illuminating lamps, Mica shield as required
 - v. Calibrated scale
7. Pressure rating : Twice the maximum working pressure
8. Temperature : 300 ° C
9. Other details :
 - For larger lengths (greater than 1200mm), additional gauge glasses shall be provided with minimum of 50 mm overlap.

4.04.00	SLIGHT GLASS	
1.	Type	: Flap-type.
2.	End connection	: Screwed / Flanged
3.	Material	
	a) Body	: SS- 304
	b) Cover plate	: SS- 304
	c) Indicator	: SS- 316
4.	Sight Glass	: Toughened Borosilicate
5.	Gasket	: Neoprene
6.	Bolts & Nuts	: High tensile steel.
7.	Hydraulic Test Pressure	: 1.5 times maximum working pressure
8.	Accessories	: Companion Flanges, Bolts, nuts, gaskets as required, SS Tag plate.
4.05.00	ROTAMETER	
1.	Type	ON-LINE for line upto and including 50 mm NB. : Borosilicate BY-PASS for line size above 50 NB
2.	Metering tube	: Toughened Borosilicate
3.	Float	: SS-316
4.	End fittings	: SS-316
5.	Packing material	: Teflon / PTFE
6.	Casing	: Stainless Steel
7.	Gland Rings /Followers/ Other wetted parts	: Stainless Steel
8.	Orifice Plate	: Stainless Steel (for bypass type)
9.	Operating Temperature	: 0-50 Deg. c

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10. Test Pressure	:	200% of maximum operating pressure
11. Scale	:	250 mm nominal length
12. Graduation	:	Direct reading
13. Process Connection	:	Flanged (RF) to line size as per ANSI standards (150#)
14. Tapping	:	D & D/2
15. Accuracy	:	+/- 2% of full scale reading
16. Reproducibility	:	Within 0.5% of instantaneous reading
17. Accessories	:	SS Tag Plate, orifice plate

5.00.00 **TEMPERATURE ELEMENTS & ACCESSORIES**

5.01.00 RESISTANCE TEMPERATURE DETECTOR

1. Type	:	Platinum (Duplex), Ungrounded
2. Platinum (Duplex), Ungrounded	:	100 ohm at 0 °C
3. Base	:	Wound on ceramic (anti-inductive)
4. Wiring	:	3 Wire
5. Protecting Tube		
a) O.D.	:	6 mm
b) Material	:	SS-316, Seamless
c) Filling	:	Magnesium oxide (Purity above 99.4%).
6. Response time	:	a) 15 sec. (bare). b) 30 sec. (with thermowell)
7. Calibration	:	DIN 43760
8. Accuracy	:	± 0.5%
9. Head		
a) Type	:	IP-65 universal screwed type

-
- b) Material : Stainless Steel
 - c) Terminal blocks : Nickel plated Brass-screw type / silver plated
 - d) Cable connection : ½" NPT gland and grommet
 - e) Others : Terminal head cover with SS chain and suitable gasket.

Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable).

- 10. Accessories :
 - a) Adjustable nipple-union-nipple [1/2" Sch 80 X ½" NPT] with thermowell connection
 - b) Compression fittings/unions
 - c) Flanges etc. (for flanged connections only)
 - d) Thermowell (As specified below)

- 11. Thermowell connection : ½" NPT (M) or 150 RF Flanged
- 12. Nameplate : Tag number, service engraved in stainless steel tag plate

Note: The specifications for RTDs of winding/ bearing 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 Pt-100.

5.02.00 THERMOCOUPLES

1. Type :
 - a) 16 SWG wire of Chromel Alumel) (Type-K)
 - b) Duplex
 - c) Ungrounded
2. Protecting Tube
 - a) O.D. : 6 mm
 - b) Material : SS-316, Seamless
 - c) Filling : Magnesium oxide (Purity above 99.4%).
3. Response time :
 - a) < 20 seconds for measurement
 - b) < 10 seconds for control
4. Accuracy : $\pm 1.1^{\circ}\text{C}$ up to 300°C & 0.4% of measured temperature range above 300°C
5. Head
 - a) Type : IP-65 universal screwed type
 - b) Material : Stainless Steel
 - c) Terminal blocks : Nickel plated Brass-screw type / silver plated
 - d) Cable connection : $\frac{1}{2}$ " NPT gland and grommet
6.
 - e) Others : Terminal head cover with SS chain and suitable gasket.

Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable).

7. Accessories :
 - a) Adjustable nipple-union-nipple [1/2" Sch 80 X 1/2" NPT] with thermowell connection
 - b) Compression fittings/unions
 - c) Flanges etc. (for flanged connections only)
 - d) Thermowell (As specified below)
8. Thermowell connection : 1/2" NPT (M) or 150 RF Flanged
9. Nameplate : Tag number, service engraved in stainless steel tag plate

5.03.00 TEMPERATURE GAUGE

1. Type : Expansion type (Liquid filled system)
2. Sensing Element : Bourdon – SS-316
3. Material : SS-316
4. Bulb and Capillary : SS-316
5. Capillary Tubing : Inner sheath - solid drawn Material
Outer sheath - PVC tube
6. Movement Materials : Stainless Steel / Direct Bourdon tip connection to pointer spindle
7. Case Material : Stainless Steel stove enameled, black finish, threaded bezel ring, clear glass

		cover conforming to IP 65.
7. Dial size	:	150 mm
8. Scale	:	Black lettering on white background in 270 Deg.C arc
9. Over range protection	:	125 percent of FSD
10. Capillary Glanding	:	1/2" NPT(M) x compression fitting (SS) to suit capillary
11. Instrument Connection	:	Bottom connection for local mounting, back connection for panel mounting
12. Process Connection	:	1/2" NPT (M) or 150 RF Flanged
13. Extension Neck Length	:	50 mm
14. Compensation	:	a) Capillary compensation
15.	:	b) Case compensation
16. Performance	:	a) Accuracy : + /- 1.0 percent of full scale Deflection
	:	b) Repeatability : Less than 0.5 percent of full range
	:	c) Response time: 15 seconds (max.).
17. Capillary length	:	3.0 meters (local) / 15.0 metres (local panel)
18. Other features	:	Shatter proof glass
19. Nameplate	:	Tag number, service engraved in stainless steel tag plate
20. Accessories	:	SS316 Thermowell

5.04.00 THERMOWELL

1. Material	:	SS-316
2. Manufacture	:	Drilled from bar stock, Hex Head, Tapered design (As per ASME PTC 19.3)

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3.	Process connection	:	M33x2
4.	Certification	:	Not applicable
5.	Bore concentricity	:	+5% of wall thickness
6.	Identification mark	:	Tag number punched on head
7.	Surface treatment	:	Polish after machining
8.	Element connection	:	½" NPT (M) or 150 RF Flanged
9.	Head	:	Hex
10.	Length of the hex head	:	31.75 mm (min.)
11.	Accessories	:	SS Plug and chain for test thermo wells SS Nameplate, Flange with companion flange & all required accessories for flanged connections.

Note: Wake frequency calculations shall be furnished for all thermowells for approval.

Thermowells shall be designed such that the resonant frequency is above the exciting frequencies generated by vortex shedding in the process fluid.

5.05.00 METAL TEMPERATURE THERMOCOUPLE

1.	Measuring medium	:	Metal temperature
2.	Type	:	Chromel Alumel (Type-K) Duplex, Ungrounded
3.	Insulation	:	Mineral Insulation Magnesium Oxide
4.	Wire gauge	:	16 AWG
5.	Protective sheath	:	SS
6.	Protective sheath diameter	:	8 mm O.D.
7.	Characteristics	:	Special limits of error as in ANSI thermocouple MC 96.01
8.	Accessories	:	½" BSP SS sliding end connector, weld pad, clamps of heat resistant steel

-
1.	Type	:	Hydrometer Type
2.	Mounting	:	On line
3.	Accuracy	:	+/- 2% of range
4.	Scale	:	Black letter on white scale
5.	End connection	:	PVC flange

9.06.00 **DENSITY/ CONCENTRATION METER**

1.	Wetted Part		Stainless Steel
2.	Enclosure		Stainless Steel (IP-65)
3.	Power Supply		24 V DC
4.	Output signal	:	4-20 mA DC (isolated) into 600 ohms
5.	Accuracy		±0.001 g/cc
6.	Indication	:	LCD display
7.	Temp. Compensation	:	Integral
8.	Accessories		Mounting hardware, integral amplifier (if required), cable glands, tag plate etc.

10.00.00 **SOLENOID VALVES**

1.	Operating Principle	:	Electromagnetic (noiseless)
2.	Coil voltage rating	:	240 V AC /24 V DC (as required)
3.	Ways	:	2/3/4 way
4.	Port size	:	1/4" NPT all ports
5.	Body	:	SS bar stock
	Trim	:	SS-316
6.	Duty	:	Suitable for continuous energization
7.	Sealing	:	Airtight and leak proof
8.	Ambient Temperature	:	0 - 50 ° C

9.	Fluid Temperature	:	0-150 ° C (approx.)
10.	Coil Enclosure	:	Stainless Steel
11.	Insulation	:	Class-H
12.	Coil Casing	:	IP-65 (Explosion proof for NEC Class- 1, Division-1 area)
13.	Mounting	:	On pipe or on panel
14.	Cable Connection	:	½" NPT
15.	Accessories	:	Cable glands, SS Tag plate



Technical specification for
CONTROL & INSTRUMENTATION

4 X 270 MW BHADRADRI TPP, TELANGANA

SECTION D

REV. NO. 00

DATE : 24.03.2015

INSTRUMENTATION CHECK LIST



STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR PRESSURE SWITCH

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	V	V	
	1.1 MODEL NO/TAG NO						
	1.2 RANGE						
	1.3 END CONN						
	1.4 NO. OF CONTACT						
2	CALIBRATION			P	V	V	
	2.1 REPEATABILITY						
	2.2 SET POINT ADJUSTMENT						
	2.3 DIFFERENTIAL						
3	OVER PR & LEAK TEST				P	V	V
4	ELECT. INSULATION/HV TEST	ONE		P	V	V	
5	REVIEW OF TC FOR MATERIALS OF	FOR LOT		V	V	V	
	5.1 SENSOR						
	5.2 MOVEMENT						
	5.3 PROCESS CONNECTION						
	5.4 HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V	
7	REVIEW OF TC OF MICROSWITCH	FOR LOT		V	V	V	

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to carry out ROUTINE TEST on 100 %.
- Contractor to provide compliance certificate for tests/checks verified by contractor and the same alongwith test certificates to be verified by BHEL



STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR TRANSMITTER

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECKS FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	VISUAL.						
	MODEL/TAG No						
2	PROCESS CONNECTION			P	W	V	
3	ACCURACY			P	W	V	
4	REPEATABILITY			P	W	V	
5	HYSTERESIS			P	W	V	
6	EFFECT OF TEMP VARIATION ON ACCURACY			P	W	V	
7	SPAN / ZERO ADJUSTMENT	ONE / TYPE		P	W	V	
8	EFFECT OF SUPPLY VOLTAGE VARIATION			P	W	V	
9	EFFECT OF LOADING (500 OHM METERS)			P	W	V	
10	HIGH PRESSURE TEST	SEE NOTE-1 BELOW		P	W	V	
11	BURN-IN TEST	ONE / TYPE		P	W	V	
12	DEGREE OF PROTECTION			P	W	V	
13	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW		V	V	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- When material corelation are not available manufacturer's compliance to be provided.
- Contractor to provide compliance certificate for tests/checks verifid by contractor and submit the same alongwith test certificates to be verified by BHEL.



STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR PRESSURE & DP GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	SENSOR TYPE						
	DIAL SIZE						
	MODEL NO/TAG NO						
	RANGE/SCALE						
	SWITCH CONTACT RATING & NOS.						
	END CONNECTION						
2	CALIBRATION			P	W	V	
	ACCURACY						
	REPEATABILITY						
	SET POINT ADJUSTMENT						
3	OVER PRESSURE & LEAK TEST	P	W	V			
4	OPERATION OF PRESSURE. RELIEF DEVICE	ONE	P	W	V		
5	REVIEW OF TC FOR	FOR LOT	V	V	V		
	MATERIALS OF SENSOR						
	MOVEMENT						
	PROCESS CONNECTION						
	HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST	V	V	V		
7	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW	V	V	V		

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- Manufacturer to carry out ROUTINE TEST on 100 %.
- When material correlation is not available, MFR's compliance to be provided
- Contractor to provide compliance certificate for tests/checks verified by contractor and submit the same alongwith test certificates to be verified by BHEL.



STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR LEVEL GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS / DRWGS	P	W	V	
	TYPE						
	MODEL/ TAG NO.						
	DAIL SIZE						
	RANGE/SCALE						
	END CONNECTION						
2	DIMENSIONS, PROCESS CONNECTION	ONE / LOT		P	W	V	
3	ACCURACY			P	W	V	
4	MATERIAL TC FOR			P	V	V	
	BODY ISO.						
	VALVE						
	GAUGE GLASS						
5	HYD. TEST	SEE NOTE-1 BELOW		P	W	V	
6	ACCESSORIES AS APPLICABLE			P	W	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL,
P = Perform, W = Witness, V = Verification

Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- Manufacturer to carry out ROUTINE TEST on 100 %.
- Contractor to provide compliance certificate for tests/checks verified by contractor and submit the same alongwith test certificates to be verified by BHEL.



STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR ANNUNCIATORS

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	TYPE/ MODEL						
	DIMENSIONS OF HARDWARE						
	MODULARITY						
	SEQUENCE						
	FACIA DETAILS						
2	FUNCTIONAL TEST	100%		P	W	V	
3	IMMUNE TO STEP VARIATIONS IN THE POWER SUPPLY	SEE NOTE-1 BELOW		P	W	V	
4	DEGREE OF PROTECTION FOR ENCLOSURE	TYPE TEST		P	W	V	
5	I/R CHECK	SEE NOTE-1 BELOW		P	W	V	
6	RESPONSE			P	W	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- Manufacturer to carry out ROUTINE TEST on 100 %.
- Contractor to provide compliance certificate for tests/checks verified by contractor and submit the same alongwith test certificates to be verified by BHEL.



Technical specification for
CONTROL & INSTRUMENTATION

4 X 270 MW BHADRADRI TPP, TELANGANA

SECTION D

REV. NO. 00

DATE : 24.03.2015

LCP & JUNCTION BOXES SPECIFICATION

1.00.00	GENERAL REQUIREMENT
1.01.00	ENCLOSURES FOR INSTRUMENTS AND OTHER EQUIPMENT
1.01.01	All panels, cabinets, distribution boxes, junction boxes, terminal boxes and all other field mounted equipment / enclosures shall have suitable environmental protection as detailed in Section-I of this volume of the specification.
1.02.00	SURFACE PREPARATION & PAINTING
1.02.01	All sheet metal panel/ desk exterior steel surfaces shall be sand blasted, ground smooth and painted as specified below.
1.02.02	Suitable filler shall be applied to all pits, blemishes and voids in the surface. The filler shall be sanded so that surfaces are level and flat; corners are smooth and even. Exposed raw metal edges shall be ground burr-free. The entire surface shall be blast clean to remove rust and scale and all other residue due to the fabrication operation. Oil, grease and salts etc. shall be removed from the panels by one or more solvent cleaning methods prior to blasting.
1.02.03	Two spray coats of inhibitive epoxy primer surfacer shall be applied to all exterior and interior surfaces, each coat of primer surfacer shall be of dry film thickness of 1.5 mil. A minimum of two spray coats of final finish color (Catalyzed epoxy or polyurethane) shall be applied to all surface of dry film thickness 2.0 Mil. The finish colors for exterior and interior surfaces shall conform to the following shades: • Exterior – Opaline green shade 275 of IS: 5 or equivalent international code.. • Interior - Brilliant White.
1.02.04	Paint films, which show sags, cheeks, blisters, teardrops, fat edges or other painting imperfections, shall not be acceptable.
1.03.00	WIRING
1.03.01	All spare contacts of relays, switches and push buttons shall be wired up to the terminal blocks. All intercommunications between sections of panels/desks shall be furnished.
1.03.02	Each wire shall be identified at both ends with wire designation as per approved wiring diagram. Heat shrinkable type ferrules with indelible computerized ink print shall be used with cross- identification.
1.03.03	All wire termination shall be made with insulated sleeve and crimping type lugs. Wire shall not be spliced or tapped between terminals. Open-ended terminal lugs will not be accepted. Wires shall not be looped around the terminal screws or studs.

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- 1.03.04 Internal wiring should be terminated uniformly on one side of the terminal block leaving the other side available for termination of outgoing cables. Internal wiring shall be grouped so that all outgoing wiring to each particular remote location is terminated on adjacent terminal blocks. Interior wiring and jumperings shall be arranged so that external connections can be made from internal side of terminal blocks. Common connections shall be limited to two (2) wires per terminal.
- 1.03.05 Wiring shall be arranged to ensure free access to all instrument or devices for maintenance. No wire shall be routed across the face or rear of any device in a manner, which will impede the opening of covers or obstruct access to leads, terminals or devices
- 1.03.06 Wires shall be dressed and run in trays or troughs with clamp-on type covers. Wirings may be neatly bunched in groups by non-metallic cleats or bands. Each group shall be adequately supported along its run to prevent sagging or strain on termination.
- 1.03.07 Shield wires shall be terminated on separate terminal blocks. Common connections shall be limited to two wires per terminal. Signal circuit shields shall be grounded at the power supply end only or as recommended by manufacturer.
- 1.03.08 All low level signal cables shall be separately bundled to from control cable and maintained at 300 mm minimum spacing from control bundles.
- 1.03.09 Panel internal wiring shall follow distinct color-coding to segregate different voltage levels viz. 24V DC, 48V, 110V AC, 240V AC, 220V DC etc.
- 1.03.10 Thermocouple lead wires, analyzer measuring lead wires, or any other lead wires carrying measuring signal of the order of low milli volt or micro volt shall be electrically and physically isolated from other AC and DC wiring. Shielded wires used in such cases for panel internal wiring shall be continuous and ungrounded with the shield terminated individually and separately in panel terminal block.
- 1.03.11 Wiring to door mounted devices shall be provided with multi-strand wires of (49 strands minimum) adequate loop lengths of hinge-wire so that multiple door openings will not cause fatigue failure of the conductor.
- 1.03.12 Internal wiring in factory pre-wired electronic systems cabinets may be installed according to the Contractor's standard wire size, insulation, and method of termination on internal equipment. Insulation for all wiring, including circuit board wiring, back panel wiring, power supply wiring and interconnecting cables between devices shall pass the vertical flame test per IPCEAS-1981. Identification of conductors may be done by insulation color-coding identified on drawings or by printed wiring lists.

1.04.00	TERMINAL BLOCKS
1.04.01	All terminal blocks shall be rail mounted/ post mounted type, cage clamp type with high quality non-flammable insulating material of melamine suitable for working temperature of 105 Deg C. The terminal blocks in field mounted junction boxes, instrument enclosures racks etc. shall be suitable for cage clamp connections. The terminal blocks in Control Equipment Room termination/ marshalling cubicles shall be suitable for post mounted cage clamp connection at the field input end. The exact type of terminal blocks to be provided by Bidder shall be subject to Owner.
1.04.02	All terminal blocks shall be provided complete with all required accessories including assembly rail, locking pin and section, end brackets, small partitions, transparent covers, support brackets, distance sleeves, warning level, marking etc. For RTDs ring - tong type lugs shall be used at Junction Boxes.
1.04.03	The characteristics of the terminal blocks shall be as follows. i) High contact force, independent of conductor cross-section and large contact surface area. ii) Integrated self-loosening protection to avoid shifting of contact surface that may allow contamination of connection point. iii) Inspection and maintenance free (resistant to thermal aging and vibration) iv) Low and constant voltage drop
1.04.04	The insulation of the terminal blocks shall be of suitable thermoplastic material.
1.04.05	The spacing between Terminal blocks channels in panels and cubicles shall be adequate for routing the cable troughs and to allow adequate free workspace for termination and removal of wires. The terminal blocks shall be arranged with atleast 100 mm clearance between two sets of terminal blocks and junction box walls.
1.04.06	Signals of different voltage levels shall be clearly segregated by providing separate rows to each type of signal and by using terminal blocks of different color for each type of signal and by providing barrier strips between them.
1.04.07	Terminal blocks shall be provided with white marking strips / self-adhesive marker cards and where permitted by the safety codes and standards, shall be without covers. Power terminals and high voltage (above 48 volts) terminals shall have protection covers. All terminals shall be provided with permanent terminal identification numbers on both sides.
1.04.08	At least 20% spare unused terminals shall be provided on each terminal block for circuit modifications and for termination of all conductors in a multi-conductor control cable.

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- 1.04.09 The bottom of the terminal block shall be at least 200 mm above the cable gland for bottom entry type panels.
- 1.04.10 For extending 24 V DC supply to panels, the size of the terminals shall be decided based on voltage drop and not based on current.
- 1.04.11 Other requirements of the terminal blocks are as follows:
- i) The last terminal in a rail-mounted assembly shall be closed with an end plate and end bracket.
 - ii) For visual and electrical separation of terminal groups, partition plates shall be provided, which can be push fitted after forming an assembly.
 - iii) Design shall permit testing of incoming and outgoing signals by using suitable test plug and socket without disconnecting the cable connections.
 - iv) It shall be possible to use jumper plugs through the above test plug socket to connect adjacent terminals. Adequate number of short circuit jumper plugs shall be provided for the purpose.
 - v) Where more than one connection to a terminal block is required, two tier terminals shall be used.
- 1.05.00 **GROUNDING**
- 1.05.01 Separate Protective and Electronic system ground as required shall be provided.
- 1.05.02 All panels, desks, cabinets shall be provided with a continuous bare copper ground bus (Frame ground), bolted to the panel structure at bottom on both sides and effectively ground the entire structure. The bolts shall face inside of panels.
- 1.05.03 For electronic system cabinets the electronic system ground bus (Electronic ground) shall be similar but insulated from the cabinet and shall be separately connected to the system ground .The same ground may be used to earth the shield of shielded signal cables, otherwise a separate ground bus shall be provided for connecting the signal cable shields. Cable shields shall be grounded at the panel end only and shall never be left open .The electronic ground between panels of a shipping section shall be firmly looped.
- 2.00.00 **CONTROL DESKS & PANELS**
- 2.01.00 **GENERAL**
- 2.01.01 All control desk, panels etc. shall be furnished fully wired with necessary provision for convenience outlets, internal lighting, utility receptacles, grounding, ventilation, space heating, anti-vibration pads, internal piping &

- accessories as required for completeness of the system.
- 2.01.02 The design shall conform to the EN ISO 11064 (Ergonomical design of Control Room), Part 1, 2 and 3.
- 2.01.03 The exact dimensions, material, construction details, grounding, general arrangement etc. shall be as per actual requirement and shall be finalized during detail engineering and subjected to Owner's approval.
- 2.01.04 Incoming power supply feeders shall be duplicated. Alarm shall be provided for failure of a power supply feed.
- 2.01.05 For Control desk/ panel mounted instruments/ devices etc. which are to be powered from UPS, all required conversion of interface equipments/ accessories to make such devices compatible with UPS supply shall be provided. All necessary hardware like input switches/ fuse unit for each feeder as well as switch fuse unit for each instrument/ device on the power supply line shall be provided. From UPS redundant feeders shall be provided with suitably rated MCB and provision of fast auto changeover of UPS feeders.
- 2.01.06 Crating of the panels and desks shall be suitable for protection against shock, vibration, inappropriate handling and inclement weather conditions during transportation and warehousing. Mounted equipment shall have adequate protection against damage during handling, transit and storage. Suitable desiccant shall be used inside the packing case.
- 2.01.07 Nameplate
- a) Nameplate shall be provided for instrument or device mounted on the panel.
 - b) Nameplates for panels shall be provided both in front and rear.
- 2.02.00 CONTROL DESK
- 2.02.01 Control desk shall be free standing, floor mounting, table top type with doors at back and shall be constructed of 3 mm thick (minimum) CRCA steel or Aluminium extrusion. Aluminium structure shall be anodized or powder coated paint finish. The top surface of control desk shall be 30 mm (minimum) thick with the top 12 mm (minimum) of acrylic solid surface and the remaining 18 mm of laminated medium density fibre (MDF) board.
- 2.02.02 Monitors with retractable keyboard shall be provided on the desk. Desk shall be arranged in arc-like shape without any sharp edges. Edges shall be extruded PVC or rounded post-formed laminate.
- 2.02.03 Desks shall be of modular, scalable and industrially ruggedized design and shall have connections for PA system handsets & telephone sets.
- 2.02.04 Desks shall have concealed cable trays for wire dressing. Both Horizontal & Side Managers (2 separate horizontal cable routing wire baskets for power & data cables) shall be provided.

Each User station will be provided with 2 separate power distribution units (1 for Main line & 1 for UPS line). Each power distribution unit will have 6 points of 5/13 Amp sockets, Mains MCB On/Off Switch & Indicator.

Adequate heat management provision for Exhaust of heat from within the Console Desk Assembly shall be provided. There will be multiple fans provided in the Main Control Desk. Each Fan will be of 230 VAC 250 CFM Ball Bearing based. Ventilation louvers will be provided on both Front & Rear Modesty with special Air Filters. Adequate space for CPU & Other equipments placed with in the desk.

2.02.05 Design shall include Earthing bolts.

2.02.06 Back installed items shall be suitably concealed from front view.

2.02.07 All operator workstations for SG, TG, Auxiliaries & Off-site Plants shall be mounted on this Control Desk. The cabling / wiring between OWS & CPUs, power supply cables etc. shall be aesthetically routed and concealed from view.

2.02.08 HARDWIRED DEVICES ON CONTROL DESK (DRAW OUT SECTION)

Release and Lamp Test push buttons shall be provided for a set of push buttons (decided during detail engineering stage). Depending on the type of control/ function, required number of push buttons/ indicating LEDs & their color, push button stations shall be selected. The size of push button stations shall be 24 x 48 mm or 25 x 50 mm and shall have service inscription details at the front. Emergency push buttons (with cover) shall be mounted on top of Control Desk.

~~2.03.00 BACK UP PANEL~~

~~2.03.01 Construction shall be from CRCA steel of thickness not less than 3mm.~~

~~2.03.02 Upright back-up panel shall be provided where hardwired devices shall be mounted on a mosaic grid type console. The mosaic grid tiles shall be of 24 mm x 48 mm (or 25 mm x 50 mm) size, made of heat & flame retardant, self extinguishing and non-hygroscopic material with flat matt finish without glare and non reflecting type.~~

~~2.03.03 DDCMIS Back-up Panel (referred as Unit Control Panel-UCP) shall also mount annunciation fascia (minimum 500 nos.) and the flame monitoring cameras along with other hardwired devices as decided during detail engineering stage by Owner. Color coding shall also subject to Owner's approval.~~

~~2.03.04 Colored Mimic for different Off-site plant control systems (as enumerated elsewhere in this specification) and hardwired annunciation system shall also~~

be mounted on the back up panels.

2.04.00 PANELS/CABINETS

2.04.01 All DDCMIS system modules, power supply components and other Local Control panels (PLC/Relay based) shall be housed in cabinets as specified below.

2.04.02 The cabinet mounted equipments shall be fully assembled, installed in mounting racks, wired and fully tested as per specification requirements and Owner approved drawings prior to shipment to the project site.

2.04.03 The Bidder shall ensure that the cabinets are complete & ready for installation before dispatch from manufacturing works. The installation work at project site for these cabinets shall only involve connections through multi-pair cables from marshalling cabinets (wherever provided) to system cabinets and inter-cabinet/cabinet to Control Desk/ Back up Panel.

2.04.04 All electronic cards, network components, power supply modules etc. located shall be suitably housed in cabinets and shall be neatly arranged in sub-racks. Network components shall be visible in door closed condition (e.g. Glass doors etc.) as approved by Owner.

2.04.05 Bidder shall design the cabinet internal arrangement, floor cutout and cable gland plate such that all the cables entering or leaving the cabinet can be properly glanded in the gland plate.

2.04.06 The packaging density of panels shall be such that the temperature rise within the panels shall never exceed 10°C above ambient even under worst operating conditions. Cooling Fans shall be provided wherever required and this shall be of industrial grade.

2.04.07 TECHNICAL PARTICULARS

1.	Material of Construction	:	Cold Rolled Coal Annealed (CRCA) steel sheet
2.	Thickness of Sheet	:	a) 2.0 mm for faces supporting instruments / terminals
		:	b) 1.6 mm for other sides and top
3.	Construction	:	Welded throughout as per approved National Standards
4.	Post welding operation	:	a) Grounding of all welds to smoothness
		:	b) Rounding of corners

- : c) Cleaning of weld spatters
- 5. Panel height : 2300 mm (approx)
- 6. Corners : 7 mm inner radius
- 7. Dimensional Tolerances :
 - a) In height & length - 3 mm
 - b) In height between adjacent sections - 2 mm
 - c) Total for a group - 6 mm
- 8. Doors : Double, recessed, turned back edges, full height front & rear
 - i) Thickness of Sheet : 2 mm
 - ii) Hinges : Stainless steel
 - iii) Door latches : Three point type
 - iv) Door gaskets : Neoprene rubber on fixed frame to result dust proof/weatherproof enclosure
 - v) Opening of the doors : Outward
 - vi) Louvers : With removable wire mesh to ensure dust and vermin proof
- 9. Gland plates : Removable in sections
4 mm thick (bottom)
- 10. Cable entry : Bottom
- 11. Hardware :
 - a) Anti vibration pad- 15 mm
 - b) Predrilled base channel ISMC – 100 or equivalent for all sides
 - c) Stainless steel buff- finished 2 mm thick kick plate for all sides
 - d) Stainless steel scratch strips along desk edges fixed with pan-head recessed screws
 - e) Rubber strips to ensure air

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		tightness between kick plate and finished floor
	f)	Lifting hook / Eye bolt
	g)	Drawing pocket
	h)	Door switch, lamps, thermostat, heaters and industrial grade cooling fans,, illumination fixtures
12.	Name Plate	: Both at front and back surface of the panel
13.	Fixing of name plate	: Stainless steel pan head screws
14.	Name plate material	: Laminated phenolic (3 layers)
15.	Lettering	: Black with white engraved
16.	Mounting of terminal blocks	: Vertical angle support bracket tack welded on sheet steel plate, screwed on internal wall of enclosure

2.05.00 FURNITURE

All the furnitures in the Central / Local control Room (s), Engineers' rooms, Instrument laboratory , SWAS Room & any other rooms with C&I equipments located in different plant buildings under Bidder's scope shall be included in Bidder's scope of supply. Bidder shall provide following industrial grade furniture items as a minimum from reputed manufacturers/suppliers meeting International Standards. The furniture shall be modular and latest with ease of operational features. The furniture shall be modern, aesthetically designed, modular, flexible, space saving and future safe.

2.05.01 WORK STATION FURNITURE

Modular work station furniture, suitable for mounting servers & historians, programmer stations, PC based systems, printers (A4/A3 color laserjet) etc. shall be provided.

2.05.02 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.

2.05.03 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.
2.05.04	TABLES Industry standard computer tables shall be provided & shall be as approved by Owner during detailed Engineering. Glass top teak wood horse shoe shaped table with vertical file mounting arrangement (two layers to house approx. 40 Nos of files and lockable drawers at both ends) for Engineering Room shall be provided.
2.05.05	ALMIRAHs Steel Almirahs shall be provided for keeping documents in the documentation room. Glass doors for each rack shall be provided such that the documents are visible from outside. Size of the rack shall be sufficient to easily fit technical manuals. The exact details shall be approved by Owner during detailed Engineering.
2.05.06	KEYPAD One keypad per unit shall be provided for the storing of keys of relevant areas of the unit in the control room.
2.05.07	LOCKERS Suitable lockers shall be provided in the room adjacent to the control room for storing of personal articles of control room personnel. Also, lockers of bigger size shall be provided in documentation Room for storing of personal documents. Details shall be finalized and approved by Employer during detailed engineering.
3.00.00	LVS PANEL
3.01.00	An arc shaped Large Video Screen (LVS) panel shall be supplied for mounting large video screens in number of tiers in various Control rooms as specified elsewhere in this specification. Bidder shall provide and fix ACP cladding around the LVS screen including covering the LVS back side and LVS stand. The cladding will be from floor finish to 600 mm above LVS screen like a self-standing partition with necessary openings for system requirement. ACP paneling shall be with 304 grade & approx. 0.5 mm mirror finish SS strip.
3.02.00	The profile, dimensions and the general arrangement shall be finalized & approved by Owner during detailed engineering. Recommendations, if any, for the control room lighting in order to ensure continuous proper viewing of the LVS screen by the operator & shift incharge (without any fatigue) shall be

	clearly brought out by the Contractor in his offer, alongwith all relevant details/basis.
3.03.00	Any other requirement for proper LVS mounting & functioning & viewing shall also be specifically brought out by the Contractor in his offer, along with all relevant details.
4.00.00	LOCAL INSTRUMENT RACK (LIR) & LOCAL INSTRUMENT ENCLOSURE (LIE)
4.01.00	GENERAL
4.01.01	Devices (Transmitters/ Switches) located in the field shall be suitably grouped together to the extent possible and installed in the LIE (Closed Rack) and LIR (Open Rack) in Boiler/TG Building and Off-site plant areas.
4.01.02	Racks and enclosure shall be factory prefabricated & painted and shall complete with internal piping, tubing, manifold, isolation valves, blowdown valves, integral junction box, illumination etc.
4.01.03	No more than six instruments shall be grouped in a single rack / enclosure.
4.01.04	Racks shall be installed above the tapping points for air, flue gas and coal air mixture application whereas for applications such as for water and steam, racks to be installed below the source point.
4.01.05	Attention shall be paid in the layout to avoid air traps in liquid piping and water accumulation in air /gas piping.
4.01.06	Racks used for furnace, flue gas and air application shall be provided with intermittent & continuous air purging
4.01.07	Welding of impulse lines shall comply with the provisions of the latest applicable ANSI Code for Pressure Piping.
4.01.08	Earth stud shall be furnished at rack for safety grounding.
4.02.00	LOCAL INSTRUMENT ENCLOSURE (LIE)
4.02.01	Enclosure shall be free standing type. Racks shall be adequately reinforced to ensure true surfaces and to provide support. Major load - bearing posts shall be suitably supported by gusset plates or moment members.
4.02.02	Enclosure outer shall be constructed from at least 3 mm thick steel plate and epoxy painted to shade gray. Base frame shall be made of ISMC 100 and black colour finish.
4.02.03	2" NB galvanized pipes shall be laid horizontally and supported at two end channels to mount transmitters at accessible height. Center posts or any

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- member, which would reduce access, shall be avoided.
- 4.02.04 Double leaf interlocking front opening doors with three point locking shall be provided and shall be arranged for maximum possible access to the interior. Key shall be of identical for all enclosures.
- 4.02.05 Doors shall have concealed quick removal type pinned stainless steel hinges and locking handles. Gaskets shall be used between all mating sections to achieve dust and weather proof enclosure rated for IP-65 including the internal junction box. All enclosures shall have access doors on front side.
- 4.02.06 Removable type bulkhead plates of thickness not less than 6 mm shall be mounted at the racks with suitable high temperature gasket. Impulse lines within the enclosures shall be properly clamped.
- 4.02.07 All internal wirings between the instruments and junction box shall run through flexible conduits. No exposed wirings within transmitter racks both open and closed type, is admissible.
- 4.02.08 Racks shall have a common blowdown drain header, which will connect individual instrument blowdown line after suitable pressure breaking through regulating globe type blowdown valves. Covered funnels shall be used for saturated liquid and steam service, whereas, open funnels may be used for cold liquid services. Header (2" NB ASTM A 106, Sch-80 Gr. C) shall be suitably sloped and shall have one end flanged and extending beyond the rack for connection to plant drain header..
- 4.02.09 Each rack shall be provided with one receptacle, light fixtures with wire guard and one lighting switch each at instrument & Junction box compartments with wire guard. Lighting switches may be door actuated & mounted inside the panel. Outlet box, switch box and device covers shall be of galvanized stamped steel. Light switches and receptacles shall be installed inside the enclosure on the wall near the latch side of the enclosure door. Light fixtures shall be installed on the ceilings of the enclosures.
- 4.02.10 Power supplies for miscellaneous devices shall be provided with MCB located within the enclosures. MCB shall be mounted in fuse blocks. Nameplates shall be furnished above the MCB blocks, identifying the devices being served.
- 4.02.11 Vibration dampeners shall be installed for supporting each enclosure. The loading at each corner of the enclosure shall be determined by actual test weighting when construction is complete to determine the correct length of each dampener for proper loading of the dampener in accordance with manufacturer's recommendations
- 4.03.00 LOCAL INSTRUMENT RACK (LIR)
- 4.03.01 Rack shall be free standing type constructed from 6 mm thick steel channel frame provided with a canopy to protect the instrument from dripping water or

falling objects and shall be epoxy painted. Canopy shall be of CRCA steel sheet of at least 3 mm thickness.

4.03.02 Rack Major load-bearing posts shall be suitably supported by gusset plates or moment members. Suitable fenders grill shall be welded to the end-posts of the rack to outline a boundary beyond which no mounted equipment shall project to protect instrument from accidental contact during personnel movement. Center posts or any member, which would reduce access, shall be avoided.

4.03.03 2" NB galvanized pipes laid horizontally and supported at two end channels shall be employed at working accessible height for mounting of instruments.

4.03.04 All internal wirings between the instruments and junction box shall run through flexible conduits. No exposed wirings are admissible.

4.03.05 Racks shall have a common blowdown drain header, which will connect individual instrument blowdown line after suitable pressure breaking through regulating globe type blowdown valves. Covered funnels shall be used for saturated liquid and steam service, whereas, open funnels may be used for cold liquid services. Header (2" NB ASTM A 106, Sch-80 Gr. C) shall be suitably sloped and shall have one end flanged and extending beyond the rack for connection to plant drain header..

Each rack shall be provided with one receptacle, one light fixture with wire guard and one lighting switch. Outlet box, switch box and device covers shall be galvanized stamped steel. Light fixtures shall be installed on the canopy of the rack

4.03.06 Power supplies for miscellaneous devices shall be provided with MCB located within the enclosures. MCB shall be mounted in fuse blocks. Nameplates shall be furnished above the MCB blocks, identifying the devices being served.

4.04.00 JUNCTION BOX

1. Type of Enclosure	:	Dust tight & weatherproof conforming to IP 65
2. Material	:	3 mm sheet steel / fiberglass reinforced polyester(UV stabilized)
3. Type of Cover	:	Solid unhinged with retention chain / Screwed at all four corners
4. Paint	:	i) Exterior : Opaline green shade 275 of IS: 5 ii) Interior - Brilliant Glossy White.

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		Surface / Two (2) inch Pipe stanchion
5.	Mounting	: (At a dry compartment at one side of the enclosure / rack with front opening type door)
6.	Cable Entry	: 3 mm (min) Bottom / side Gland plate
7.	Gasket	: Neoprene
8.	Grounding	: Brass earth lug with green screw head External-2 nos , Internal-1no. (M6)
9.	Number of Drain Holes	: Two at bottom capped
10.	Identification	: Label for JB and Tags for cable
11.	Accessories	: Rail mounted cage clamp type screwless terminals (suitable for conductor size up to 2.5sq.mm of suitable voltage grade) with markers and 20% spare terminals
		b) Cable gland (Brass) & raceways
		c) Ferrules & lugs (Brass)
		d) Aluminum back panel
		e) Canopy at top
		f) Mounting brackets
		g) bolts and nuts made of brass etc.



Technical specification for
CONTROL & INSTRUMENTATION

4 X 270 MW BHADRADRI TPP, TELANGANA

SECTION D

REV. NO. 00

DATE : 24.03.2015

LCP Quality Plan

		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL										STD QUALITY PLAN NO.: PE-QP-999-145-1056 VOLUME IIB SECTION D REV. NO. 01 SHEET 1 OF 7 DATE: 22-02-2008			
Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks			
									P	W	V				
1.0	INCOMING Sheet Steel (CRCA & HR)	1. Chemical Composition	MA	Chemical analysis	Sample	Relevant standard	Relevant standard	Test Certificate	3	---	2				
		2. Bend Test	CR	Mech. test	Sample	Relevant standard	Relevant standard	Log Book	2	---	---				
		3. Surface finish	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---				
		4. Waviness	MA	Visual	100%	Factory Standard	No Waviness	Log Book	2	---	---				
		5. Thickness	MA	Measurement	100%	BHEL Spec.	BHEL Spec.	Log Book	2	---	---				
		6. Mill marking	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	1				
2.0	Flats / Angles / Channels	1. Dimensions	MA	Measurement	Sample	Relevant standard	Relevant standard	Log Book	2	---	---				
		2. Surface Defects	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---				
		3. Straightness	MA	Measurement	100%	Factory Std.	Factory Std.	Log Book	2	---	---				
		4. Mill marking	MA	Visual	100%	Relevant standard	Relevant standard	Log Book	2	---	1				
3.0	Cables / Wires	1. Visual / Surface defects	MA	Visual	100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	2	---	---				
		2. IR and HV	MA	Electrical	100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	2	---	---				
LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics													\$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.	1 - BHEL 2 - Vendor 3 - Sub-vendor	

भारतीय वैद्युत विकास निकाय BHEL PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL										STD QUALITY PLAN NO.: PE-QP-999-145-1056 VOLUME IIB SECTION D REV. NO. 01 DATE: 22-02-2008 SHEET 2 OF 7			
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks			
									P	W	V				
		3. Conductor a) Resistance b) Size c) Sheet colour	MA MA MA	Electrical Measurement Visual	100% 100% 100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	2	---	---				
		4. Type / Routine Test Certificates	MA	Verification	100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	3	--	2				
4.0	Electrical Components like Annunciator Transformers Lamps Switches PBs Contactors Relays Timers Space Heaters Thermostat Indicating meters etc.	1. Verification at make and Type 2. Verification of Test Certificates 3. Operation / Functional check 4. I.R. 5. H.V. 6. Calibration 7. Pick up / Drop off Voltage	CR CR CR MA MA MA	Visual Scrutiny of Type / Routine T.Cs. Electrical Electrical Electrical Electrical	Sample 100% Sample+ 100% 100% 100%	BHEL Spec. and BOM Relevant standard Relevant standard & Catalogue Relevant standard & Catalogue Relevant standard & Catalogue Relevant standard & Catalogue	BHEL Spec. and BOM Relevant standard Relevant standard & Catalogue Relevant standard & Catalogue Relevant standard & Catalogue	Log Book Log Book Log Book Log Book Log Book Log Book	2 2 2 2 2 2	--- --- --- --- --- ---	--- --- --- --- 1 ---	 			

STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL										STD QUALITY PLAN NO.: PE-QP-999-145-I056					
										VOLUME		IIB			
										SECTION		D			
										REV. NO.		01		DATE: 22-02-2008	
										SHEET		3		OF 7	
Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks			
									P	W	V				
5.0	Misc. Components like Gaskets , Terminal Blocks etc.	1. Verification of Type / Make 2. Surface defects 3. IR / HV on Terminal Blocks	MA MA MA	Visual Visual Electrical	Sample Sample Sample	BHEL Spec. & Mfrs. Catalogue BHEL Spec. & Mfrs. Catalogue BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue BHEL Spec. & Mfrs. Catalogue BHEL Spec. & Mfrs. Catalogue	Log Book Log Book Log Book	2 2 2	--- --- ---	--- --- ---				
6.0	IN PROCESS Blanking / Bending / Forming	1. Dimensions 2. Surface defects after bending	MI MA	Measurement Visual	100% 100%	Approved Mfr. drgs. Factory Standard	Approved Mfr. drgs. Factory Standard	Log Book Log Book	2 2	--- ---	--- ---				
7.0	Nibbling / Punching	1. Cutout Sizes 2. Deburring	MI MA	Measurement Visual	100% 100%	Approved Mfr. drgs. Approved Mfr. drgs.	Approved Mfr. drgs. Approved Mfr. drgs.	Log Book Log Book	2 2	--- ---	--- ---				
8.0	ASSEMBLY Frame Assembly & Sheet fixing	1. Dimensions 2. Alignment 3. Welding Quality 4. Surface defects	MA MA MA MA	Measurement Measurement Visual Visual	100% 100% 100% 100%	Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards Approved drg. / Mfr. Standards	Log Book Log Book Log Book Log Book	2 2 2 2	--- --- --- ---	2 2 2 2				
LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics															
\$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.															
1 - BHEL 2 - Vendor 3 - Sub-vendor															

PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL							STD QUALITY PLAN NO.: PE-QP-999-145-1056				
Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks	
									P	W	V		
9.0	Pre-treatment and Painting	1. Pretreatment Process 2. Process parameters like bath temp. concentration etc. 3. Dipping / Removal Time 4. Surface quality after every dip 5. Primer after phosphating 6. Putty Application & Rubbing after primer 7. Paint first coat 8. Putty Application and Rubbing after first coat of paint 9. Paint second coat	MA MA MA MA MA MA	Visual Measurement Measurement Visual Visual, Thickness Visual Visual, Thickness, Scratch test Colour adhesion	100% Periodic 100% 100% 100% 100% 100%	Factory Standard & Relevant standard Factory Standard & Relevant standard Factory Standard & Relevant standard Factory Standard & Relevant standard Factory Standard & Relevant standard Factory Standard & Relevant standard Factory Standard & Relevant standard	Factory Standard & Relevant standard Factory Standard & Relevant standard Factory Standard & Relevant standard Factory Standard & Relevant standard Factory Standard & Relevant standard Factory Standard & Relevant standard Factory Standard & Relevant standard	Log Book Log Book Log Book Log Book Log Book Log Book Log Book	2 2 2 2 2 2 2	-- -- -- -- -- -- --	1 1 1 1 1 1 1		

LEGEND:

* CR

- Critical characteristics

MA

- Major characteristics

MI

- Minor characteristics

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P

- Agency Performing the Test.

W

- Agency Witnessing the Test.

V

- Agency Verifying the Test.

1

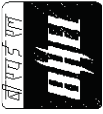
- BHEL

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- Vendor

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- Sub-vendor



PEM :: C&I

STANDARD QUALITY PLAN
FOR
LOCAL CONTROL PANEL

STD QUALITY PLAN NO.: PE-QP-999-145-1056

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SECTION D

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$				Remarks
									P	W	V		
10.	Panel Wiring	1. Wiring Layout	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	--	--	--	
		2. Wiring Termination (Crimped Lugs)	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	--	--	--	
		3. Ferrule numbers	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	--	--	--	
		4. Colour of wiring	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	--	--	1	
		5. Size of Conductor	MA	Measurement	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	--	--	1	
11.	Component Mounting	1. Correct components	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	--	--	--	
		2. Fixing	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	--	--	--	
12.	FINAL Final Inspection	1. Workmanship	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.
		2. Component layout (neatness, accessibility & safety) Mounting / Proper fixing of all components	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	1	
		3. Components identification Marking / Name plates	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	1	

LEGEND: *	CR	- Critical characteristics	\$	P	- Agency Performing the Test.	1	- BHEL
	MA	- Major characteristics		W	- Agency Witnessing the Test.	2	- Vendor
	MI	- Minor characteristics		V	- Agency Verifying the Test.	3	- Sub-vendor

 PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL										STD QUALITY PLAN NO.: PE-QP-999-145-1056					
												VOLUME		IIB			
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												SHEET		6		OF 7	
												7					
Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks					
									P	W	V						
		5. Dimensions	MA	Measurement	100%	BHEL approved drg. / Spec., BOM	BHEL approved drg. / Spec., BOM	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.					
		6. Door functioning	MA	Functional	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1						
		7. Paint Shade	CR	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1						
		8. Paint Thickness	CR	Measurement	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1						
		9. Workmanship of Gaskets	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1						
		10. Wiring Layout	MA	Visual	100%	BHEL approved drg.	BHEL approved drg.	Inspection Report	2	1	1						
		11. Wire Termination	MA	Pulling manually	Sample	-----	Firm termination	Inspection Report	2	1	1						
		12. Continuity	MA	Electrical	100%	-----	Continuity OK	Inspection Report	2	1	1						

LEGEND: * CR - Critical characteristics
 MA - Major characteristics
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1 - BHEL
 2 - Vendor
 3 - Sub-vendor

BHEL भारतीय भारती PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL							STD QUALITY PLAN NO.: PE-QP-999-145-1056				
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Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks	
									P	W	V		
13.	TYPE TEST	Degree of Protection	CR	Mech. Protection	Sample	BHEL approved spec., drg relevant IEC-60947, IEC-60079	BHEL approved spec., drg relevant IEC-60947, IEC-60079	Type Test Certificate	3	--	1		
14	ROUTINE TEST	IR before & after HV Test	CR	Electrical	100%	BHEL approved spec., drg., BOM & relevant standard	BHEL approved spec., drg., BOM & relevant standard	Test Report	2	1	1		
15	FUNCTIONAL TEST	1. Control Logic Operation	CR	Electrical	100%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1		
		2. Instrument Calibration	CR	Electrical	10%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1		
		3. Temperature rise	CR	Electrical	100%	BHEL approved spec/drg. & relevant standard	BHEL approved spec/drg & relevant standard	Inspection Report	2	1	1		

LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics		\$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.		1 - BHEL 2 - Vendor 3 - Sub-vendor	



Technical specification for
CONTROL & INSTRUMENTATION

4 X 270 MW BHADRADRI TPP, TELANGANA

SECTION D

REV. NO. 00

DATE : 24.03.2015

ERECTION HARDWARE

1.00.00 GENERAL TECHNICAL REQUIREMENTS

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.

However, any item required for erection of Bidder supplied system but not categorically indicated in this section, shall be supplied by the Bidder and all these items shall conform to International / National standards / codes.

1.01.00 Electrical Accessories

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 IS:9537 Part-I (1980) and Part-II(1981).. The conduit interior and exterior surfaces shall have a continuous zinc coating with an over coat of transparent enamel lacker or zinc chromate. Conduits shall be furnished in standard length of 3 meters, threaded at both ends.
 - iv) All rigid conduit fittings shall conform to requirements of IS:2667,1976. Galvanised steel fittings shall be used with steel conduit. All flexible conduit fittings shall be liquid tight, galvanized steel. The end fitting shall be compatible with the flexible conduit supplied.
- 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.

1.02.00

Please refer to Section VII , Subsection – D of this volume of the Specification.

1.03.00

1. Type : Double compression
2. Entry Thread : NPT / ET
3. Material : Brass
4. Finish : Cadmium Plated.
5. Protection : IP 54 or better
6. Accessories : Neoprene gasket, locknuts, reducers etc

1.04.00

1. Material : Mild steel, slotted
2. Thickness : not less than 2.0 mm
3. Finish : Hot dip galvanized
4. Perforation : As per MFR standard
5. Cover : Suitable for tray

1.05.00

Material and rating of the hook up items shall suit the piping and fluid condition. Hook up materials shall be IBR certified for applicable cases. Bidder shall furnish hook up drawings and the drawings for open racks & closed racks for owner's approval.

1.05.01

1.	Reference	: ASTM A-312 TP 316
2.	Material Grade	: TP 316
3.	Type	: Seamless /Plain end
4.	Size	: As applicable (e.g. 1½" NB etc)
5.	Schedule	: 40
6.	Standard Length	: 5 meter

1.05.02

1. Reference : ASTM A-182 F 316 / ANSI B16.11
2. Type : Forged
3. Rating : 3000 lbs / 6000 lbs / 9000 lbs
4. Size : To suit related SS pipe.
5. End connection : Generally socket weld
6. Type of Fittings : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.

1.05.03 Seamless Stainless Steel Tube

1. Reference : ASTM A-213 , ASTM A-249 or ASTM A-269
2. Material Grade : TP 316
3. Size : As applicable (e.g. ½" OD X 0.083" wall thickness / ¼" OD X 0.049" wall thickness etc.)
4. Type : Cold drawn annealed, pickled, passivated, de-scaled, hydraulically cleaned seamless tube.
5. 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.
6. Test Pressure : 400 Kg/Sq. cm (minimum)
7. Tolerance : ± 0.13 mm for outside diameter
: ± 15 % for wall thickness
8. Standard Length : 5 meter
9. Test : Flare, Hardness, Ball and Bubble Test

1.05.04 Stainless Steel Tube Fittings

1. Reference : ASTM-A-182
2. Type : Double ferrule double compression
3. Material : 316 Stainless steel forged
4. Ferrule : 316 Stainless Steel

	5.	Type of Fittings	: Male / female connector, elbow, cross /equal tee, straight connector, bulkhead union, ferrule etc. as required to suit installation.
	6.	Size	: To suit SS tubing and NPT end connection
1.05.05		C.S. Pipe	
	1.	Reference	: ASTM-A 106 Gr. C
	2.	Material	: Cold drawn seamless black C.S.
	3.	Type	: Seamless / Plain ends
	4.	Size	: As applicable (e.g. ½" NB etc)
	5.	Schedule	: 80, 160, XXS as required
	6.	Standard Length	: 5 meter
1.05.06		C.S. Pipe Fittings	
	1.	Reference	: ASTM-A 105 / ANSI B16.11
	2.	Type	: Forged
	3.	Rating	: 3000 lbs / 6000 lbs / 9000 lbs
	4.	Size	: Suitable to related C.S.Pipe
	5.	End connection	: Generally socket weld
	6.	Type of Fittings	: Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.
1.05.07		A.S. Pipe	
	1.	Reference	: ASTM-A 335 P22 AS PER ANSI B 36.10
	2.	Material	: Cold drawn seamless A.S.
	3.	Type	: Seamless / Plain ends
	4.	Size	: As applicable (e.g. ½" NB etc)
	5.	Schedule	: XXS
	6.	Standard Length	: 5 meter
1.05.08		A.S. Pipe Fittings	

	1.	Reference	: ASTM-A 182 F22 AS PER ANSI B 16.11
	2.	Type	: Forged
	3.	Rating	: 9000 lbs
	4.	Size	: Suitable to related A.S.Pipe
	5.	End connection	: Generally socket weld
	6.	Type of Fittings	: Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.
1.05.09		G.I.Pipe	
	1.	Reference	: IS-1239, Part-I
	2.	Type	: Medium grade, threaded at both ends protected with end caps
	3.	Material	: Continuous ERW galvanized MS pipe
	4.	General	: Pipe shall be galvanized both inside and outside
	5.	Size	: As applicable (e.g 1/2"/3/4"/1" etc.)
1.05.10		G.I.Pipe Fittings	
	1.	Reference	: IS-1239, Part-II for material, dimension, thread etc.
	2.	Style	: Threaded
	3.	Type of Fittings	: Equal tee, three piece union, unequal tee, straight socket, 90 Deg. elbow, reducing socket cap. etc. to suit installation.
	4.	Size	: Suitable to related G.I.Pipe
1.05.11		Carbon Steel Globe Valve	
	1.	Reference	: ASTM A-105
	2.	Type	: Globe
	3.	Construction	: Forged Body Cadmium Plated
	4.	End Connection	: As applicable (eg. 1/2" Socket Weld etc.)
	5.	Rating	: Cl. 800 / CL. 2500

-
6.	Material	: Body - Carbon steel
		: Stem - Hardened Steel
		: Plug - AISI 316 SS
		: Seat- Stainless steel stellited
7.	Packing	: Teflon / Grafoil as required
8.	Yoke	: ASTM A105
9.	Hand wheel	: Carbon steel
10.	Design standard	: As per ANSI B 16.34

1.05.12 Stainless Steel Globe Valve

1.	Reference	: ASTM A-182 F316
2.	Type	: Globe
3.	Construction	: Forged Body
4.	End Connection	: As applicable (eg. ½" Socket Weld etc.)
5.	Proof Pressure	: 400 Kg/Cm2
6.	Material	: Body - Stainless steel
		: Stem - Hardened Steel
		: Plug - AISI 316 SS
		: Seat- Stainless steel stellited
7.	Packing	: Teflon as required
8.	Yoke	: ASTM A182 F316
9.	Handwheel	: Carbon steel
10.	Design standard	: As per ANSI B 16.34

1.05.13 Alloy Steel Globe Valve

1.	Reference	: ASTM A-182 F22
2.	Type	: Globe
3.	Construction	: Forged Body

-
4.	End Connection	: As applicable (eg. ½" Socket Weld etc.)
5.	Rating	: CL. 2500
6.	Material	: Body - Alloy steel
		: Stem - Hardened Steel
		: Plug - AISI 316 SS
		: Seat- Stainless steel stellited
7.	Packing	: Grafoil as required
8.	Yoke	: ASTM A182 F22
9.	Handwheel	: Carbon steel
10.	Design standard	: As per ANSI B 16.34

1.05.14 Structural Steel

Steel supports for JB's, trays; tubes and related equipments shall not be limited to the following:

a)	MS Angle
b)	MS Channel
c)	I-Beam
d)	Hexagonal head Bolt & Nut with washer
e)	Foundation Bolt & Nut
f)	Expansion Bolt
g)	Steel Plates / Flats
h)	CRCA sheet
i)	50 NB Pipe
j)	Pipe clamps, U Bolts & Nuts
k)	Checker plate

1.05.15 Condensate Pot

1.	Reference	: ASTM A182 F22 /ASTM A105
2.	Material	: Alloy steel / carbon steel as per application
3.	Construction	: Drilled from barstock
4.	End connection	: As applicable (e.g 3 nos. ½" socket weld end etc.)

	5. Accessories	: Vent valves
1.05.16	Instrument Valve Manifold	
	1. Type	: Two valve manifold : Five valve manifold
	2. Mounting	: Remote 2" Pipe Mounting / Transmitter Rack mounting
	3. Construction	: Single block (bar stock)
	4. Material	: Forged body and bonnet AISI 316 stainless steel
	5. Ports	: Mfg std. (e.g 1/2 " NPT (F) etc.)
	6. Rating	: 420 Kg/Sq. cm at ambient
	7. Operating Temperature	: (-)30 to (+)170 Deg C
	8. Packing	: PTFE Wafer
	9. 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	: Plugs for all ports, Mounting Bracket , bolts , nuts

1.06.00 Pneumatic Hook Up Accessories

1.07.00 Air Header

Technical Particulars	For Panel	For Field
Material of Construction	: Stainless steel	: Stainless steel
Inlet Connection	: 2" NPT (M)	: 1" NPT (M)
Header Take-off Material	: Stainless steel	: Stainless steel
Take off connection	: 1 / 2" NPT (M)	: 1/ 2" NPT (M)
Take-off Valves Material	: stainless steel	: stainless steel

Tube Take-off

: Tube adapter on
valve

: Tube adapter on valve

Drain

: SS drain valve
at lowest point

: SS drain valves at
lowest point



Technical specification for
CONTROL & INSTRUMENTATION
4 X 270 MW BHADRADRI TPP, TELANGANA

SECTION D

REV. NO. 00

DATE : 24.03.2015

APPLICABLE CABLE TYPES

CABLE SIZES FOR 4 X 270 MW BHADRADRI TPS PROJECT JOB NO. 411 (PER UNIT)

Sl no.	Cable Type
	G-TYPE
1	2P X 0.5 sqmm
2	4P X 0.5 sqmm
3	8P X 0.5 sqmm
4	12P X 0.5 sqmm
	F-TYPE
1	4P X 0.5 sqmm
2	8P X 0.5 sqmm
3	12P X 0.5 sqmm
4	24P X 0.5 sqmm
	CONTROL CABLE
1	3C X 2.5 sqmm
2	5C X 2.5 sqmm
3	12C X 1.5 sqmm



Technical specification for
CONTROL & INSTRUMENTATION
4 X 270 MW BHADRADRI TPP, TELANGANA

SECTION D

REV. NO. 00

DATE : 24.03.2015

APPLICABLE CODES & STANDARDS

4.45.00 Local Instruments , Flow Elements and Control Valves

Required local instruments including gauge boards, etc. and Flow Elements , Control valves shall be provided for safe and efficient operation of the plant. .

4.46.00 Erection Hardware

Standard and good engineering practice of international standard shall be adopted throughout. All materials supplied shall be suitable for tropical, dust laden, humid power plant environment and shall be from reputed manufacture.

4.47.00 C&I Cabling

Instrumentation cables shall be copper, overall screened for binary signals and individual pair and overall screened for analog signals. All cables shall be FRLS type (inner and outer sheath) ,armored, other than short run cables which may be unarmored. Unarmored cables shall run through conduits.

C&I cable type shall also include FO , Prefab , Coaxial , compensating cable , special cable etc

The screen shall be grounded at the remote panel end at control / equipment room only.

5.00.00 CODES AND STANDARDS

The design, manufacture, inspection, testing, site calibration and installation of all C&I equipment and systems covered under this specification shall conform to the latest editions of applicable codes and standards eg. ANSI, ASME, IEEE, ISO, IEC, IGCI, AWS, NFPA, AISC, IGS, SAMA, UBC, UL, NESC, NEMA, ISA, DIN, VDE , IS etc. Generally, the following latest edition of codes and standards prevailing at the time of award of contract shall 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-255.4.
 - f) Printed circuit boards - IPC TM-650, IEC 326C.
 - g) General requirements and tests for printed wiring boards - IS-7405 (Part-I)/1973.
 - 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)
 - k) Direct Acting Electrical Indicating Instruments - IS - 1248 - 1968
 - 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) / IEC 60947 / IEC 60529
 - c) Protection Class for Enclosures , Cabinets Control Panels and Desks - IS 2147 1962

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- 7) Apparatus, Enclosures and Installation Practices in Hazardous Area
- a) Classification of hazardous area - NEMA Article 500, Volume-6, 1978./ NFPA Article 500 , Vol.70-1984
 - 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, 1982.
- 8) Sampling System
- a) Stainless Steel material of tubing and valves, for sampling system - ASTM A 269-79 GRT0-316.
 - b) Submerged helical coil heat exchangers for sample coolers -- ASTM D11-98.
 - c) Steam and water sampling ,conditioning and analysis in the power cycle - ASME PTC - 19.11
 - d) Standard methods of sampling system - ASTM D 1066-69
- 9) Annunciators
- a) Specifications and guides for the use of general-purpose annunciators - ISA RP 18.1.
 - b) Surge withstand capability tests -ANSI C37.90 a -1971 and IEEE Standard 472-1974.
- 10) Interlocks, Protections
- a) Relays and relay system associated with electric power apparatus - IEEE Standards 3.13.
 - b) Surge withstand 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.
 - d) Turbine water damage prevention - ASME-TDP-1-1980.
 - e) Boiler safety interlocks - NFPA Section 85B, 85D, 85E, 85F, 85G.
 - f) Installation and operation of Pulverized fuel system - ANSI / NFPA 8503
 - g) Functional diagramming of Instrument and control systems - SAMA PMS 22.1
 - h) Digital interface for programmable instrumentation - ANSI / IEEE 488

11) Control Valves

- a) Control valve sizing (Incompressible fluids) - ISA-S39.2 / 1972.
- b) Control valve sizing (Compressible fluids) - ISA-S39.4 / 1972.
- c) Control Valve seat leakage – ANSI / FCI 70.2
- d) Face to face dimensions of Control Valves - ANSI B16.10
- e) Control Valve Capacity Test Procedure – ISA – S75.02

12) Process connection Piping and Tubing

- a) Seamless Carbon Steel Pipe - ASTM-A-106.
- b) Forged carbon steel fittings - ASTM-A-105.
- c) Dimensions of fittings - ANSI-B16.11.
- d) Code for pressure piping, welding, hydrostatic testing - ANSI-B 31.1.
- e) Nomenclature for instrument tube fittings - ISA-RP 42.1 / 1982.
- f) Seamless Stainless Steel Tube ASTM A-213 TP 316 / ASTM A-269 TP 316
- g) Seamless Alloy Steel Pipe ASTM A 335 P22
- h) Seamless Stainless Steel Pipe ASTM A-312 TP 316
- i) Forged and Rolled alloy steel pipe flanges , forged fittings , valves and parts ASTM A - 182
- j) Pipe fittings of wrought carbon steel and ally steel - ASTM A - 234
- k) Composition bronze metal castings ASTM B - 62
- l) Seamless copper tube , bright annealed ASTM B- 168
- m) Valves flanged and butt welding ends ANSI B 16.34

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.



Technical specification for
CONTROL & INSTRUMENTATION
4 X 270 MW BHADRADRI TPP, TELANGANA

SECTION D

REV. NO. 00

DATE : 24.03.2015

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:**

- 1) Mill Reject Handling System: EUA

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

		<u>N1</u>	<u>N2 N3</u>
Motorised (<i>on/off duty</i>)	-	0	01 to 50
Motorised (<i>inching duty</i>)	-	0	51 to 99
Pneumatic (Control)	-	1	01 to 50
Motorised (<i>thyrestor Control</i>)	-	1	51 to 99
Sol. Operated	-	2	01 to 99
(Open / Close duty (Valves, NRVs, Gate)			
Hydraulic	-	3	01 to 99



DOCUMENT TITLE

KKS NUMBERING PHILOSOPHY

4X270MW TPP BHADRADRI TPP, TELANGANA

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.

VOLUME: VI
SECTION-I
GENERAL TECHNICAL REQUIREMENTS

CONTENT

1.00.00	INTENT OF SPECIFICATION
2.00.00	GENERAL PERFORMANCE REQUIREMENT
3.00.00	GENERAL DESIGN REQUIREMENTS
4.00.00	GENERAL TECHNICAL REQUIREMENTS
5.00.00	CODES AND STANDARDS
6.00.00	DESIGN CRITERIA
7.00.00	METERING BASES AND CHART UNITS
8.00.00	PROCESS CONNECTION & INSTRUMENT HOOK UP
9.00.00	POWER SUPPLY SYSTEMS
10.00.00	ENVIRONMENTAL CONSIDERATIONS
11.00.00	SECURITY
12.00.00	ACCEPTANCE TESTS

1.00.00	INTENT OF SPECIFICATION
1.01.00	This part of the specification is intended to provide the technical guidelines for the fully coordinated Control & Instrumentation system with auxiliaries and accessories for the 1 x 800 MW Stage VII , Unit # 12 Kothagudem Thermal Power Station for Telangana State Power Generation Corporation Ltd. (TSGENCO)..The duty of services specified below and in other drawings and documents forming part of this specification are considered required for safe, reliable, trouble free and efficient operation with adequate maintenance facilities as per modern power station practice and as per terms and conditions enumerated in this specification.
1.02.00	The technical specifications that follow serve as the guide specification for the entire C&I as well as the proprietary controls like SG & its integral controls, TG set & its integral controls etc. supplied as part of equipment packages within the contract and also various standalone system controls to be supplied as part of BOP /Offsite plant sub-packages. Interfaces with other external / existing plant systems have also been addressed.
1.03.00	In conformity with the guidelines provided in the specification, the scope of works shall completely cover all the Control & Instrumentation equipment, functions, activities and documentation specified under the accompanying Technical Specifications and shall not be limited to the following: - Detailed design and engineering of the manufactured equipment; system integration and system engineering. - Complete manufacture including shop testing before shipment. - Specifying, procurement, quality inspection of bought-out items from sub-suppliers. Design co-ordination for and integration with bought-out items with sub - suppliers. - Coordination, integration & interfaces between the Bidder's C&I systems and various proprietary , plant auxiliary control systems , C&I systems for BOP/Offsite packages such as, Coal Handling , Ash Handling , Water Treatment plant, Hydrogen Generation Plant , Effluent Treatment Plant Mill reject handling system, Fire protection and detection system, Condensate polishing unit , Compressed air system, Heating Ventilation & Airconditioning unit , Steam and Water Analysis System , Continuous emission monitoring System , Station Electrical system, Switchyard etc., Owner's central load dispatch centre , other third party / existing unit C&I systems for co-ordinated operation and centralized monitoring & limited control. - Providing engineering drawings, documents, licensed copy of software and developmental tools, data, instruction, operation and maintenance manual etc. for Owner's review/ approval / record. - Arranging for Owner's inspection and testing of manufactured as well as bought-out items at the respective works. - Packaging and transportation of instruments, equipment, accessories and erection hardware from the manufacturer's works to the site, including transit insurance.

- h) Opening of site office at location provided by Owner.
- i) Receipt, storage, preservation of instruments, equipments and erection hardware at the site. DDCMIS and all electronic cabinets shall be kept in the Air conditioning area.
- j) Fabrication of site-constructed items.
- k) Pre-assembly (if any), erection, testing and commissioning of all the equipment and instruments supplied, in totality.
- l) Performing availability tests and Performance and Guarantee tests.
- m) Prepare and submit approved & as-built drawings and documents in hard and soft copies.
- n) Furnishing of spares, tools and tackle and test instruments.
- o) Fulfilling post-commissioning liabilities.
- p) Arranging for the training of Owner's personnel of different categories at manufacturer's works as well as plant site.
- q) Other activities detailed in subsequent sections of the Specification.
- r) Any other activity, not mentioned explicitly, but felt essential by Bidder for successful completion of work.

1.04.00 The requirements enumerated in this specification are qualitative in nature and are based on typical configuration of the plant for the purpose of bidding. It shall be the responsibility of Bidder to offer Control & Instrumentation system to meet the actual functional requirements of the plant offered.

1.05.00 The Control and Instrumentation shall be based on state of art microprocessor based Distributed Digital Control and Management Information System (DDCMIS) for the entire main plant covering the total functional requirements of modulating control, sequence control, interlocks & protection, monitoring, alarm, data logging, fault analysis, performance calculation & optimization, maintenance scheduling & machine monitoring & analysis etc. Complete operation and control of Steam Generator, Turbine Generator, Station, unit and Electrical system including metering and auxiliary systems shall be carried out from DDCMIS from a Central Control Room (CCR).

Automatic powerplant control (APC) and Automatic Burner Control System (ABS) shall be included. Single command operation for automatic startup and shutdown of the plant shall be established.

1.06.00 The control room operator shall be provided with color-graphic displays of the power plant equipment through Large Video screens and TFT monitors; DDCMIS Driven Hardwired Annunciation windows shall be provided on the Unit Control Panel (UCP) cum Backup panel to be located in CCR. In addition, hardwired push button stations will be provided on UCP to ensure fast and reliable tripping of the unit and major auxiliaries in case of emergency. Any other back up instruments for safe shutdown, if any recommended, shall

also be installed on the UCP. Start pushbuttons for some critical drives on UCP shall also be provided. These drives shall be finalized during detailed engineering.

Soft alarm windows shall also be made available and shall be same as it is available on UCP and shall be made in graphic pages. These alarm windows shall pop up the concerned inputs of alarm once operator clicks each window. The color of the latest window shall be such that the operator shall be able to discriminate,

- 1.07.00 PLC / microprocessor based standalone control and monitoring systems shall be provided for offsite packages. Operator workstations & Back up control panels / desks shall be located in local control room as operator interface. Also suitable servers / soft links (OPC) and time synchronization including all required software & hardware shall be provided for all PLC / microprocessor-based offsite packages for interfacing with plant Master Clock System (MCS) and DDCMIS for monitoring and limited control. Separate OPC server shall be provided for off-site PLCs to export the plant data to MIS / ERP requirement.
- 1.08.00 All OPC links shall be redundant bidirectional and HAD (Historical Data Access) - AE (Alarms and Events) based. In general all softlinks shall be dual redundant.
- 1.09.00 It is not the intent to completely specify the details of design and construction features herein. Nevertheless, the instruments / equipment and their installation shall conform to high standards of engineering design and workmanship in all respects.
- 1.10.00 In the event of conflict between requirements of any two clauses of this specification / documents or requirements of different codes / standards specified, the more stringent requirements as per the interpretation of the Owner shall apply.
- 2.00.00 **GENERAL PERFORMANCE REQUIREMENT**
- 2.01.00 Control & Instrumentation equipment shall be guaranteed to meet the performance, functional and accuracy requirements enumerated in the specification.
- 2.02.00 Control & Instrumentation equipment shall be guaranteed against manufacturing defect for at least two (2) years from the date of handing over to Owner.
- 2.03.00 The guaranteed performance criteria shall be met in full during the guarantee period.
- 2.04.00 Any predictable or planned deterioration and / or obsolescence of equipment shall be clearly brought out in the Bid.
- 2.05.00 Control & Instrumentation equipment shall be capable of maintaining the specified performance and accuracy standard over the complete regime of operation of main equipment, taking into account the excursion of parameters during emergency or malfunction of main equipment.

- 2.06.00 In the event of loss of a major plant equipment, controls shall be coordinated to ensure that the plant is automatically brought to a safe holding condition consistent with maintaining maximum safe generation permissible under reduced plant availability.
- 2.07.00 Control & Instrumentation system shall not impose any limitation or constraint on the operation of the main equipment. It shall be possible to utilize any in-built over capacity in design of an equipment with complete controllability and observability.
- 2.08.00 The control system shall be designed to prevent abnormal swings due to loss of control power, instrument air, failure of any system component, open/short circuits or any other such failure or degradation in the system and shall drive the plant and equipment to fail safe condition.
- 2.09.00 All modulating devices shall be in stay put condition during any of the above failures if not otherwise asked in the control philosophy.
- 2.10.00 Mean Time Between Failure (MTBF) of the instruments shall be considerably higher than the equipment they shall cater to in order to avoid shutdown on account of instrumentation failure.
- 2.11.00 Bidder shall introduce redundant control equipment or instruments wherever it is felt that the introduction of the same may lead to reduction of downtime of plant and equipment, in addition to the cases clearly identified in the specification.
- 2.12.00 In cases where continuous monitoring of performance of equipment is envisaged, Bidder shall supply instruments of suitable accuracy class to meet the accuracy requirements of the calculation as per ASME standard.
- 2.13.00 All instruments and control equipment shall ensure high reliability, low downtime and ease of maintenance.
- 2.14.00 Protective systems and their safety features shall be guaranteed to ensure the main equipment safety in the event of tripping, maloperation and malfunction.
- 2.15.00 The performance guarantee shall be on complete system basis as well as on the basis of isolated, individual instrument or component.
- 2.16.00 Bidder shall replace all instruments failing to meet the performance stipulations of the specification at any stage of the project.
- 2.17.00 All instruments / equipment shall be capable of performing satisfactorily in continuous commercial operation conforming to all relevant codes and regulatory requirement under the specified environmental conditions.
- 2.18.00 In general, equipment located in air condition environment shall be capable of operating without any degradation of performance or damage for at least twelve (12) hours to keep the plant in running condition in case failure of air conditioning units. For any equipment or component that cannot conform to this requirement, Bidder shall consider back-up packaged split type air conditioning unit/s.

2.19.00 Trial Operation

	The trial operation shall be conducted by Bidder as per the stipulation of this specification which shall be witnessed and signed off by Owner.
2.20.00	Performance and guarantee test Bidder shall perform the tests for performance and guarantee as per the stipulations of this specification.
2.21.00	Performance and Guarantee Test Procedure Bidder shall perform the tests for performance and guarantee as per the stipulations of the specification Bidder shall guarantee that the Control System shall be responsive and stable and shall maintain the deviation of controlled variables from set point within the limits specified in the specification. Bidder shall operate the unit fully in automatic mode with no intervention from the operator. Bidder shall successfully demonstrate the performance of the Control Systems as per attached table before acceptance and taking over by Owner.
2.22.00	Total System Availability Bidder shall guarantee the total system availability of 99.7% by selecting suitable components and by judicious incorporation of redundancies.
3.00.00	GENERAL DESIGN REQUIREMENTS
3.01.00	Equipment and system shall be designed and constructed to perform accurately and safely under the environmental and operating conditions described or implied in this specification without undue heating, vibration, wear, corrosion.
3.02.00	Equipment and systems shall be supplied from latest proven product range of reputed experienced manufacturer whose successful performance has been established by a considerable record of satisfactory operation in large capacity coal fired thermal power stations. Bidder shall obtain Owner's approval for the selected manufacturers for critical items.
3.03.00	The equipment, systems and accessories furnished shall be designed and constructed to meet the all specification requirements and performance specification during the continuous service life of the plant. Equipment or components that cannot meet these requirements shall be identified in the Bid and their expected failure rate be indicated. Otherwise, it shall be deemed that the equipment or components are suitable for the service life of the entire plant.
3.04.00	Bidder shall indicate the year in which the offered models of the instruments and control system have been introduced and how long the commercial production of the same is expected to continue. In any case, Bidder shall ensure supply of spare parts for lifetime of the plant. In case if it is felt by Bidder that certain equipment/components is likely to become obsolete, Bidder shall clearly bring it to the notice of Owner and indicate step proposed to deal with such obsolescence like maintaining "bonded spares" with the manufacturer/s.

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- 3.05.00 Any part/module of the C&I system which are not listed under recommended spares shall be deemed as having life expectancy not less than the expected life of the plant i.e. 30 years.
- 3.06.00 Bidder shall supply proven latest version of hardware and software available at the time of system designing. All software user licenses shall be valid for entire life of power plant. User should not have to pay any recurring license fee during the usage period of the system. In case of future up-gradation of software, Bidder shall remain committed to upgrade the supplied system at par with the new version within the warranty period and ensure successful integration of the system without any additional cost to owner. Beyond the warranty period and during the remaining life of the plant, any upgradation in hardware and software shall be brought to the notice of Owner indicating whether it shall be possible to upgrade the system by partially replacing,
- 3.07.00 All C&I equipment like field instruments eg. transmitters, switches, positioners etc., shall be of latest models.
- 3.08.00 For the sake of completeness of the system and in order to ensure desired performance & safety measures, any hardware or software item felt required, shall be in the scope of Bidder irrespective of their explicit or implicit inclusion in this specification .
- 3.09.00 All the modules of the control and monitoring system including for DDCMIS / PLC / Proprietary control system shall be from latest product range and from same family only.
- 4.00.00 **GENERAL TECHNICAL REQUIREMENTS**
- 4.01.01 Control & Instrumentation system design will aim at high availability, fuel efficient performance, plant & personnel security and high level of automation with minimum deployment of operational manpower.
- 4.02.00 Uniformity of make and type of instruments and control components shall be followed throughout for rationalization of spares' inventory, except for certain proprietary items where this requirement can not be met. Bidder shall , however take the Owner's approval on the make and type during detailed engineering for such proprietary items .
- 4.03.00 In general, the plant operation shall not depend on local measurement or local manual operation.
- 4.04.00 Suggestive Plant Control System Overview Diagram for the DDCMIS is schematically shown in Drawing No. 13A06-DWG-I-0001.
- 4.05.00 Transmitters shall be SMART type and of uniform make . Each SMART equipment shall communicate in the form of analog signal 4-20 mA DC with superimposed digital signal, zero adjustment, calibration and diagnostic from remote location. One no. HART portable communicator for each offsite package and five nos. for BTG and auxiliaries shall be supplied.
- In general transmitters shall be used instead of switches.

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- 4.06.00 Power supply for Transmitters, contact interrogation, interposing relay and solenoid shall generally be ungrounded 24V D.C only. Power supplies for interrogation, relay and solenoid shall be provided from the control systems viz. DDCMIS , PLC , proprietary control systems . In all cases redundancy in power modules shall be considered.
- 4.07.00 When more than one device utilizes the same signal, the signal source shall meet such signal requirement and with proper isolation and without overloading. Short circuiting or grounding of one device shall not have any perceptible influence on any other consumer point nor shall change the transmitter calibration.
- 4.08.00 Final control device for regulating control shall have pneumatic actuator. Actuators for isolating and inching duty dampers and valves shall be, in general, electrical motor operated. Critical service valves like PRDS , HP/LP bypass , BFP recirculation , Boiler feed control , SH/RH steam temperature , Sootblower pressure control valves shall be of DRAG design with Class VI leakage class. Control valves for HP & LP bypass system , Separator drain control MEFCV shall be hydraulically operated. SMART positioner along with position transmitter (4 - 20 mA output) and limit switches shall be provided for all types of control valves & pneumatic dampers . Hydraulic operated control valves shall also be operated from DDCMIS in addition to the local control and all the operation parameters for hydraulic system shall also to be developed in the DDCMIS with all IOs.
- 4.09.00 Electronics located outside control room areas shall be tropicalized and enclosed in dust & weatherproof cabinets suitable for the environment.
- 4.10.00 Local instruments shall be provided in cases where these are required for maintenance, commissioning and recommissioning of major equipment or for calibration and setting of other instruments and for equipment safety. All equipment like field instruments like transmitters, switches, positioners etc., shall be of latest models
- 4.11.00 In general, instruments installed outdoors and in areas where these may be exposed to Heat , Dust , splashing oil, water, steam etc. shall be mounted in closed type enclosures. For other areas (indoor), open type racks may be used.
- 4.12.00 Drain from instrument rack/enclosure shall be routed to nearby plant drainage system.
- Temperature measurement shall have up scale / down scale drive to protect from process upset in case of sensor failure. Both the elements of duplicate temperature sensors shall be terminated to junction boxes. For RTDs ring - tong type lugs shall be used at Junction Boxes ,especially for motor winding temp JB, Motor bearing temperature JB at both motor end and at field local JB end.
- 4.13.00 In general, for temperature measurements up to 300°C, Platinum resistance temperature detectors shall be used unless the area is prone to vibration. For temperature measurement above 300°C up to 750°C, Chromel-Alumel (K) type thermocouples shall be used. For high temperature applications, noble-

	metal thermocouple (T/C) such as Pt Rh-Pt (R) type in Inconel sheathed thermowell shall be used. For lower temperature with vibration prone areas Iron Constantan (J) / Chromel constantan (E) type thermocouples shall be used.
4.14.00	Temperature elements shall be in sheath tube and in thermowells of suitable material. Thermowell made of Tungsten carbide shall be used for highly abrasion application. In all flue gas path, thermowells shall be provided with protecting semicircular SS pipe to protect against erosion.
4.15.00	Temperature elements shall be directly connected to their respective input modules through compensating cables. For Boiler Metal temperature measurement Remote I/O or for bulk data acquisition shall be provided for monitoring in DDCMIS.
4.16.00	In general, temperature switching function shall be configured by use of temperature elements and software configured limit value monitors instead of using conventional field mounted temperature switch.
4.17.00	The instruments and control equipment shall be logically grouped in electronic cabinets in functional order for convenient fault location, troubleshooting and maintenance.
4.18.00	Equipment and devices, which require maintenance, shall be suitably located to ensure easy accessibility.
4.19.00	On-line automatic periodic testing, self-checking & diagnostic facility shall be provided with fault indication for easy identification of the faulty module. The system shall continuously check health of the component elements including the stand-by ones and shall permit carrying out of the on-line checks while maintaining safe condition of the plant without endangering the safety of equipment and without influencing the process being controlled.
4.20.00	Failure of equipment used for alarm & trip purposes shall initiate alarm.
4.21.00	Automatic unadministered switchover to standby equipment (such as fan/blower/pump) is foreseen in case of either running equipment is not adequate to maintain the desired process condition or due to tripping of running equipment.
4.22.00	End positions of manually operated suction valves of critical pumps and all other manually operated critical isolation valves shall be monitored & interlocked.
4.23.00	In case of HT motors, winding temperature for each stator winding and bearing temperature of motors & driven equipment shall be monitored for abnormal rise. For monitoring of such temperature in a local panel where no operator station has been provided suitable electronic display device driven by output of DDCMIS / PLC system shall be provided.
4.24.00	Microprocessor based Vibration monitoring and analysis system (VMAS) shall be provided for all HT drives including SG,STG and all BOP drives..
4.25.00	Electrical drives rated at 30 KW or more and for critical drives including all lubrication pumps, fuel oil pumps current rated at less than 30 KW shall be monitored for current in DDCMIS.

- 4.26.00 Process fluids shall not be piped directly in to Central Control Room (CCR) and Electronic Equipment Room (EER) areas.
- 4.27.00 Ergonomically & aesthetically designed furniture viz. control desks & chairs shall be provided for workstations, programming stations, PCs and various peripherals at control room/computer room/equipment room. Furniture shall include documentation racks, tables for laydown etc.
- 4.28.00 KKS identification system shall be adopted consistent with the plant equipment numbering system.
- 4.29.00 Steam Generator (SG) Integral Control and Monitoring
- 4.29.01 Steam Generator (SG) Integral Control shall be synthesized from the same family of hardware as the DDCMIS through redundant controllers and shall integrate seamlessly.
- 4.29.02 Major Boiler interlock and protections like Burner Management System (BMS) / Furnace safeguard and supervisory system (FSSS) including safety related interlock and protections, Master fuel Trip (MFT) shall be of triple-modular redundant (I/Os and controllers) configurations and shall be part of DDCMIS. Hardwares related to this system shall be housed in a distinctly separate cabinet set. All trip and interlocking inputs shall be hardwired.
- 4.29.03 HP bypass control, Secondary Air Damper (SADC), Soot Blower Control and other controls shall be implemented in the DDCMIS.
- 4.30.00 Turbo Generator (TG) Integral Control and Monitoring
- 4.30.01 This shall include controls and protective trips functions like Electro Hydraulic Governor (EHG) control, Automatic Turbine Run up System, Automatic Turbine Testing, Turbine Stress Evaluator, Turbine Protective Trip System, Turbine supervisory Instruments, LP Bypass system, Gland Seal Steam System, Turbine Air Evacuation, TG Cooling water, TG stator coil cooling water, TG H₂ / CO₂ System, TG Seal Oil system, and Other closed loop & Open loop controls of TG system and auxiliaries related to the integral performance and safety. TG integral Control and Monitoring system shall be implemented in the DDCMIS through redundant controllers. All trip and interlocking inputs shall be hardwired. Safety related interlock and protection functions shall be implemented through two out of three (Triple Modular Redundant - I/Os and controllers) configurations.
- 4.31.00 Station C&I System
- 4.31.01 This shall include the control & monitoring of all other balance non-integral functions in SG area, TG area and other Balance of Plant equipment and auxiliaries such as Boiler circulation water, ID fans, FD fans, PA fans, Air preheater, Coordinated master control, Air and flue gas, Blow down, Fuel oil pressurizing pumps, Boiler feed water pumps, Condensate pumps, DM make up pumps, Boiler fill pumps, Condensate transfer pumps, Pressure reducing & de-super heating system, Chemical Dosing, Service /potable, DM water distribution system etc. These shall be implemented through redundant controllers of DDCMIS.
- 4.31.02 Plant Auxiliaries and Off site Plants Controls

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- 4.31.03 In order to achieve optimum manning of the plant in terms of operating personnel, all auxiliaries like, Generator monitoring and Auxiliary Control system, Water system, Effluent Treatment Plant, Mill Reject System, HVAC, Fire Detection and Protection system, DG Set, Switchyard SCADA, etc. in addition to their standalone control and monitoring systems, shall also be hooked up to the common DDCMIS network, as detailed in Section V of this volume of this specification, from the CCR.
 - 4.31.04 CW & ACW pumping system, Fuel oil system, Filtered water transportation system, DM transportation, Condensate Polishing unit along with regeneration system, Compressed air system along with proprietary control system shall be controlled & operated from DDCMIS workstations as well as from local operator workstations / panels. Remote terminal units shall be provided at appropriate locations for these purpose.
 - 4.31.05 Common DDCMIS network shall also control and monitor packages envisaged for PLC based local control systems. Operator workstations shall be provided in CCR for the overall control and monitoring through this network. Such links (OPC) with Common DDCMIS are largely foreseen as Optical Fiber redundant bidirectional data highways.
 - 4.32.06 ESP controls shall have Control and Monitoring systems in ESP building and shall have interface with DDCMIS for monitoring.
 - 4.32.07 In general no relay based control system is acceptable. These shall be either DDCMIS or PLC based only.
 - 4.32.00 Electrical Drive Control Interface
 - 4.32.01 Electrical drives shall all be operated from DDCMIS. In order to segregate different voltage levels, interposing relays shall be located at the respective Motor Control Centers or Switch Gears. Interposing relays shall be rated at 24 Volt DC driven directly from DDCMIS. Relay contacts shall actuate the drive contactors. Specification drawing no. 13A07- DWG - I - 0231 shall be referred for Drive interface technique with control systems.
 - 4.34.00 Performance Analysis Diagnostics and Optimisation (PADO) System
PADO shall be provided for the plant to enhance operational efficiency
 - 4.35.01 Electrical Distribution and Management System (EDMS)
 - 4.35.02 The entire unit and station electrical system within power house area shall be monitored and operated from DDCMIS. For detail requirements, Electrical part of the specification Volume IIF shall be referred.
 - 4.36.00 Master Clock System (MCS)
 - 4.36.01 GPS based Master Clock System shall be for time synchronization of DDCMIS, PLC based and proprietary control systems
 - 4.37.00 Steam and Water Analysis System (SWAS)
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	Continuous analysis shall be done for steam and water services to establish their purity and suitability for long life of different parts of the unit. The measurements shall be carried out at different cycle points of the plant. The steam and water analysis system (SWAS) includes all requisite analyzers, sampling system. All data shall be available in DDCMIS for information.
4.38.00	Alarm Annunciation System Microprocessor based Annunciation system with windows / facade shall be provided for critical services on UCP in CCR. The annunciation sequence logic will be implemented in DDCMIS / PLC and the annunciation lamps shall be driven by DDCMIS / PLC.
4.39.00	Rotating Machine Condition Monitoring & Analysis System (RMCMA) including analysis system. Continuous monitoring and analysis of the mechanical health of rotating equipment viz, Turbine, Generator & Exciter, BFP drive turbine & pump and all HT motors & their driven equipment shall be performed by proven and state of the art microprocessor based RMCMA. RMCMA for TG and HT motor & their driven equipment shall be same and of same family of hardware of Turbine Supervisory Instruments (TSI) / systems and HT drives Vibration Monitoring System.
4.40.00	Close Circuit Television (CCTV) System and Furnace & Flame monitoring System The CCTV system shall be able to provide surveillance of different locations of the plant. The cameras for furnace and flame monitoring system shall be provided for on line continuous viewing in CCR of the coal / oil flame as well as the condition of furnace internals.
4.41.00	EPABX, PA and Paging System EPABX system shall be provided for establishing point to point communication amongst offices / plant areas. PA and Paging system shall be meant for public announcement and talk back systems amongst various locations within the plant.
4.42.00	Computerised Maintenance & Inventory Management System (CMIMS) The system shall have capabilities to document maintenance related functions and shall streamline the entire maintenance activities.
4.43.00	Ambient Air Quality Monitoring System (AAQMS) This online monitoring system shall be provided to monitor the ambient air and Meteorological Monitoring Parameters.
4.44.00	C&I Laboratory One state of the art C&I laboratory shall be provided for the day-to-day maintenance / testing and calibration of the C&I equipment of the plant

4.45.00 Local Instruments , Flow Elements and Control Valves

Required local instruments including gauge boards, etc. and Flow Elements , Control valves shall be provided for safe and efficient operation of the plant. .

4.46.00 Erect ion Hardware

Standard and good engineering practice of international standards shall be adopted throughout. All materials supplied shall be suitable for tropical, dust laden, humid power plant environment and shall be from reputed manufacture.

4.47.00 C&I Cabling

Instrumentation cables shall be copper, overall screened for binary signals and individual pair and overall screened for analog signals. All cables shall be FRLS type (inner and outer sheath) ,armored, other than short run cables which may be unarmored. Unarmored cables shall run through conduits.

C&I cable type shall also include FO , Prefab , Coaxial , compensating cable , special cable etc

The screen shall be grounded at the remote panel end at control / equipment room only.

5.00.00 CODES AND STANDARDS

The design, manufacture, inspection, testing, site calibration and installation of all C&I equipment and systems covered under this specification shall conform to the latest editions of applicable codes and standards eg. ANSI, ASME, IEEE, ISO, IEC, IGCI, AWS, NFPA, AISC, IGS, SAMA, UBC, UL, NESC, NEMA, ISA, DIN, VDE , IS etc. Generally, the following latest edition of codes and standards prevailing at the time of award of contract shall 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-255.4.
- f) Printed circuit boards - IPC TM-650, IEC 326C.
- g) General requirements and tests for printed wiring boards - IS-7405 (Part-I)/1973.
- 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)
- k) Direct Acting Electrical Indicating Instruments - IS - 1248 - 1968

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) / IEC 60947 / IEC 60529
- c) Protection Class for Enclosures , Cabinets Control Panels and Desks - IS 2147 1962

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- 7) Apparatus, Enclosures and Installation Practices in Hazardous Area
- a) Classification of hazardous area - NEMA Article 500, Volume-6, 1978./ NFPA Article 500, Vol.70-1984
 - 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, 1982.
- 8) Sampling System
- a) Stainless Steel material of tubing and valves, for sampling system - ASTM A 269-79 GRT0-316.
 - b) Submerged helical coil heat exchangers for sample coolers -- ASTM D11-98.
 - c) Steam and water sampling, conditioning and analysis in the power cycle - ASME PTC - 19.11
 - d) Standard methods of sampling system - ASTM D 1066-69
- 9) Annunciators
- a) Specifications and guides for the use of general-purpose annunciators - ISA RP 18.1.
 - b) Surge withstand capability tests - ANSI C37.90 a -1971 and IEEE Standard 472-1974.
- 10) Interlocks, Protections
- a) Relays and relay system associated with electric power apparatus - IEEE Standards 3.13.
 - b) Surge withstand 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.
 - d) Turbine water damage prevention - ASME-TDP-1-1980.
 - e) Boiler safety interlocks - NFPA Section 85B, 85D, 85E, 85F, 85G.
 - f) Installation and operation of Pulverized fuel system - ANSI / NFPA 8503
 - g) Functional diagramming of Instrument and control systems - SAMAPMS 22.1
 - h) Digital interface for programmable instrumentation - ANSI / IEEE 488

11) Control Valves

- a) Control valve sizing (Incompressible fluids) - ISA-S39.2 / 1972.
- b) Control valve sizing (Compressible fluids) - ISA-S39.4 / 1972.
- c) Control Valve seat leakage – ANSI / FCI 70.2
- d) Face to face dimensions of Control Valves - ANSI B16.10
- e) Control Valve Capacity Test Procedure – ISA – S75.02

12) Process connection Piping and Tubing

- a) Seamless Carbon Steel Pipe - ASTM-A-106.
- b) Forged carbon steel fittings - ASTM-A-105.
- c) Dimensions of fittings - ANSI-B16.11.
- d) Code for pressure piping, welding, hydrostatic testing - ANSI-B 31.1.
- e) Nomenclature for instrument tube fittings - ISA-RP 42.1 / 1982.
- f) Seamless Stainless Steel Tube ASTM A-213 TP 316 / ASTM A-269 TP 316
- g) Seamless Alloy Steel Pipe ASTM A 335 P22
- h) Seamless Stainless Steel Pipe ASTM A-312 TP 316
- i) Forged and Rolled alloy steel pipe flanges , forged fittings , valves and parts ASTM A - 182
- j) Pipe fittings of wrought carbon steel and alloy steel - ASTM A - 234
- k) Composition bronze metal castings ASTM B - 62
- l) Seamless copper tube , bright annealed ASTM B- 168
- m) Valves flanged and butt welding ends ANSI B 16.34

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.

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

- i) Electrical Fast Transient : IEC-801.4
- i) Surge Withstand : IEC-255.4
- iii) Radiated Electromagnetic Field : IEC-801.3
- iv) Electrostatic Discharge : IEC-801.2
- 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.

Codes and standards as described in different subsections of this specification shall also be followed.

Items such as thermo wells, control valves, flow elements and other in line devices in high and medium pressure steam, feed water and similar services, which fall under the purview of Indian Boiler Regulation Act shall be either certified by IBR or shall be certified by authorities acceptable to IBR. It shall be responsibility of Bidder to obtain the necessary approval of the concerned Authority / Chief Inspector of Boilers for the design and design calculations, manufacturing and erection procedure as called for under the IBR Act for all items requiring such certification.

6.00.00 DESIGN CRITERIA

This section lays down the general design criteria to be adapted in designing the Control & Instrumentation system of the plant.

6.01.00 General Requirements

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- 6.02.00 Instrumentation, control and automation devices and accessories shall be designed with the following considerations:
- a) Stable in spite of temperature fluctuations.
 - b) Able to withstand high humidity.
 - c) Weather proof.
 - d) Dust proof.
 - e) Corrosion resistant.
 - f) Erosion resistant.
 - g) Able to withstand high vibration.
 - h) Easily accessible for operation & maintenance.
- 6.03.00 Parts subject to high pressure, temperature or other severe duty shall be of materials and construction suitable for the service conditions and long operating life.
- 6.04.00 Components of instruments, control devices, accessories, piping etc. which contact steam, condensate or boiler feed water shall be manufactured from copper-free materials.
- 6.05.00 Instrument Accuracy, Standard Scales and Ranges
- 6.05.01 Instrument Accuracy
- Instruments shall meet the following general requirements.
- a) Pressure measurement shall be linear with respect to the measured pressure.
 - b) Flow meter shall meet the specified accuracy criteria when operating between 25 and 100 % of full-scale flow. The accuracy 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 water specific gravity of 1.00.
 - d) Wherever the measured parameter is influenced by process pressure & temperature, required compressibility correction shall be introduced.
- 6.05.02 Instrument Scale Displays
- a) All displays shall be in engineering units. Instrument scales displayed on screen will 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

6.05.03 Instrument Ranges

Instrument ranges shall be selected to have the normal reading, preferably between 50% and 70% of full scale for linear parameters and 70% to 80% 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.

6.06.00 Operability & Maintainability

- 6.06.01 The system shall be designed such that any 'single-failure' shall not lead to loss of availability of the plant, alteration in operating routine or degradation of performance. This shall be achieved by judicious introduction of redundancy at all critical levels. The plant operator remains totally transparent to 'single-failures'.

- 6.06.02 The system and operator interface s / consoles shall be designed for the operation of the unit with minimum operational manpower deployment . Bidder shall ensure proper operability and also take into account protections to achieve no accidental maloperations .

- 6.06.03 The choice of hardware shall take into account sound maintainability principles and techniques and shall not be limited to the following:

- a) Standardization of parts.
- b) Minimum use for special tools.
- c) Modular and hot replacement.
- d) Logical grouping of functions.
- e) Separate and non-interactive adjustability.
- f) Malfunction identification facility through self-diagnostics.
- g) Easy removal, replacement and repair.
- h) Easy assembly and disassembly.
- i) Fool-proof design to preclude improper mounting and installation.
- j) Redundancy of critical parts.
- k) Unique process equipment vis a vis hardware identifiability by assigning sub-racks / sub-rack sections to specific plant areas.

- 6.06.04 Intercommunications in between sub-racks and system termination cabinets and in between sub racks and other panels shall be made by pre fabricated connectors and cables with mechanical latch.

- 6.06.05 Adequate test facility shall be incorporated in the design.

- 6.07.00 Established Reliability & Availability
- 6.07.01 The minimum target reliability of each component/module shall be established by taking into consideration its Mean time between failure (MTBF) and Mean time to repair (MTTR), so that availability of the complete system is assured for 99.7%.
- 6.07.02 In order to establish the target reliability Bidder shall perform necessary availability tests and burn-in tests for major systems. Surge protection for solid state systems, selection of proper materials, manufacturing processes, quality controlled components and parts, adequate derating of electronic components and parts shall be ensured to meet the reliability and life expectancy goals.
- 6.07.03 Continuous self-checking features shall be incorporated in system design with automatic transfer to healthy/redundant circuits to enhance the reliability of the complete system.
- 6.08.00 Security and Failure Philosophy
- 6.08.01 General
- It is essential that interlock, protection, supervision and automatic control systems shall have high integrity. Control & Instrumentation system shall meet the following requirements:
- a) No single failure shall cause failure of the control.
 - b) No single fault shall cause the protection system to operate spuriously or cause the protection system to become inoperative.
 - c) Grouping of the control functions into system blocks shall be such that failure of any one block will only partly degrade the overall system.
 - d) Control system shall be structured with redundancy so that no single failure within the control system can cause the failure of plant on duty and at the same time cause the standby plant to be unavailable.
 - e) Due to control system failure if a final control element or plant item does not respond then the control element shall go into a fail safe status.
 - f) Field wiring for contact interrogation or device control shall be protected such that a fault on the cable does not cause loss of more than a minimum tolerable functionality of the system.
- 6.08.02 Measurement , Control & Channel Redundancy
- To meet the failure and self checking criteria for the control system, measurement redundancy shall be provided for all the critical parameters. Throughout the control system, the security and validity of signals are to be ensured based on the following design principles.
- a) Where a plant measurement is to be duplicated or triplicated such signals shall be separately fed to the different input modules.

- b) Signals, after due security and validity checking by means of voting, averaging, median, difference monitoring or similar technique shall be used for control functions.
- c) Where duplicated measurements are used, provision shall be there for selecting any one as the duty signal. Continuous monitoring of difference between the signals shall be made.
- d) For binary and analog inputs required for protection of SG, TG and major auxiliaries whose non availability may result in loss of generation triple sensing devices shall be provided. Binary and analog inputs, which are required for protection of more than one equipment as well as protection signals for important auxiliaries and HT drives etc. triple sensing devices shall be provided. Also other binary and analog inputs required for CLCS dual sensing devices shall be provided. However, for those binary and analog inputs which are also required for protection in addition to CLCS, triple sensing devices shall be provided.
- e) Measurement system, CLCS and OLCS shall all be configured with redundancy at processor modules, communication modules, data bus and power supply modules. Triple redundancy shall be followed as described elsewhere in the specification. All servers shall be dual redundant.
- f) Both CLCS & OLCS shall be configured with Redundant I/O channels for each sensor/signals. Where redundant sensors are provided redundant I/O channels shall be provided for each sensors/signals.
- g) Redundant sensors shall be provided for all control applications. For all closed loop controls (CLCS) triple redundant sensors shall be provided. This will include sensors provided for compensation also. Similarly for critical protection logic requirements triple redundant sensors for 2 out of 3 logic shall also be provided to avoid spurious tripping. For all other control application dual redundant sensors shall be provided. Dual and Triple redundant sensors shall also be provided as described elsewhere in the specification.
- h) Signals shall be verified against cable failure / non coincidence monitoring for critical trip signals for SG/TG/ all HT auxiliaries.

6.08.03 Redundancy in input / output modules

1. Redundancy

- a) Redundancy in input / output modules for close loop control systems, open loop control system, protection, interlocking and sequential control shall be provided as follows:
 - i) Wherever redundant sensors are employed each sensor shall be wired to a separate input module so that even if one input module fails, the parameter will be available from the other input module.
 - ii) If only one sensor is provided then redundant input cards shall be provided and wired accordingly.
 - iii) Redundant output card shall be provided for the signals from

Control System going to final drive control elements.

- b) As regards redundancy for drive control functions the following philosophy may be adopted.
 - i) For open loop control system input/output I/O modules for realizing drive control functions redundancy in input/output and processing modules shall be envisaged for HT drives and critical LT drives. For BMS / FSSS and Turbine Trip system relevant sections elsewhere. Shall be referred.
- c) In addition to above, 20% wired input/output spare channel shall be provided for each I/O module.

- 2. Bidder to note that all I/O, Processor, network interface, communication modules etc., shall be sourced from their Original Principal's works.
- 3. The system shall be provided with extensive diagnostic features so that a system failure can be diagnosed down to the module level giving location and nature of fault. Ease of maintenance and troubleshooting shall be a primary consideration in equipment selection.
- 4. The system shall provide inherently safe operation under all plant disturbances and component failures so that under no circumstances safety of the plant personnel nor equipment is jeopardized.. The DDCMIS hardware shall be suitably sized to ensure that the implemented scheme meets the desired requirements. The Bidder through detailed calculations shall establish the adequacy of the system selected and demonstrate the same during shop testing and site testing.

6.08.04 Data highway Redundancy

There shall be Redundancy in the system for high reliability of communication. The redundant buses shall work continuously. All communication modules, bus couplers, bus interfaces etc. shall also be hot redundant.

Communication between the operator station and the functional groups of control microprocessors shall be by means of hot redundant data highways. Redundancy failure shall also be indicated in operating station.

All soft links amongst DDCMIS and various PLC / proprietary control systems including MCS shall be redundant bidirectional OPC link.

6.08.05 Redundancy for Power supply unit

All power supply feeders from UPS (in parallel mode having 50% load sharing) or 24 V DC system (in parallel mode having 50% load sharing) shall be redundant with auto changeover in each ACDB/DCDB panel.

6.08.06 Redundancy in Operator's Console

Operators' Consoles shall have fall back feature. so that in case of failure of any console, its functions can be taken up in an adjacent console and LVS.

6.08.07 Design Of Enclosures

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- 6.08.08 Design of outdoor enclosures shall be weather proof , dust-tight, drip-proof and shall take into account the environmental conditions.
 - 6.08.09 Enclosures shall be adequately sized so that the maximum permissible temperature rise above 50 Deg C ambient is 10 Deg C (maximum).
 - 6.08.10 Enclosures design shall also take into account greatest possible personnel safety.
 - 6.09.00 Electrical Noise Control
 - 6.09.01 Equipment furnished by Bidder shall incorporate necessary techniques to eliminate problems caused by electrical noise interferences and power line borne surges encountered in power plant environment. Equipment, which are vulnerable to electrical noise interference or surge shall be suitably immunized to eliminate possible problems.
 - 6.09.02 Bidders shall be responsible for implementation of the shielding, input balancing, ripple filtration and grounding for field inputs to achieve installation with minimum noise coupling.
 - 6.09.03 Radiated immunity test shall be in accordance to IEC 801.3.
 - 6.10.00 Surge-Protection For Solid State Equipment
 - 6.10.01 All solid-state equipment shall be able to withstand the surges inherent in a powerhouse environment. Equipment shall be designed to successfully withstand surges without damage to components and/or wiring on application of surge wave whose shape and characteristics are defined in ANSI publication C37.90-a (IEEE-472-1974) entitled "Guide for Surge Withstand Capability (SWC) Tests".
 - 6.10.02 To immunize the system against surge, coupling free wheeling diodes, surge suppressors, opto / galvanic isolators shall be used as required.
 - 6.11.00 Burn-In And Elevated Temperature Test

Solid-state equipment / system shall be certified to be tested for a minimum period of 168 hours continuously under power. Solid-state logic systems shall be subject to the elevated temperature test and burn-in test as complete assemblies.
 - 6.12.00 Elevated Temperature Test
 - a) During the first 48 hours the ambient temperature shall be maintained at 50° C and the equipment shall be made to repeatedly perform operations it will be expected to perform in service with loads on various components being equal to those which will be experienced in actual service.
 - b) The 48 hours test period shall be continuous but shall be divided into four 12-hour segments. The power supply voltage during each 12 hours segment shall be nominal voltage for 11 hours; followed by 110 percent of nominal voltage for 30 minutes; followed by 90 percent of nominal voltage for 30 minutes.
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	c) During the elevated temperature test the cubicle doors shall be kept closed and inside temperature in the zone of highest heat dissipating component/module shall be monitored. Temperature rise inside the cubicle shall not exceed 10 Deg.C above the ambient temperature of 50 Deg.C.
6.13.00	Burn in Test The 48 hours elevated temperature test shall be followed by 120 hours of burn in test at normal operating temperature. This test shall also be conducted as per above procedure.
6.14.00	Panels, Cubicles and Enclosures
6.15.00	General
	a) All panels, cubicles and enclosures shall be furnished complete with integral piping, internal wiring, convenience outlets, internal lighting, grounding, ventilation, space heating, vibration isolating pads and other accessories. b) Unless otherwise specified cable entry for panels / desks / cabinets shall be through bottom via a g landing plate. Fireproof seal shall be used to seal the bottom to prevent entry of dust. c) Panels and cabinets shall be constructed from steel sheet reinforced as required to provide true surface and adequate support for devices mounted thereon. Thickness of the CRCA steel for UCP / backup panel and other panels/cabinets shall be as described in Section VII of this volume of the specification. Panels and cabinets shall be of adequate strength to support mounted components during shipment and to support a concentrated load of 100 Kilograms on their top after erection. d) Panel /cabinet shall have eyebolt on top for lifting. e) Mounting , wiring , powering of all items to be mounted / installed on desks irrespective of the source of procurement shall fall in the scope of erection of Bidder ,this shall include free issue items furnished by Owner.
6.15.01	Surface Preparation and Painting Sheet metal exterior steel surfaces shall be sand blasted, ground smooth and painted as specified below: a) Suitable filler shall be applied to all pits, blemishes and voids in the surface. The filler shall be sanded so that surfaces are level and flat; corners are smooth and even. Exposed raw metal edges shall be ground burr-free. The entire surface shall be blast clean to remove rust and scale. Oil, grease and salts etc. shall be removed from by one or more solvent cleaning methods prior to blasting. b) Two spray coats of epoxy primer surface shall be applied to all exterior and interior surfaces, each coat of primer surface shall be of dry film thickness of 1.5 mil. A minimum of two spray coats of final

finish color (Catalyzed epoxy or polyurethane) shall be applied to all surface of dry film thickness 2.0 Mil. The finish colors for exterior and interior surfaces shall conform to the following shades:

- i) Exterior : Opaline green shade 275 of IS: 5
 - ii) Interior - Brilliant Glossy White.
- c) Paint films, which show sags, cheeks, blisters, teardrops, fat edges or other painting imperfections shall not be acceptable.

6.15.02 Wiring

Wiring within the panels shall conform to NEC standards and shall be factory installed and tested at the works. All interior wiring shall be installed neatly. Features shall not be limited to the following :

- a) All spare contacts of relays, switches and push buttons shall be wired up to the terminal blocks.
- b) Each wire shall be identified at both ends with wire designation as per approved wiring diagram. Heat shrinkable type ferrules with indelible computerized print shall be used with cross-identification.
- c) Wire termination shall be made with insulated sleeve and crimping type lugs. All external connections shall be made with one wire per terminal. Wire shall not be spliced or tapped between terminals. Open-ended terminal lugs shall not be used.
- d) Internal wiring shall be terminated uniformly on one side of the terminal block leaving the other side available for termination of outgoing cables.
- e) Thermocouple lead wires, analyzer measuring lead wires, or any other lead wires carrying measuring signal of the order of low milli volt or micro volt shall be electrically and physically isolated from other AC and DC wiring.
- f) All low-level signal cables shall be separately bundled from control cable.
- g) Wires shall be dressed and run in troughs with clamp-on type covers. Wirings shall be neatly bunched in groups by non-metallic cleats or bands. Each group shall be adequately supported along its run to prevent sagging or strain on termination.
- h) Shield wires shall be terminated on separately.
- i) Common connections shall be limited to two wires per terminal.
- j) Wiring to door mounted devices shall be provided with multi-strand wires of (49 strands minimum) adequate loop lengths of hinge-wire so that multiple door openings will not cause fatigue to the conductor.
- k) Wiring shall be arranged to enable instruments or devices to be removed and/or serviced without disturbing the wiring. No wire shall be routed across the face or rear of any device in a manner, which will

impede the opening of covers or obstruct access to leads, terminals or devices.

- l) Panel internal wiring shall follow distinct color-coding to segregate different voltage levels viz. 24V DC, 48V, 110V AC, 240V AC, 220V DC etc.
- m) Panels /cabinets /desks shall be provided with removable gasketed cable gland plates and cable glands. Split type grommets shall be used for prefab cables.
- n) Wire shall be multi-stranded annealed flexible high purity copper conductor with heat resistant FRLS PVC insulation and shall pass vertical flame test per IPCEAS-1981.
- o) Wire sizes used for internal wiring shall not be lower than the followings :
 - Control wiring (switches, pushbuttons etc.) : 1.5 Sq.mm
 - Power supply/receptacle : 2.5 sq. mm or higher as per load
 - 4-20mA DC current and low voltage signal upto 48V DC : 0.5 Sq. mm
- p) Identification of conductors shall be done by insulation color-coding identified on drawings or by printed wiring lists.

6.15.03 Grounding

- a) System cabinet AC and DC ground shall be electrically isolated from each other and also electrically isolated from the Instrumentation signal ground. All the above ground shall be individually connected to the single point on the ground pit. Dedicated redundant earth pit shall be provided which shall be away from the HV equipment. This earth pit shall not be shared with other electrical equipment ground and shall also be insulated from other electrical system ground to ensure single point grounding of the system. Grounding resistance shall be better than 1.0 ohm. IEEE guideline shall be followed while designing the grounding system.
- b) Panels and cabinets shall be provided with a continuous tinned copper ground bus bar of minimum 25 mm x 6 mm cross section, extending along the entire length of the panel / desk / cabinet assembly. The ground bus shall be bolted to the panel structure and effectively ground the entire structure.
- c) The panel /desk /enclosure /JB ground shall have two (2) bolt drilling with GI bolts and nuts at each end to connect to GI/ copper flat ground riser by means of insulated copper ground cable of required cross section with lug.
- d) Circuits requiring grounding shall be individually and directly connected to the panel ground bus.

- e) For electronic system cabinets, the electronic system ground bus shall be similar but insulated from the cabinet and shall be separately connected to the system ground. Signal cable shields shall be grounded at the panel end only and shall not be left open. The ground in between panels of a shipping section shall be firmly looped.
- f) Electrical meters, relays, transmitters and switching devices, operating at a voltage less than 50V may be grounded through the steel structure.

6.16.00 Panel / Cabinet/ Desk/ Enclosures / junction boxes & instruments Environmental Protections

- a) Panels, cabinets, desks, distribution boxes, racks, junction boxes, terminal boxes, instruments and all other field mounted equipment / enclosures shall suit the environmental condition of the area and shall not be inferior than the requirement indicated in the following table.

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

- b) The construction of electrical enclosures located in areas subject to conditions classified in the National Electrical Code (NEC) as hazardous shall be of a type designated suitable for the environment in which they are located.

6.17.00 Terminal Blocks

All terminal blocks shall be provided complete with all required accessories including . Each terminal shall have LED indication with fuses to indicate and isolate earth faults. Spring-loaded (Cage-clamp type) terminals shall be used for termination of instrumentation cables at field JBs, FTCs and local panels.

7.00.00 METERING BASES AND CHART UNITS

The following system of units shall be followed for various displays and scales unless otherwise mentioned:

i)	Pressure	: Kg/cm ²
	Differential Pressure	: mm of H ₂ O column / Kg/cm ²
ii)	Draught	: mm of H ₂ O column
iii)	Vacuum	: Kg/cm ² (abs)/mm of Hg column
iv)	Temperature	: Degree Celsius (°C)
v)	Flow (Steam, Water)	: Tonnes / hr, M ³ /Hr
vi)	Flow (Oil)	: M ³ / Hr, Liter/Hr
vii)	Flow Air	: Tonnes / hr / M ³ / Hr.
viii)	Density	: gms / c.c.
ix)	Level	: Mm /%
x)	Conductivity	: Siemens / cm
xi)	Gas Analyzer	: Percentage by weight or as specified in respective case.
xii)	Dissolved Oxygen / Sodium	: ppm /ppb

8.00.00 PROCESS CONNECTION & INSTRUMENT HOOK UP

- 8.01.00 Instrument connection to the process system (piping, vessel etc.) shall be according to the process & piping specification upto and including the root valves. Root valves shall be installed as close as possible to the piping or vessel.
- 8.02.00 Each instrument shall have its own independent connection to the process except for instruments located on standpipe. Each instrument shall be connected independently to the standpipe through isolation valve.
- 8.03.00 Process connection for instruments lines and vessels shall be in accordance to standards such as ASME or other recognized international standards.

9.00.00 POWER SUPPLY SYSTEMS

- 9.01.00 Instrumentation power supply system shall include all conditioning equipment required to accommodate normal variations in the electrical supply. All panels and cabinets shall accept redundant power feeds from two different sources.
- 9.02.00 Type of power supply systems envisaged for the various C&I system including DDCMIS are as follows:
- 240V AC Redundant UPS system for C&I control & monitoring system including DDCMIS , HMIs, Main Plant Field devices / equipment, CCTV, EWLI, CEMS, SWAS , AAQMS etc. and PLC / proprietary control and

monitoring system ,Training Simulator , RIOs , LCPs for package Systems. Volume V of this specification shall be referred for details requirement of the UPS.

10.00.00 ENVIRONMENTAL CONSIDERATIONS

C&I components shall operate properly with no degradation in expected lifetime or in operation parameter in the normal power plant environment. C&I system shall be designed considering all the operating conditions which may be encountered during installation and operation.

10.01.00 Temperature

10.01.01 Where the environmental extreme exceeds the capabilities of the selected system, Bidder shall take appropriate steps to control the environment.

10.02.00 Humidity

10.02.01 C&I system shall be designed to withstand the humidity limits specified for the project. Condensation shall not be allowed to form in the cabinets nor shall water be allowed to be admitted through conduit entering the cabinets from top or sides.

10.03.00 Atmospheric Contamination

10.03.01 Particulate contamination from fly ash and coal dust and gaseous contaminants such as SO₂ and other flue gas constituents in the coal fired plant are foreseen. This hazard shall be taken into design considerations.

10.04.00 Vibration

10.04.01 Design of the systems shall include features such as locking devices, anti vibration pads etc, to withstand vibration. In general, C&I equipment shall be installed away from the vibration zone.

10.05.00 Lightning

10.05.01 Protection against lightning shall be considered by providing proper grounding, metal oxide varistors, spark gap lightning arrestor, optical isolator and isolation transformer.

11.00.00 SECURITY

11.01.00 Door lock shall be provided in all Panels, Cabinets and Enclosures.

11.02.00 System mode key switch or password to prevent tampering of system program.

11.03.00 Redundant elements of the system shall not be exposed to the common hazards. For example routing of the redundant network cable through separate cable raceway, using separate cabinet / separate rack for redundant controller and redundant IO modules.

12.00.00 ACCEPTANCE TESTS

The Bidder shall be required, as part of his Bid, to fully integrate and test all the equipment, included in his Bid and respective Control packages at site and at the manufacturer's works. Owner / Consultants shall witness these tests.

The Bidder shall consider in his Bid the following minimum tests:

(a) Factory Acceptance Test (FAT)

After completion of manufacture of all control and monitoring systems like DDCMIS, PLC, BOP network PLC, Proprietary control systems, HART management system, RMCMS, MCS, Alarm annunciation system, AAQMS, CEMS, CCTV, Plant telephone System, CMIMS, SWAS, etc. and prior to delivery to site, the manufacturer shall functionally test the assembled system. The integrated test shall be carried out with all input / output cubicles, control processors, data highway, operator's consoles, Engineer's console and peripheral devices connected in the specified configuration. The fully configured software shall also be loaded and tested at the same time.

The FAT shall include, as a minimum, the following activities:

- Complete hardware and software inspection;
- Heat cycle run test as per the prevailing standards;
- Functional test of a 100 % of all configured points, logic routines, control functions, graphic displays, reports and logs;
- Demonstration of special calculations (e.g. efficiency calculation, performance calculations etc.);
- Testing of redundancy facilities to demonstrate automatic change over to standby data highway, power supply and control processor etc.;
- Demonstration of displays, logs and system diagnostic facilities;
- Demonstration of spare capacity
- Demonstration of third party interface

The FAT shall be witnessed by the Owner / Engineer who shall be notified at least three (3) weeks before the commencement of the tests. The system shall have been fully pre-tested by the manufacturer at his works prior to notifying the Owner / Engineer to ensure any component, equipment or system fault have been identified and cleared. The test procedure for the FAT shall be issued to the Owner and agreed prior to notification. All documents / drawings and test equipment shall be available at the manufacturer's works during the FAT.

The FAT shall include a 72 hour continuous operational run, any equipment fault or failure during this time shall make this part of the test null and void and the test run shall be re-started after rectification of the fault. A test certificate, accompanied by the relevant test results, shall be issued after successful completion of the tests.

Duration of the FAT shall be at least six weeks for each system .

(b) Site Acceptance Test (SAT)

After installation, connection, integration with other systems and all pre-commissioning checks have been carried out on the complete system, the SAT shall be performed and witnessed by the Owner. The SAT shall include the following as a minimum:

- a) Complete hardware , software and installation inspection;
- b) Testing of redundancy facilities by simulating data highway, power supplies and control processor failures. All such units shall be tested to demonstrate the automatic operation of the standby units and initiation of the relevant system alarms;
- c) Demonstration of system diagnostic facilities; by the simulation of the appropriate fault conditions . The system fault reporting techniques shall also be demonstrated;
- d) Testing of data highway integrity using continuity test equipment based on signal injection / reflection techniques;
- e) Demonstration of data logging, displays, sequence of events trending system operation.
- f) Pre-commissioning checks shall include the following as a minimum :
 - i) Calibration of all field instruments, analyzers and equipment, in the scope of supply of this package, at site;
 - ii) Loop checking, for all open and close loops, between source and destination with manual signal injection as well as from Operating Consoles for entire DDCMI S / PLC/ Proprietary control systems I/Os;
 - iii) Logic sequence check with the manual signal injection at signal source as well as checking of feed back signals.

All individual configured data points, logic routines, control functions, graphic displays and reporting facilities shall be verified as part of the loop tests.

The Owner shall be notified at least 2 weeks before the commencement of the test. The procedures shall be issued and agreed before notification.

A test certificate accompanied by the relevant test results shall be issued after successful completion of the calibration and test.

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SECTION – II

STANDARD TECHNICAL SPECIFICATION

SUB-SECTION IIA – Standard Technical Requirement (Mechanical)

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SECTION – IIA

STANDARD TECHNICAL REQUIREMENT (MECHANICAL)

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ELECTRO MAGNETIC VIBRATING FEEDER (IF APPLICABLE)

1.0 GENERAL

- 1.1 This specification covers the purchaser's general requirements of design, material, construction, manufacture, inspection and testing at Vendor's works and / or his Sub – Vendor's works and performance testing at site of Electro Magnetic vibrating feeder. The electro-magnetic vibrating feeder shall be complete with all accessories as specified herein after.

2.0 CODES & STANDARDS

- 2.1 The design, material, construction, manufacture, inspection, erection, testing and performance of the electro-magnetic vibrating feeder shall comply with all the latest statutory regulations and safety codes applicable in the locality where the equipment will be installed. The equipment shall conform to good engineering practice and shall be of best workmanship.

3.0 DESIGN REQUIREMENT

- 3.1 Electromagnetic Vibrating feeders shall be provided at the location as show in flow diagrams or as indicated in technical specification. The capacity of each feeder shall be suitable to match system requirement. The flow of material shall stop as soon as vibration of the trough or pan ceases. The feeders shall be fitted with replaceable sideliners and trough bottom. Inclination of vibrating feeder shall be as per system requirement.
- 3.2 The control equipment for electromagnetic vibrator shall be silicon rectifier circuits or solid-state thyristor control type as per the proven design of the bidder.
- 3.3 Noise level at a distance of 1M and at a height of 1.5 M shall not be more than 90 DB.

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DATA SHEET - A

Sl. no.	Description of item	Data / Technical particulars
1.	Location	: Beneath each pyrite hopper (if applicable)
2.	Continuous duty	: 24 Hrs/day
3.	Rated / Design Capacity in T.P.H	: 8 / 10
4.	Number required	: Below each pyrite hopper
5.	Material Handled	: Mill rejects / Pyrites
6.	Maximum lump size in mm	: 50 mm or higher
7.	Density of material in T / M3	: 1.6
8.	Material of Pan / Trough	: To be indicated by the bidder
9.	Material and thickness of Liner	: To be indicated by the bidder

DATA SHEET - C

1. Detailed dimensioned & sectional general arrangement drawings indicating details of electromagnet, housing, fixing details, loading data, material list, weight etc.
2. Manufacturer's test certificate for materials.
3. Calculation in support of selection of electromagnet.
4. Operating and maintenance manuals.

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MILL REJECT SILO/ BUNKER AND ITS ACCESSORIES

1.0 GENERAL

1.1 This specification covers the PURCHASER'S general requirement of design manufacture, fabrication, assembly, inspection, testing and delivery to site or mill reject bunker and accessories specified.

2.0 CODES AND STANDARDS

2.1 The design, material, construction, manufacture, inspection, testing and performance of the mill reject bunker shall comply with all statutory regulations and all safety codes currently applicable in the locality where the equipment will be installed.

2.2 The material of construction and other works of the mill reject bunker shall in general conform to the following standards /codes but will be subject to any modification and requirements as specified in data sheet A of Section-D.

a) Structural steel	:	IS-2062 Gr A (min)
b) Rolled Steel Beams, Channels and Angle Sections	:	IS-808
c) Scheme of Symbols for Welding	:	IS-813
d) Covered Electrodes for Metal Arc Welding of Structural Steel	:	IS-814
e) Code of practice for use of Metal Arc Welding for general Construction in Mild Steel	:	IS-816
f) Code of practice for inspection of Welds	:	IS-822
g) Code of practice for use of structural steel in general building construction	:	IS-800
h) Dimension for steel plate, sheet and Strip for structural and general Engineering purposes	:	IS-1730
i) Recommendation for metal arc welding	:	IS-9575

2.3 Where the above standards are in conflict with the stipulations of this specification, the specification supercedes them. In case of any further conflict in this matter, the decision of the ENGINEER shall be final binding.

3.0 DESIGN REQUIREMENT

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3.1 The coal mill reject bunker shall be fabricated of mild steel plate with adequate stiffeners welded on. The bunker shall be supported on the concrete foundation provided by the purchaser. Foundation bolts, gratings etc. shall be provided by the bidder.

3.2 The reject bunker shall be complete with twin sector discharge gate, stainless steel liners, flanged connections, platforms, gratings/chequered plates, access staircase, hand railings etc. The equipment shall be designed and equipped for outdoor operation, complete with all accessories.

4.0 CONSTRUCTIONAL FEATURES

4.1 The bunker shall be of welded structure and shall be provided with necessary supporting structure. Flanged opening shall be provided at the bottom of the bunker for attaching the twin sector gate. The inclined part of the bunker shall be designed with a valley angle of not less than 60 deg. To the horizontal. The design of the bunker shall be such that the problem of formation of arch is eliminated. The inside surface shall be provided with liner MOC as specified elsewhere in the specification. Explosion diaphragm/Pressure relief valve shall be provided to release air from the bunker if required.

4.2 Vendor shall furnish all steel work required for support and access for operation and maintenance. This shall include platforms, grating/ chequered plates, stairways, hand railings, base plates, foundation bolts etc. Purchaser will provide only the foundation with pockets. The bunker shall be provided with monorail & hoist for equipment handling. There shall be shed over monorail of Electric Hoist for the protection of Electric hoist.

4.3 The storage bunker shall be so arranged that any 10 ton capacity truck can be conveniently loaded under it by an operator standing on the platform. The bunker-supporting column shall be so spaced to have a clear road access of 5.0 m width & clear headroom of 5.0 m.

4.4 Access and platform shall be provided with 32 mm thick MS grating & 32 mm MS GI pipe hand railing.

4.5 The storage bunker shall be provided with filter bags as specified elsewhere in the specification. Filter bags shall be suitably treated to minimize the chances of filter catching fire. It shall be possible to plug opening for damaged bag filters, if any, to facilitate un-interrupted operation. Suitable explosion vents shall be provided for the bag filter unit. Sequential cleaning cycle shall be initiated with pressure drop signal across the bag filter once sufficient cleaning air pressure is available. Solenoid/pneumatic valves shall be provided for this purpose. Bag cleaning mechanism shall be automatic and shall comprise of solenoid valves. Air nozzles shall be provided just above the filter to facilitate individual cleaning of each bag.

5.0 INSPECTION AND TESTING

5.1 The purchaser shall have a free access at all reasonable times to these parts of manufacturer's works which are concerned with the fabrication of the steel work and shall be afforded all reasonable facilities at all stages of preparation, fabrication and trial assemblies for satisfying himself that the fabrication is being undertaken in accordance with the provisions of this specification.

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5.2

Should any structure or part of a structure be found not to comply with any of the provisions of this specification, it shall be liable to rejection. No structure or part of structure, once rejected shall be resubmitted for inspection/ test except in cases where the purchaser or his authorized representative considers the defect as rectifiable. Defects which may appear during fabrication shall be made good with the consent of and according to the procedure laid down by the purchaser. The purchaser may, at his discretion, check the test results obtained at the manufacture's works by independent tests at the government test house or elsewhere and should the material so tested be found to be unsatisfactory shall be rejected. The cost of such tests shall be borne by the contractor.

5.3

Examination of material of construction, verification, correlation and identification with material test certificate.

5.4

Ensuring that the relevant weld procedure and welder qualifications tests are in accordance with fabrication code.

5.5

Inspection during fabrication at appropriate stage including fit up. Witness of dye penetrant testing at root and final run for all groove welds and final run for fillet welds as per ASTM E 165. All surfaces examined shall be free of:

a)

Relevant linear indications (Linear indications are those indications in which length is more than three times the width and only indication with major dimension greater than 1.6 mm shall be considered relevant).

b)

Four or more rounded defects in a line separated by 1.6 mm or less (edge to edge). Rounded indications are those where length less than three times the width.

5.6

Any other tests as specified in the fabrication code.

5.7

Dimensional check match marking as per approved drawings.

6.0

SCOPE OF INSPECTION FOR MANUALLY OPERATED DISCHARGE VALVE (SWING TYPE)

6.1

Examination of materials of construction, verification, correlation/testing and identification of material with test certificate for important items like body, drives, worm shaft, rack & pinion, wheel etc.

6.2

Dye Penetration check on drive shaft & worm shaft as per IS-3658 and there shall be no surface defects.

6.3

Dimensional check

6.4

For chain (if applicable) proof load shall be carried out.

6.5

Hardness of rubber component

6.6

Check for overall dimension, completeness, no load working after assembly.

6.7

Clearing, marking and painting.

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CHAIN CONVEYOR AND ACCESSORIES

1.0 GENERAL

This specification covers the purchaser's general requirement of design, material, constructional features, manufacture, assembly, inspection and testing at vendor's works and / or his sub - vendor's works and performance testing at site of mechanical steel conveyors complete with all accessories as specified hereinafter.

2.0 CODES AND STANDARDS

The design material, construction, manufacture, shop testing, erection, testing and commissioning of the mechanical steel conveyor system shall conform to the latest revisions of the latest codes and standards, subject to any modification, requirement as specified hereinafter.

3.0 DESIGN REQUIREMENTS

3.1 DRAG LINK CONVEYOR / STEEL PAN TYPE CONVEYOR / STEEL APRON TYPE CONVEYOR / STEEL MESH BELT TYPE AS APPLICABLE

3.1.1 The details of conveyors shall be as indicated in data sheet - A.

3.1.2 The conveyors shall be carefully selected considering the specified requirement, loading cycles, loading and unloading points. It shall be adequately designed to convey the required tonnage of the material. The width of conveyor shall be suitable for the performance required.

3.1.3 The chain / pan shall be constructed to facilitate mounting and running on troughed idlers, as applicable for the system offered by the bidder.

3.1.4 The tenderers shall quote pan / chain of adequate strength and size / specification to meet the system requirement.

3.1.5 The tenderers shall furnish calculation for the selection of conveyors.

3.2 IDLERS (Applicability depends upon system offered by the bidder)

3.2.1 All idler assemblies shall be of heavy - duty construction with rigid frame designed to prevent vibration or deflection in all directions and suitable for continuous operation under full load conditions.

3.2.2 Suitable idlers on carrying side and on return side shall be provided.

3.2.3 The rollers shall be of equal length for interchangeability.

3.2.4 Idler rolls shall have deep groove ball bearing. Idlers shall be sealed for life and shall have triple labyrinth type dust scaling arrangement. The sealed for life idlers shall be of proven design. Performance test shall be carried out on the idlers in presence of purchaser or his authorised representative to prove the effectiveness of dust sealing arrangement before the idlers are accepted. The bearing shall be designed for a minimum life of 25000

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working hour. Idler design shall be suitable so that individual rolls can be easily removed from the idler brackets. The bolts, which attach idler assemblies to the stringer, shall be connected in such a manner as to permit safe and rapid adjustment for training while conveyor is operating.

3.2.5 Conveyor horse power calculation shall be submitted during detail engineering stage for approval by customer / consultant.

3.2.6 The weight of the revolving idler parts shall be kept to a minimum.

3.2.7 The troughing idlers shall be close spaced at convex curves.

3.2.8 The rollers shall be mounted on suitable brackets. Each roller shall be complete, removable and inter-changeable with other rollers.

3.2.9 The tenderer shall furnish in their offer cross section drawings of all types of idlers indicating clearly the labyrinth seal and bearing arrangement and material of construction of all components.

3.3 PULLEY (Applicability depends upon system offered by the bidder)

3.3.1 All the pulleys / drums shall be of heavy duty welded steel construction. The material, nominal diameter and face width shall be selected as to meet the system requirement. The pulleys shall be capable of resisting fatigue failure in the members connecting the hub to the rim.

3.3.2 The pulley shaft shall be of adequate size to keep deflection to the minimum and to avoid fatigue failure in the pulley. The bending slope angle of the pulley shaft at the pulley hub must be designed for less than four (4) minutes. Pulley shafts of 150 mm diameter or less shall be made of machined and hot rolled or turned and ground cold finished steel. Pulley shafts larger than 150 mm diameter shall be made of steel forgings. Shafting shall have to be keyed. Dead ends of shafts shall not protrude from pillow blocks.

3.3.3 Pulleys shall run in antifriction, double row self-aligning roller bearings.

3.4 DRIVE ARRANGEMENT

3.4.1 The driving gear of each conveyor shall include an electric motor of adequate power and a reduction gear, high and low speed couplings, driving pulleys etc. shall be selected based on the motor ratings. The drive gear and motor shall be amply sized to take care of possible over loading in practice. Unless otherwise specified mechanical service factor for reducer shall be 1.5 based on motor horse power or as specified in relevant standard whichever is more. The thermal horse power capacity shall be equal to or more than the motor horse power rating. All gears shall be helical totally enclosed, oil immersed, silent, smooth and efficient in power transmission.

All gear boxes shall be of helical type only. However bevel-helical gears may be used for conveyors where space is found to be insufficient to house helical type of gear box.

Lubricating oil in the gearbox shall be so selected that no external cooling arrangement is required to keep oil temperature within permissible limit.

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3.4.2

All gear boxes shall be provided with glass level gauge type indicator. To compute motor kW rating, all motors shall have suitable margin over and above the motor shaft horse power as indicated in data sheet – A. Overall transmission efficiency of 90% shall be considered for drive arrangement. The motor kW rating of various conveyors shall be indicated by the bidder in data sheet - B.

3.5

CONVEYOR TENSIONING / TAKE - UP ARRANGEMENT

The take up / tensioning arrangement shall be sufficient to cope with the anticipated stretch of the conveyor during service and maintain the necessary slack side tension. This take up shall be calculated based on the worst case of stretch.

Screw take-up or other type of take up shall be provided for the conveyors along with other accessories and auxiliaries.

Shiftable hoist of adequate capacity and lift shall be provided at all take-up units and accordingly monorail of adequate size and length shall be provided at all take-up units.

3.6

HOLD BACK DEVICES

Automatic hold back device shall be provided on inclined conveyors to prevent backward movement of the loaded conveyor. The hold back devices shall be of roller type with adequate torque rating and shall be integral with the reduction unit. The hold backs shall be of totally enclosed type to exclude all dust.

3.7

SAFETY SWITCH

3.7.1

All emergency protection switches shall be provided along with the conveyors. The switches shall be provided to stop the conveyor in case of eccentricity in running or excessive slipping or any other reason which tenderer feels is necessary. Each switch shall be provided with prominent visual indication of tripping and it shall only be possible to reset the switch with a key by authorised person.

3.7.2

The tenderer shall also specify the make of the switches and submit details of the same with tender. Switches shall be rated to break 10 Amp. at 240 volt 50 Hz.

3.7.3

All these switches for each conveyor shall be suitably terminated in a separate junction box near its drive from where these will be wired up for sequential interlocking to the control panel. The location of these junction boxes shall be indicated in the layout of the conveyor.

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<u>DATA SHEET - A</u>		
Sl. no.	Description of item	Data / Particulars
1.	Type of conveyors	: Drag link conveyor / steel pan type conveyor / steel apron type conveyor / steel mesh belt type.
2.	Pan width in mm	: To be indicated by the bidder
3.	Pan speed in M / Sec.	: To be indicated by the bidder
4.	Design capacity of conveyor in T.P.H	: 8
5.	Capacity (Normal) of conveyor in T.P.H	: 10
6.	Lift in metres	: Refer enclosed drawing
7.	Centre to centre distance in metres	: Refer enclosed drawing
8.	Hours of operation	: 24 hours / day
9.	Material handled	: Mill rejects / Pyrites
10.	Bulk Density of material in T / M3	: 1.6
11.	Maximum lump size of material in mm.	: 50
12.	Ratio of operating and rated maximum working tension	: To be indicated by the bidder
13.	Troughing angle in degrees	: To be indicated by the bidder if applicable
14.	Maximum inclination of Conveyor in degrees	: Refer enclosed drawing
15.	Fluid coupling required	: To be indicated by the bidder
16.	Minimum % of motor margin required over the motor shaft horse power	: 10
17.	Conveyor calculation shall be done as per	: To be indicated by the bidder

	TITLE 4 x 270 MW BHADRADRI TPS MILL REJECT SYSTEM (CONVEYOR TYPE) STANDARD TECHNICAL REQUIREMENTS	SPECIFICATION NO. PE-TS-411-160-A002	
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ANNEXURES

Format for operation and maintenance manual

Operation and maintenance manual is to be required to submit in the format as per attached **Annexure I** during detailed engineering.

Site storage and preservation

Instructions for Site storage and preservation is attached as **Annexure II**.

Annexure-I

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 centres ,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				

SITE STORAGE AND PRESERVATION GUIDELINES

FOR

MECHANICAL BOPs

(Doc No: PE-DC-SSG-A001 REV.00)



PROJECT ENGINEERING MANAGEMENT, POWER SECTOR
BHARAT HEAVY ELECTRICALS LIMITED-NOIDA

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 ₂ SO 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.

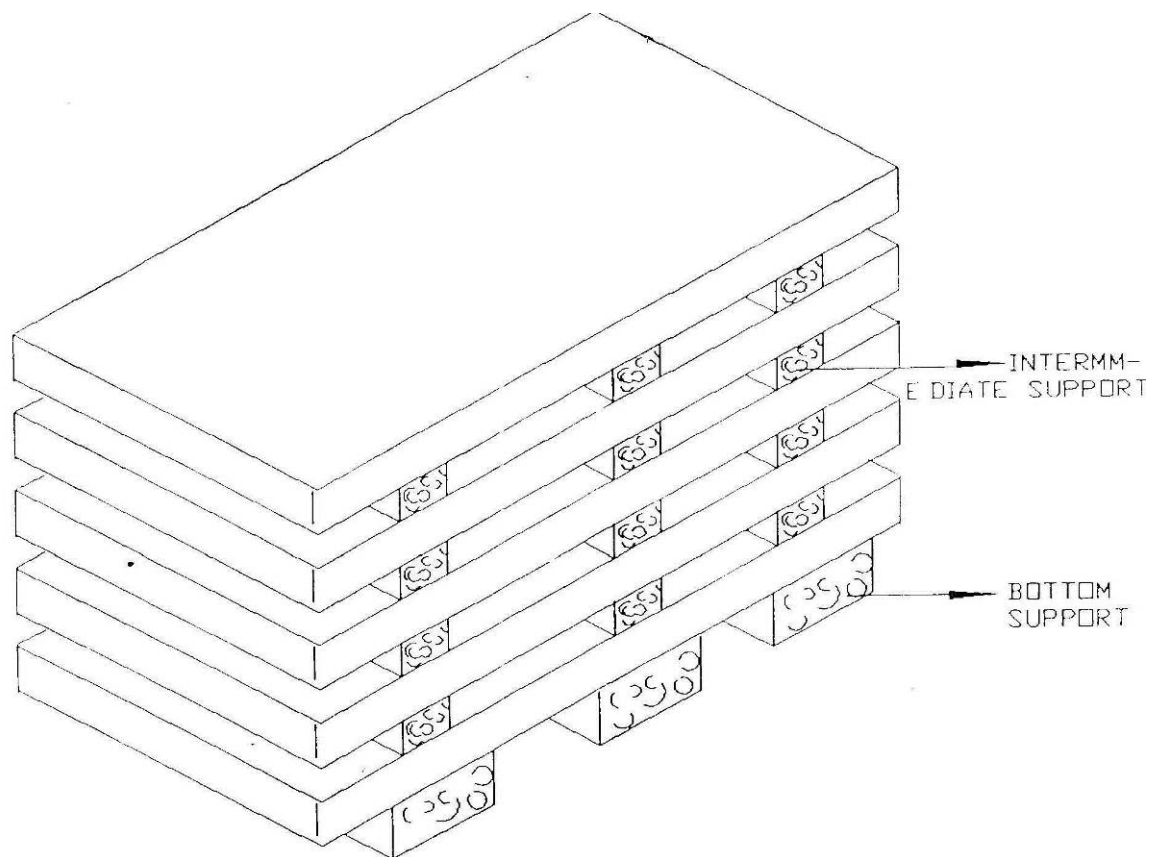


Figure – 1 – PLATE STACKING ARRANGEMENT

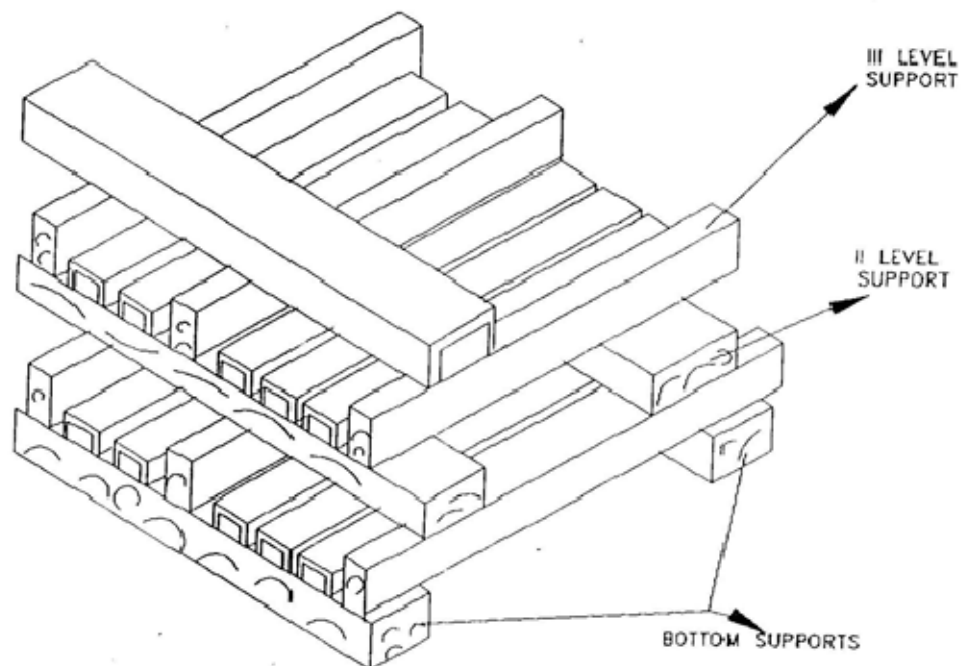


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT



TITLE
4 x 270 MW BHADRADRI TPS
MILL REJECT SYSTEM (CONVEYOR TYPE)
TECHNICAL SPECIFICATION

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Volume – III

**TITLE**

4 x 270 MW BHADRADRI TPS
MILL REJECT SYSTEM (CONVEYOR TYPE)

TECHNICAL SPECIFICATION

SPECIFICATION NO. PE-TS-411-160-A002

SECTION: III

REV 01

Sub-Section: IIIA

Date 7/4/17

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DRAWINGS/ DOCUMENTS TO BE SUBMITTED WITH THE BID

Bidder shall submit the following drawings/documents along with their bid:

- a) Credentials meeting Pre-qualification requirement
- b) **Unpriced schedule of Cost of Withdrawal sheet 'Deviation schedule'** with reference to specific clauses of the specification along with reason for such deviation in the format attached in GCC, otherwise 'No deviation' should be clearly marked in schedule in case of no deviation to technical specification.
- c) Signed and stamped copy of Utility requirement sheets as attached with Sub section-IIID.
- d) Un-priced copy of price format indicating quoted/ not quoted against each row / column.
- e) Signed and stamped copy of Compliance cum confirmation certificate as attached with sub section IIIB.
- f) Signed and stamped copy of load list as attached with Sub section-IIIE.
- g) Filled up copy of guaranteed power consumption in the format attached with sub section IIIF.

OFFER WILL BE CONSIDERED AS INCOMPLETE IN ABSENCE OF ANY OF ABOVE DOCUMENTS.

DOCUMENT OTHER THAN ABOVE, IF ANY, SUBMITTED WITH THE OFFER WILL NOT FORM PART OF CONTRACT AND ACCORDINGLY WILL NOT BE CONSIDERED FOR BID EVALUATION.

	TITLE 4 x 270 MW BHADRADRI TPS MILL REJECT SYSTEM (CONVEYOR TYPE) TECHNICAL SPECIFICATION	SPECIFICATION NO. PE-TS-411-160-A002	
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COMPLIANCE CUM CONFIRMATION CERTIFICATE

The bidder shall confirm compliance with following by signing/ stamping this compliance certificates (every sheet) and furnishes 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, other than those resolved as per 'Schedule of Deviations', with regard to same.
- b) There are no other deviations w.r.t. specifications other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'
- c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL/ CUSTOMER approval & 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. This is within the contracted price with extra implications to BHEL after award of the contract.
- d) All drawings / data-sheets / calculations etc. submitted along with the offer shall be considered for reference only, same shall be subject to BHEL/ CUSTOMER approval in the event of order.
- e) The offered materials shall be either equivalent or superior to those specified in the specification & shall meet the specified / intended duty requirements. In case the material specified in the specifications is not compatible for intended duty requirements then same shall be resolved by the bidder with BHEL during the pre-bid discussions, otherwise BHEL/ Customer's decision shall be binding on the bidder whenever the deficiency is pointed out.

For components where materials are not specified, same shall be suitable for intended duty, all materials shall be subject to approval in the event of order.

- f) The commissioning spares shall be supplied on 'As Required Basis' & prices for same included in the base price itself. Prices for special tools & tackles, if any, shall also be included in the base price.
- g) All sub vendors shall be subject to BHEL/ CUSTOMER approval in the event of order.
- h) Guarantee for plant /equipment shall be as per relevant clause of GCC /SCC /Other Commercial Terms & Conditions.
- i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities. This clause will apply in case during site commissioning additional requirements emerges due to customer and / or consultant's comments. No extra claims shall be put on this account.
- j) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to

	TITLE 4 x 270 MW BHADRADRI TPS MILL REJECT SYSTEM (CONVEYOR TYPE) TECHNICAL SPECIFICATION	SPECIFICATION NO. PE-TS-411-160-A002	
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BHEL's/ Customer's/ Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.

- k) As built drawings shall be submitted as and when required during the project execution.
- l) That the bidder has not tempered with this compliance cum confirmation certificate and if at any stage any tempering in the signed copy of this document is noticed then same shall be treated as breach of contract and suitable actions shall be taken against the bidder.

**TITLE****4 x 270 MW BHADRADRI TPS**
MILL REJECT SYSTEM (CONVEYOR TYPE)**TECHNICAL SPECIFICATION**

SPECIFICATION NO. PE-TS-411-160-A002

SECTION: III

REV 01

Sub-Section: III /

Date 7/4/17

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PRE-BID CLARIFICATION SCHEDULE

S. No.	Section/Clause /Page No.	Statement of the referred clause	Clarification Required

The bidder hereby certifies that above mentioned are the only clarifications required on the technical specification for the subject package.

SIGNATURE: _____

NAME: _____

DESIGNATION: _____

COMPANY: _____

DATE: _____

COMPANY SEAL

**TITLE****4 x 270 MW BHADRADRI TPS**
MILL REJECT SYSTEM (CONVEYOR TYPE)**TECHNICAL SPECIFICATION**

SPECIFICATION NO. PE-TS-411-160-A002

SECTION: III

REV 01

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UTILITY REQUIREMENT

S. No.	Utility	Requirement	Tapping point location
1.	Instrument air	Pressure-5-7 bar Flow- 1 Nm ³ /min	3-6 m at first column of mill bay
2.	Service water	Pressure-2.5-3 bar Flow- 3-4 m ³ / hour	3-6 m at first column of mill bay

The bidder have to signed and stamped copy of this sheet along with bid.

COMPANY SEAL

LOAD TITLE	RATING (KW)		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.
	NAME PLATE	MAX. CONT. DEMAND (MCR)		SIZE CODE	Nos													
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
HORIZONTAL CONVEYOR																		
DRIVE MOTOR	7.5 KW		U	1	0	D	U	-	C		Mill bay area							
VERTICAL CONVEYOR																		
DRIVE MOTOR	7.5 KW		U	1	0	D	U	-	C		Mill bay area							
VIBRATING FEEDERS (IF APPLICABLE)																		
MOTOR	1.1 KW		U	6	0	D	U	-	C		Pyrite hopper of mills							
VENT FAN OF BAG FILTER																		
MOTOR	2.2 KW		U	1	0	D	U	-	C		MRS SILO TOP							
SUMP PUMP																		
MOTOR	3.7 KW		U	1	0	D	S	-	I		Mill bay area							
ELECTRIC HOIST																		
MOTOR	1.5 KW		U	1	0	D	S	-	I		MRS SILO TOP							
Note: 1) Control supply for sump pump shall be derived using control transformer (bidder's scope) 2) Ratings of motors have been finalized for different drives. Bidder shall provide the motor of same KW as specified in above table for various application.																		
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) 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 (DC): 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 (CONTACTOR CONTROLLED)																		
	LOAD DATA (ELECTRICAL)	JOB NO.	411				ORIGINATING AGENCY				PEM (ELECTRICAL)							
		PROJECT TITLE	4X270MW BHADRADRI TPP.				NAME				DATA FILLED UP ON							
		SYSTEM / S	MILL REJECT SYSTEM				SIGN.				DATA ENTERED ON							
		DEPTT. / SECTION	MAUX / MH				SHEET 1 OF 1		REV. 02		DE'S SIGN. & DATE							

4x270 MW Bhadradri TPS, Khammam, Telangana - MECHANICAL STEEL CONVEYOR TYPE MILL REJECT SYSTEM

Sl.No.	Description / Item	Working	Standby	Power Consumption (KW) (at motor input terminal)	Duty Factor	Total Power Consumption (KW)
1	2	3	4	5	6	7 = 3 x 5 x 6
1	Total power consumption per unit	1	0		1.00	
					Total KW	

Notes

- 1 If the actual power consumption exceeds the guaranteed power consumption, liquidated damages shall be payable by the Contractor at the rate of ₹ 2,52,000/- per KW (Rupees Two lacs and fifty two thousand per Kilowatt) excess power consumption, over the base guaranteed figure indicated by him in his bid. Such liquidated damages may be recovered by the Owner by deduction from the contract price or by enforcing the contract performance guarantee or in any other manner deemed fit by the Owner. For this purpose, the drives of standby equipment shall not be considered.
- 2 Power consumption (KW) of motors shall be measured at motor input terminals when the system operating at the rated capacity, Power consumed by Horizontal and vertical conveyor motors along with vent fan motor shall be taken into consideration for the purpose.
- 3 For bid evaluation purpose on account of guaranteed auxiliary power consumption, the same shall be loaded at the rate of ₹ 2,52,000/- per KW (Rupees Two lacs and fifty two thousand per Kilowatt) for the differential power consumption.
- 4 Base aux power figure is 13.75 KW per unit at duty factor 1.0.