LARA SUPER THERMAL POWER PROJECT
STAGE-II (2X800 MW)

TECHNICAL SPECIFICATION
FOR

MILL REJECT SYSTEM (CONVEYOR TYPE)

SPECIFICATION No. **PE-TS-508-160-A101**
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BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA, INDIA

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SECTION – I

SPECIFIC TECHNICAL REQUIREMENTS

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PROJECT INFORMATION

SUB-SECTION–I-B

PROJECT INFORMATION

1.00.00 BACKGROUND

Lara STPP Stage-I(2X800 MW) units are in operation near Lara village in Raigarh Distt. of Chhattisgarh. The Present proposal is for Lara STPP, Stage-II (2x800 MW) as extension of existing stage-I.

2.00.00 LOCATION AND APPROACH

The project is located in Raigarh district of Chhattisgarh State. The project is located south-east of Raigarh town near village Lara, bounded by villages Lara, Chhapora & Lohakhan and on the western side of Odisha State boundary.

2.01.00 RAIL LINK

The project site is approachable from NH-200 (Raigarh–Sarangarh) via Kondatarai through State PWD Road.

The nearest rail head Raigarh Railway Station (on South East Central Railway, Howrah-Bilaspur Broad Gauge), is approximately 30 kms from the project site.

2.02.00 AIRPORT

The nearest commercial airport, Raipur is about 250 kms from the project site.

Vicinity Plan is placed at **Annexure-I.**

3.00.00 CAPACITY

Stage-I	:	1600 MW (2x800 MW) – Under Operation
Stage-II	:	1600 MW (2x800 MW) - Present proposal

4.00.00 LAND

About 2450 Acre of Land has been acquired for Lara Super Thermal Power Project. The expansion project is envisaged to be accommodated with in the land already acquired during Stage-I.

5.00.00 WATER

Water Cooled Condenser is envisaged for Lara Stage-II of 2 X 800 MW units. Make up water requirement for this project would be about 4800 Cu.M/hr.

The make-up water will be drawn from Mahanadi river. Raw water will be drawn to supply to PT Plant & Ash Handling Plant.

WRD, Govt. of Chhattisgarh have accorded Water availability confirmation of 45 MCM for Stage-I (2x800 MW) and 68 MCM for Stage-II of Lara STPP from Saradih Barrage on river Mahanadi. Thus the total committed water by WRD, Govt. of Chhattisgarh for Lara STPP is available for 113 MCM.

Closed cycle cooling water system using cooling towers is envisaged for Stage-II of the project.

SUB-SECTION – IA

SPECIFIC TECHNICAL REQUIREMENTS (MECHANICAL)

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, Mandatory spares, E&C spares and maintenance tools and tackles, Supervision of Erection & Commissioning, 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 2X800 MW LARA SUPER THERMAL POWER PLANT STAGE-II is being set up by NTPC at Lara in Raigarh district of Chhattisgarh State.

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, supervision of 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.

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.

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

S. No.	Descriptions	Unit	Quantity
1	Number of mills (Working + Standby) at 100% BMCR	Nos.	9 Nos. (9W + 1S)
2	Maximum mill rejects generation rate per mill (@ 1% of mill capacity)	t/h	0.83 TPH per mill
3	Mill rejects temperature (normal/ max)	°C	180 /200
4	Mill arrangement		Front 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	50mm (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
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 30 minutes of maximum specified mill reject collection (0.83TPH per mill) whichever is maximum. 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 silo.

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 One no. level switches (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 working coal mills. Pyrites will be then discharged to vertical conveyor (Bucket conveyor) and then to silo.

Manual discharge sector gate shall be provided at the bottom of the silo along with canvass chute to unload the material onto purchaser's truck

A DDCMIS (By BHEL) 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 mal-functioning 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, including mandatory spares, maintenance tools & tackles and erection & commissioning spares, Supervision of Erection & Commissioning, Performance and guarantee testing and handing over of Metallic belt conveyor/Chain Flight Conveyor type **Mill Reject Handling System** as per details in different sections of this specification.

3.1 SCOPE OF SUPPLY

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

1) Mechanical conveyor system (1 no. per unit) of Metallic belt conveyor/Chain Flight Conveyor.type along with accessories including belt/chain flight, pans, carrying idlers, head pulley, tail pulley, take up device, suitable electric drives / gear box / geared motor, hydraulic/pneumatic tensioning arrangement, safety guard, sensors for automatic control system, bearings, shafts etc. as applicable for the system shall be provided. 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. 800 MM walkways on both sides of the conveyor shall be provided for maintenance. Conveyor shall be inclined at the end to discharge the material in bucket elevator (Bucket elevator shall be above ground no pit shall be provided for bucket elevator)

2) Bucket elevators (1 no. per unit) along with all accessories and auxiliaries for successful installation and operation of the system shall be provided.

3) Pyrite Hoppers (1 no. per mill) 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. RTDs for pyrite hoppers (one at each pyrite hopper) shall be provided. RF type level switches for pyrite hoppers (one per pyrite hopper) shall be provided. Vibrating feeders 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.

4) Mill reject storage silos (1 no. per unit) factory prefabricated along with structures, complete with lining in the conical portion as well as straight portion, lever operated discharge gate with canvas chute at silo outlet, staircase up to silo top, operating & maintenance platform, hand railing, bag filter with pulse cleaning arrangement and vent fan, 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, Monorail hoists at each silo and monorail arrangement etc. The capacity of silo shall be as indicated elsewhere in the specification. All steel structures shall be fabricated in factory, transported and erected at site. All factory fabricated structures shall have bolted field connections.

5) Pneumatic panels or boxes / Solenoid box / Local Control Panel / JBs properly mounted on rack / pyrite hopper structure as required to complete the system. All signals from instruments sensors on each pyrite hopper are to be terminated on local control panel / pneumatic panel dedicated to each pyrite hopper.

6) Pneumatic cylinder operated plate / knife gate valve with impulse tubing and open and close limit switches at mill outlet/pyrite hopper inlet, at pyrite hopper outlet, at by pass chute of pyrite hopper with manual override to provision hand-wheel operation of valve.

The chutes shall be provided between mill outlet and pyrite hopper, between pyrite hopper and conveyor, between conveyor discharge end pulley and silo. The chutes shall also be provided between pyrite hopper and vibrating feeder, between vibrating feeder and conveyor and between conveyor and bucket elevator.

7) 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.

8) Instrumentation shall meet the requirement of C&I requirements as mentioned elsewhere in the specification.

9) 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 equipment, may supply the same shall be quoted.

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

10) Mandatory spares as per **Annexure-II**
11) Initial fill of all lubricants and fluids.
12) Electrical scope and requirements are indicated elsewhere in the specification.
13) One set of Erection & commissioning spares and start up spares as required to complete the system shall be provided.
14) 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 **unless specifically EXCLUDED from the scope under Clause No. 4.0 below.**

3.2 SCOPE OF SERVICES

Detailed Erection and commissioning procedure shall be submitted by successful bidder for carrying out the erection and commissioning at site by BHEL.

Scope of Supervision for Erection & commissioning: Tentatively following visits shall be planned by site team which shall be as follows:-
a) One visit per unit for supervision for erection & commissioning (total 2 Visits).
b) One visits per unit for initial operation of system (total 2 Visits).
c) Any additional visit as per requirement of BHEL site office during erection of equipment.

Note: Bidder shall be informed at least 10 days in advance for the requirement of visit at Site. Visiting team shall consist of one or two expert of bidder as deemed necessary by them. 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.**

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4.0 EXCLUSION

1) Civil work associated with Mill Reject Handling system including the following:-

a) Road approach for various facilities related to Mill Reject Handling System.
b) Conveyor drive unit foundation
c) Mill Reject silo foundation

2) Lighting of Mill bay and silo 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 downstream up to mill reject silo outlet with canvas chute and discharge gate is by bidder.

Mill Reject outlet towards road tanker / Truck	:	Mill reject silo 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 1.5 m^3 /min per unit and 5 – 7 kg/cm^2.
Service Water for quenching	:	Total 6-8 m^3/ hour per unit 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**.

11.0 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 III.**

14.0 General Technical Requirement

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

14.0 PERFORMANCE GUARANTEE

General technical requirement of end customer is attached as **Annexure VI.**

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 – 508 – 160 – A001

2) Layout for Mill rejects handling system

3) General Arrangement of Mill HP-1103 (with planetary gear box)

4) Foundation plan of Mill

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.

16.0 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, if required, 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 10 (min).

3) Bag filter with vent fan shall be provided in the silo 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 except 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) 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.

9) 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.

10) Civil works will be provided by BHEL / customer. Hence, bidder has to furnish the civil inputs in time. Bidder to furnish the civil foundation drawing along with the loading data for approval during detailed engineering stage showing / indicating the following:-

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.

ANNEXURE A: EQUIPMENT DESIGN/SELECTION CRITERIA

S. No.	Equipment	Design / Selection / Sizing Criteria
01.	Metallic belt conveyor/Chain Flight Conveyor.	1) Continuous normal operating capacity – 7.5 T/Hr. 2) Continuous maximum operating capacity – 10 T/Hr. 3) Should have provision of variable speed through VVVF drive.
02.	Bucket Elevator	Design, type, speed, 75%percentage feeling shall be as per IS:7167 or equivalent standard Should have provision of variable speed through VVVF drive.
03.	Pyrite Hopper & Accessories	*a)* Capacity of pyrite hoppers: 30 Minutes of Maximum specified mill reject collection(1TPH) *b)* MOC: MS to IS 2062 Gr. A (min), min. 10 mm thk. suitably stiffened with rolled steel sections. *c)* Rupture Disc Bursting Pressure – 0.5 kg /cm2 (g)
04.	Silo & its Accessories	*a)* Quantity – One (1) per unit *b)* Effective Storage Capacity – 120 T *c)* Minimum free board – 500 mm *d)* Silo Plate – 10 mm thk. MS Plate conforming to IS 2062 Gr A *e)* Liner: 3 mm thick SS - 304 in conical & straight length portion of the Silo Manually operated sector Gate along with canvas chute 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 / TISCRAL LINER on inner surface 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 – 1.5 (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 – 30 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. g) Vent fan
05.	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

<table>
<tr><td>06.</td><td>Lines for Various Services</td><td>
<table>
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<tr><td></td><td>Material of Construction & other details</td></tr>
<tr><td></td><td>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.</td></tr>
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Flanges
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<tr><td>All services</td><td>Fabricated out of IS 2062 Gr. A Plates/ Equivalent as per ASME B 16.5</td></tr>
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SUB-SECTION–IIA-17

MILL REJECT HANDLING SYSTEM

MILL REJECT SYSTEM

1.00.00 To handle the Mill Rejects on a continuous basis, the Bidder shall provide a Mill Reject Handling System. The Mill Reject Handling System shall comprise Mechanical Conveying system. The Rejects shall be stored in storage silo. From the storage silo, the Mill Rejects shall be disposed off in trucks.

1.01.00 The scope of supply for mill reject handling system shall include but not limited to the following:

1.01.01 Mechanical conveying system:

(a) One (01) no. pyrite hopper with discharge chute, emergency chute work etc. for each mill as required.

(b) One (01) no. pneumatically operated isolation gate for inlet and one (1) no. pneumatically operated isolation gate for outlet of pyrite hoppers complete with compressed air pipe work, solenoid valves & supporting arrangement for each pyrite hopper.

(c) Mechanical feeder including Vibrating Feeder (if applicable) for mill rejects below each pyrite hopper for feeding at consistent rate to the mill reject conveyor.

(d) Metallic Belt conveyor/Chain Flight Conveyor along with drives, accessories, supports etc for conveying the mill rejects from the mills for each row of mills in each unit. The conveyor shall be fully enclosed.

(e) Bucket elevator along with drives, accessories and supporting structures to raise the mill rejects discharge by the metallic belt conveyor for discharging into storage silo.

(f) Mill reject storage silos, one (1) no for each row of mills in steel construction each having an effective storage capacity of sixteen (16) hours considering all the working mills of the respective Mill bay in operation and rejecting @ of 1 % of mill capacity for the worst coal conditions. Necessary supporting steel structure, platform, staircase, manual operated unloading Gate, 3 mm thick SS plate liners covering straight length portion and conical portion of mill reject system hoppers (bunkers), level switches, air relief devices, etc. shall also be provided.

The storage Silos shall be designed to provide a clear access of 4.5 m for a Road Tanker/Truck to be placed under the silo & receive the rejects using suitable chute work.

(g) Suitable spray quenching system, to cool the mill reject in pyrite hoppers.

(h) Complete control & instrumentation as specified in C&I section.

(i) Necessary electrical equipment as specified.

(j) Civil structural works associated with Mill reject handling system including foundation bolts, pockets, grouting and underpinning etc.

(k) One (1) no. fixed type sump pump of 10 m^3/hr capacity for each underground pit for Bucket elevator area, if applicable.

SUB-SECTION–A-22

MILL REJECT HANDLING SYSTEM

1.00.00 **MILL REJECT HANDLING SYSTEM**

Mechanical conveying system shall be employed for handling of the mill rejects. Each mill reject discharge hopper shall be fitted with Feeder which shall discharge the mill rejects through Mechanical Conveyors to a storage Silo. The transmitting vessel shall operate on level probe mode with timer back-up.

2.00.00 **MILL REJECT HANDLING SYSTEM OF MECHANICAL TYPE MEETING THE FOLLOWING REQUIREMENT SHALL BE PROVIDED:**

The discharged rejects from coal mill shall be collected in a dedicated pyrite hopper. Each pyrite hopper shall be provided with cylinder operated knife gate valves at inlet and outlet. Material from pyrite hoppers shall be removed by Mechanical conveyor and fed to main conveyor for further conveying. The main conveyor shall feed to a bucket elevator which in turn will feed to main storage silo.

2.01.00

1.	**Pyrite Hopper**		
a)	Minimum effective storage	:	30 minutes of maximum specified mill reject collection
b)	No. pyrite hopper	:	One (1) for each mill, supported independently on steel columns
c)	Function	:	To store mill reject on load maintenance of conveyors and act as a transition tank for falling mill rejects during normal working.
d)	Number and type of isolation gates	:	Cylinder operated sliding type gates reject feeding at inlet and outlet of pyrite hopper.
e)	Accessories		
	Pyrite hopper	:	Access doors/ manholes /Inspection windows/ Poke holes Size: 300 mm dia circular or 300 mm x 300 mm, if rectangular
			or
2)	**Material of construction**	:	
a)	Pyrite hopper	:	Tested quality mild steel plates of thickness not less than 10 mm (IS: 2062) and suitably stiffened with rolled steel sections.
b)	Slide gates	:	Carbon steel

2.02.00 **Metallic Conveyors**

2.03.00 **Data Sheet**

1)	Function	:	To convey mill rejects, from pyrite hopper to main storage silo.
2)	Location	:	Under the coal mill, and up to main mill reject storage silo in each unit/ bucket elevator.
3)	No.	:	one (1) no. working set of conveyors per row of mills per boiler
4)	Capacity	:	It shall be designed for continuous removal of mill rejects.
5)	Continuous normal operating capacity	:	To meet the mill rejects removal rates specified.
6)	Continuous maximum operating capacity	:	At least 25% margin on normal operating capacity.
7)	Tensioning arrangement		Hydraulic/pneumatic
8)	Metallic belt conveyor/Chain Flight Conveyor will be required to handle highly abrasive rejects continuously. So all components shall be of proven design having a track record of trouble free-operation in order to avoid problems of frequent stoppages. The conveyor shall be sized for startup with load.		
9)	The conveyor shall be fully enclosed in casing.		
10)	Separate conveyor (<u>if applicable</u>) shall be provided to remove fines. The conveyor may operate continuously/intermittently.		
11)	The conveyor/rollers bearings shall be grease packed with facility of recharging from outside		
12)	Reliable and proven hydraulic/pneumatic auto take up arrangements, with facility of adjustment of tension. The tension assembly shall be designed to absorb any momentary shock loading.		
13)	800 mm walkway along both sides of conveyor for Maintenance shall be provided.		
14)	Suitable clean (<u>if applicable</u>) out conveyor shall be provided for removal of spillage/fines.		

2.04.00 Material of construction of conveyor components

a)	conveyor	:	Heat resistant stainless steel /Stainless steel / alloy carbon steel / carbon steel, suitable for 200 deg C (minimum). Any other suitable material of construction of proven design is also acceptable.
b)	casing		Carbon steel

2.05.00 **Bucket Elevator**

2.05.01 **General Requirement**

Suitable type of the Bucket Elevator shall be chosen for mill rejects handling. The bucket shall be sized to handle rated capacity of mill rejects discharge by the metallic belt conveyor at the minimum material bulk density and maximum bucket filling of 75%.

2.05.02.1.1 **Casing**

Casing to be self-supported, dust-tight construction and capable of supporting head shaft, drive, and service platform.

Boot section to be fabricated of minimum 6mm steel plate, with front and rear access panels as on shown in the attached layout drawing.

A beam is to be provided in casing for servicing internal gravity take-up. The beam may be located either in the boot section or intermediate section as applicable.

2.05.02.1.2 **Belting (if applicable)**

Suitable heat resistant and fire resistant belting shall be provided

2.05.02.1.3 **Take-up**

Take-up shall be screw or internal gravity type with guide rails and weights included.

2.05.02.1.4 **Drive**

Bucket elevator drive should be sized as follows:

Minimum power for drive, either:

100% bucket filling @ minimum material bulk density, or

75% bucket filling @ maximum material bulk density, whichever is greater.

2.05.06 **Inspection and Access Doors**

Inspection doors and access doors shall be loose-hinged type with quick-opening jamb bar fasteners and gaskets enclosed and retained in the door. Access doors shall be 1.5X1.5m minimum.

	B. Air Conditioning System: Adequate number of air changes to Maintain in uniform temp. & humidity as specified elsewhere.
4.02.19	**Chutes:**
	Minimum clear cross section of chute: 1800 mm X 1200 mm (inside both ways) for Coal Handling plant
4.02.20	Bidder to comply Safety guidelines while designing Coal & Biomass Conveying Plant, and to follow safety requirement as mentioned elsewhere in the Technical Specification.
4.03.00	**MILL REJECT HANDLING SYSTEM**
4.03.01	Mill Reject system shall be provided for all vertical type mills.
4.03.02	The capacity of mill rejects system shall be at least 1% of mill design capacity for worst coal or maximum actual, whichever is higher, considering maximum no. of working mills.
4.03.03	In case of mechanical conveying system, a vibrating feeder and metallic belt/chain flight conveyor carry mill reject from hopper to subsequent metallic /chain flight conveyor for further conveying to Bucket elevator for final storage at Silo.
4.03.04	Each Mill Bay shall be provided with an independent `SILO' having a collection capacity of 16 effective hours of mill reject considering all mills of that particular bay are working. Clear head room of minimum 4.5 m below silo outlet shall be kept for truck entry.
4.03.05	For the purpose of design temperature of rejects shall be assumed as 200°C or as specified by the boiler/ mill manufacturer, whichever is higher. However quenching system shall be provided.
4.03.06	Sizing grid shall be provided in mill reject pyrite hopper to remove mill reject of size >40mm. The mill reject systems shall be designed for input size of 40mm.
4.03.07	Bulk density of mill reject shall be considered as: i) For volumetric computation -1600 kg/m^3 ii) For load/ strength - 2400 kg/m^3
4.04.00	**GYPSUM HANDLING PLANT**
4.04.01	(a) The rated capacity of all Gypsum handling conveyors shall be 150 MTPH. (b) Belt speed for 150 MTPH conveyors shall not be more than 2.0 m/s.
4.04.02	All conveyors shall be designed for 110% of rated capacity. Rated capacity (corresponding to **GHP** capacity) shall be guaranteed capacity for 100% duty equipment. For 50% duty equipment design capacity shall be guaranteed capacity. For purpose of guaranteed power consumption rated capacity shall be considered in either case

10.05.13A Mill body thickness at grinding zone shall be suitable to take care of coal abrasion. Suitable thickness material or/along-with liners shall be provided to accommodate the high wear at such areas.

10.05.14 Ensure that flap / knife in the power (electric / pneumatic) operated pulverizer discharge valve is totally out of coal path during operation of the pulverizer.

10.05.15 All pulverizer wear parts shall be arranged so as to facilitate easy replacements without total dismantling of pulverizer(s).

10.05.16 Ensure minimum mill turn-down ratio(s) of 3:1.

10.05.17 Provide suitable arrangement for readily determining the oil level in the gear box(es) and all other lubricated parts.

10.05.18 For pulverized coal sampling for fineness and distribution:

(a) Provide tapping points on each PF pipe at pulverizer outlet suitable for coal sampling as per IS 16617: 2018.

(b) Ensure that the coal sampling provisions are complete with screwed plugs, compressed air purging connections at tapping points, heating arrangement and other requirements as required for IS 16617: 2018 sampling.

(c) Provide

(1) Rota Probe for coal sampling as per IS 16617: 2018 and ASME respectively.

(2) Dirty Pitot tubes per Steam Generator, suitable for measurement of coal-air velocity in coal pipes.

(d) Provide convenient approach/access for above coal sampling/measurement points, from nearest platform floor.

10.05.19 Provide suitable arrangement for readily determining the oil level in the gearboxes and all other lubricated parts.

10.05.20 Provide mill outlet temperature control capable of achieving and maintaining rated values for adequately drying the specified coal range for all unit loads.

10.05.21 **Primary Air Flow Measurement**

(a) Each PA flow measuring device shall be provided with three sets of tappings.

(b) The location, type and design of flow measuring devices shall be to Employer's approval.

(c) Necessary tapping points for temperature compensation shall be provided.

10.05.22 **Mill Rejects System:**

(a) Mill reject system shall automatically discharge the tramp iron and other non grindable material through an outlet connection at a suitable height (to be approved by Employer). The conveying system shall be as defined elsewhere in the specifications.

Pyrite hopper outlet spout should be having adequate ground clearance.

Adequate maintenance space (as approved by employer) should be provided for various C&I instruments, valves and other equipment of mill reject system.

(b) Mill rejects collection & discharge system shall be designed (as detailed in Mill Reject sub-section in Part-B of Technical Specification) to ensure sequential automatic operation of the coal mill discharge gates for flow of rejects into the reject spout.

(c) The necessary mill isolation dampers/valves, to facilitate automatic continuous or automatic intermittent discharge of rejects to the conveyor.

10.05.24 Fire Detection and Extinguishing System shall be provided for the complete coal preparation firing system including coal feeding system.

10.05.25 Lubrication of bearings & other parts shall be automatic and continuous.

10.05.26 **Handling of Pulverizer Parts**

(a) The pulverizer shall be designed to facilitate ease of handling of heavy parts for maintenance purpose.

(b) Motorized hoists shall be provided for lifting of heavy parts including mill discharge valves.In case the weight of such part is below 500 kg, manual hoist shall also be acceptable.

(c) All pulverizer wear parts shall be arranged so as to facilitate easy replacements without total dismantling of pulverizer(s)

10.05.27 Accessible gear case suitable for removing gearing without removing upper structure for vertical mills.

10.05.28 **Access Doors/Windows**

(a) Adequate numbers of hinged access doors/windows with access ladders shall be provided to facilitate access to various parts of pulverizer. The access doors shall be suitable for on load inspection and maintenance of pulverizer.

(b) Oil pumps & filters shall be readily accessible.

10.05.29 **Approach platforms**

Access & platform shall be provided to carryout maintenance of pulverizer for replacement & removal/installation of pulverizer wear parts.

Continuous platform of adequate width/area (more than the mill diameter plus sufficient margin at both side) connecting all adjacent mills (at each side) at around roller level (grinding part) shall be provided to facilitate ease of removal of grinding parts & their maintenance. While platform shall suit the specific offered design of mill, it should facilitate the O&M requirements of other parts/components of the milling system. This continuous platform (at each side) shall be approachable from ground floor at both sides through suitable stairs. Suitable ladder & platform shall be provided to approach & inspect mill discharge valve and also dynamic classifier including its vane inspection/setting requirements.

Necessary ladders and approach platforms for mill bay hoist shall be provided to carry out any maintenance activity on hoists.

10.05.30 The mill and its motor, gear box foundation bolts shall have adequate maintenance space and accessibility for tightening both from top and bottom side of foundation bolts.

SUB-SECTION–E-26

MILL REJECT HANDLING SYSTEM

1.00.00 **PNEUMATIC CONVEYING SYSTEM**

1.01.00 **PIPING, VALVES, STRAINERS AND FITTINGS**

(a) All pipes and fittings shall be tested as per applicable code.

(b) All valves shall be hydraulically tested for body, seat and back seat (if applicable) as per relevant Standard. Check valves shall also be tested for leak tightness test at 25% of the specified seat test pressure. Valves shall be offered in unpainted condition only.

(c) Functional checks of the valves for smooth opening and closing shall also be done.

(d) Strainer body shall be hydraulically tested. One of each type and size of Strainer shall be tested for Pressure drop v/s flow rate, if not tested earlier.

1.02.00 **PRESSURE AND STORAGE VESSELS:**

(a) Atmospheric Tank

(i) All weld joints shall be DP tested and complete tanks shall be water fill tested.

(ii) All atmospheric storage tanks fabricated and erected at site shall be subjected to all tests (Hydro, NDT and Vacuum) according to design code as applicable.

(b) Pressure Vessel

(1) NDT on weld joint shall be as per respective code requirements or the minimum as specified as below:

(i) 100% DPT on root run of butt weld, nozzle welds and finished fillet welds.

(ii) 100% DPT on all finished butt welds

(iii) 10% RT (covering all 'T'/cross joints) of butt welds

(2) Butt Welds of dished ends shall be stress relieved and subjected to 100% RT.

(3) Each finished vessels shall be hydraulically tested to 150% of the design pressure for a duration of 30 minutes.

1.03.00 **PACKAGE AIR COMPRESSOR**

In addition to Hydraulic tests of pressure parts, performance test of the compressor shall be done for FAD, pressure, power consumption, as per relevant code. Noise and vibration shall also be measure.

1.04.00 **BAG FILTERS:**

1.04.01 Leakage test shall be carried out for casing and other pressure parts

1.04.02 Pulsing and sequential test on bag filter cages shall be done.

1.05.00 **MONORAIL HOIST/CHAIN PULLEY BLOCKS:**

1.05.01 Chain pulley blocks shall be tested as per IS:3832

1.05.02 UT & MPI/DPT shall be done on gear blank, pinion shaft, axles.

1.05.03 Proof Load Test on hooks shall be carried out followed by DPT.

1.05.04 100% Radiography on weld joints under tension and 10% radiography on compression butt joints followed by 100% DPT shall be done for rope drum, girder, end carriage etc.

1.05.05 Complete hoists shall be tested for load and overload test as per IS:3938

1.06.00 **VENTILATION SYSTEM:**

1.06.01 Shop Run Test for all Centrifugal Fans to check noise, temp. rise & vibration.

1.06.02 Performance test on one fan of each type for capacity, pressure, efficiency and power consumption.

D-1-12(D)

Annexure- (D)

CRITERIA FOR WIND RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT

All structures shall be designed for wind forces in accordance with IS:875 (Part-3) and as specified in this document. See Annexure – I for site specific information.

Along wind forces shall generally be computed by the Peak (i.e. 3 second gust) Wind Speed method as defined in the standard.

Along wind forces on slender and wind sensitive structures and structural elements shall also be computed, for dynamic effects, using the Gust Factor or Gust Effectiveness Factor Method as defined in the standard. The structures shall be designed for the higher of the forces obtained from Gust Factor method and the Peak Wind Speed method.

Analysis for dynamic effects of wind must be undertaken for any structure which has a height to minimum lateral dimension ratio greater than “5” and/or if the fundamental frequency of the structure is less than 1 Hz.

Susceptibility of structures to across-wind forces, galloping, flutter, ovalling etc. should be examined and designed/detailed accordingly following the recommendations of IS:875(Part-3) and other relevant Indian standards.

It should be estimated if size and relative position of other structures are likely to enhance the wind loading on the structure under consideration. Enhancement factor, if necessary, shall suitably be estimated and applied to the wind loading to account for the interference effects.

Damping in Structures

The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for:

a) Welded steel structures : 1.0%

b) Bolted steel structures/ RCC structures : 2.0%

c) Prestressed concrete structures : 1.6%

d) Steel stacks : As per IS: 6533 & CICIND Model Code whichever is more critical.

ANNEXURE-I

SITE SPECIFIC DESIGN PARAMETERS

The various design parameters, as defined in IS: 875 (Part-3), to be adopted for the project site shall be as follows:

a) The basic wind speed "V_b" at ten metres above the mean ground level : 44 metres/second

b) The risk coefficient "K_1" : 1.07

c) Category of terrain : Category-2

D-1-12(E)

Annexure-(E)

CRITERIA FOR EARTHQUAKE RESISTANT DESIGN OF STRUCTURES AND EQUIPMENT

All structures and equipment shall be designed for seismic forces adopting the site specific seismic information provided in this document and using the other provisions in accordance with IS:1893 (Part 1 to Part 4). Pending finalization of Part 5 of IS:1893, provisions of part 1 shall be read along with the relevant clauses of IS:1893:1984, for embankments.

A site specific seismic study has been conducted for the project site. The peak ground horizontal acceleration for the project site, the site specific acceleration spectral coefficients (in units of gravity acceleration 'g') in the horizontal direction for the various damping values and the multiplying factor (to be used over the spectral coefficients) for evaluating the design acceleration spectra are as given at Appendix-I.

Vertical acceleration spectral values shall be taken as 2/3rd of the corresponding horizontal values.

The site specific design acceleration spectra shall be used in place of the response acceleration spectra, given at figure-2 in IS:1893 (Part 1) and Annex B of IS:1893 (Part 4). The site specific acceleration spectra along with multiplying factors specified in Appendix-I includes the effect of the seismic environment of the site, the importance factor related to the structures and the response reduction factor. Hence, the design spectra do not require any further consideration of the zone factor (Z), the importance factor (I) and response reduction factor (R) as used in the IS:1893 (Part 1 to Part 4).

Damping in Structures

The damping factor (as a percentage of critical damping) to be adopted shall not be more than as indicated below for:

a)	Steel structures	:	2%
b)	Reinforced Concrete structures	:	5%
c)	Reinforced Concrete Stacks	:	3%
d)	Steel stacks	:	2%

Method of Analysis

Since most structures in a power plant are irregular in shape and have irregular distribution of mass and stiffness, dynamic analysis for obtaining the design seismic forces shall be carried out using the response spectrum method. The number of vibration modes used in the analysis should be such that the sum total of modal masses of all modes considered is at least 90 percent of the total seismic mass and shall also meet requirements of IS:1893 (Part 1). Modal combination of the peak response quantities shall be performed as per Complete Quadratic Combination (CQC) method or by an acceptable alternative as per IS:1893 (Part 1).

In general, seismic analysis shall be performed for the three orthogonal (two principal horizontal and one vertical) components of earthquake motion. The seismic response from the three components shall be combined as specified in IS:1893 (Part 1).

The spectral acceleration coefficient shall get restricted to the peak spectral value if the fundamental natural period of the structure falls to the left of the peak in the spectral acceleration curve.

For buildings, if the design base shear (V_B) obtained from modal combination is less than the base shear ($\bar{V}_B$) computed using the approximate fundamental period (T_a) given in IS:1893:Part 1 and using site specific acceleration spectra with appropriate multiplying factor, the response quantities (e.g. member forces, displacements, storey forces, storey shears and base reactions) shall be enhanced in the ratio of $\bar{V}_B$/ V_B. However, no reduction is permitted if $\bar{V}_B$ is less than V_B.

Design/Detailing for Ductility for Structures

The site specific design acceleration spectra is a reduced spectra and has an in-built allowance for ductility. Structures shall be engineered and detailed in accordance with relevant Indian/International standards to achieve ductility.

APPENDIX – I

SITE SPECIFIC SEISMIC PARAMETERS FOR DESIGN OF STRUCTURES AND EQUIPMENT

The various site specific seismic parameters for the project site shall be as follows:

1) Peak ground horizontal acceleration (MCE) : 0.16g

2) Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') to obtain the design acceleration spectra

a) For special moment resisting steel frames designed and detailed as per IS:800 : 0.04

b) For special concentrically braced steel frames designed and detailed as per IS:800 : 0.03

c) for special moment resisting RC frames designed and detailed as per IS:456 and IS:13920 : 0.024

d) for RCC chimney, RCC Natural Draft Cooling Tower :0.08

e) For Liquid retaining tanks :0.048

f) for Steel chimney, Absorber tower, Vessels : 0.06

g) for design of structures not covered under 2 (a) to 2 (f) above and under 3 below, in general (excluding special structure/ configuration/materials) : 0.04

3) Multiplying factor to be applied to the site specific horizontal acceleration spectral coefficients (in units of gravity acceleration 'g') for design of equipment and structures where inelastic action is not relevant or not permitted : 0.08

Note: g = Acceleration due to gravity

The horizontal seismic acceleration spectral coefficients are furnished in subsequent pages.

APPENDIX – I

HORIZONTAL SEISMIC ACCELERATION SPECTRA COEFFICIENTS (In units of 'g')

Time Period	Damping Factor (as a percentage of critical damping)		
(Sec)	2%	3%	5%
0.000	1.000	1.000	1.000
0.030	1.000	1.000	1.000
0.031	1.032	1.025	1.021
0.050	1.646	1.480	1.379
0.060	1.966	1.702	1.546
0.070	2.284	1.915	1.704
0.080	2.602	2.122	1.853
0.086	2.792	2.243	1.940
0.088	2.855	2.283	1.968
0.090	2.919	2.322	1.996
0.095	3.077	2.421	2.065
0.098	3.171	2.479	2.106
0.100	3.234	2.518	2.133
0.103	3.329	2.576	2.173
0.108	3.487	2.671	2.238
0.110	3.549	2.709	2.264
0.112	3.612	2.747	2.290
0.115	3.707	2.803	2.328
0.118	3.801	2.859	2.366
0.121	3.895	2.914	2.404
0.122	3.927	2.933	2.417
0.125	4.021	2.988	2.454
0.127	4.083	3.025	2.478
0.129	4.146	3.061	2.503
0.130	4.177	3.079	2.515
0.131	4.210	3.097	2.527
0.134	4.210	3.152	2.564

APPENDIX – I

HORIZONTAL SEISMIC ACCELERATION SPECTRA COEFFICIENTS (In units of 'g')

Time Period	Damping Factor (as a percentage of critical damping)		
(Sec)	2%	3%	5%
0.140	4.210	3.259	2.635
0.141	4.210	3.260	2.647
0.150	4.210	3.260	2.750
0.200	4.210	3.260	2.750
0.250	4.210	3.260	2.750
0.300	4.210	3.260	2.750
0.350	4.210	3.260	2.750
0.400	4.210	3.260	2.750
0.431	4.210	3.260	2.750
0.442	4.210	3.260	2.750
0.450	4.210	3.260	2.750
0.470	4.210	3.260	2.750
0.492	4.108	3.260	2.750
0.500	4.042	3.260	2.750
0.517	3.909	3.153	2.660
0.525	3.850	3.105	2.619
0.542	3.729	3.007	2.537
0.550	3.675	2.964	2.500
0.562	3.596	2.900	2.447
0.576	3.509	2.830	2.387
0.588	3.437	2.772	2.338
0.597	3.385	2.730	2.303
0.603	3.352	2.703	2.280
0.609	3.319	2.677	2.258
0.615	3.286	2.650	2.236
0.625	3.234	2.608	2.200
0.640	3.158	2.547	2.148
0.658	3.071	2.477	2.090
0.667	3.030	2.444	2.061
0.690	2.929	2.362	1.993
0.700	2.887	2.329	1.964
0.750	2.695	2.173	1.833

APPENDIX – I

HORIZONTAL SEISMIC ACCELERATION SPECTRA COEFFICIENTS (In units of 'g')

Time Period	Damping Factor (as a percentage of critical damping)		
(Sec)	2%	3%	5%
0.755	2.677	2.159	1.821
0.800	2.526	2.038	1.719
0.850	2.378	1.918	1.618
0.900	2.246	1.811	1.528
0.950	2.127	1.716	1.447
1.000	2.021	1.630	1.375
1.050	1.925	1.552	1.310
1.100	1.837	1.482	1.250
1.150	1.757	1.417	1.196
1.200	1.684	1.358	1.146
1.250	1.617	1.304	1.100
1.300	1.555	1.254	1.058
1.350	1.497	1.207	1.019
1.400	1.444	1.164	0.982
1.450	1.394	1.124	0.948
1.500	1.347	1.087	0.917
1.550	1.304	1.052	0.887
1.600	1.263	1.019	0.859
1.650	1.225	0.988	0.833
1.700	1.189	0.959	0.809
1.750	1.155	0.931	0.786
1.800	1.123	0.906	0.764
1.850	1.092	0.881	0.743
1.900	1.064	0.858	0.724
1.950	1.036	0.836	0.705
2.000	1.011	0.815	0.688
2.050	0.986	0.795	0.671
2.100	0.962	0.776	0.655
2.150	0.940	0.758	0.640
2.200	0.919	0.741	0.625
2.250	0.898	0.724	0.611
2.300	0.879	0.709	0.598

APPENDIX – I

HORIZONTAL SEISMIC ACCELERATION SPECTRA COEFFICIENTS (In units of 'g')

Time Period	Damping Factor (as a percentage of critical damping)		
(Sec)	2%	3%	5%
2.350	0.860	0.694	0.585
2.400	0.842	0.679	0.573
2.450	0.825	0.665	0.561
2.500	0.808	0.652	0.550
2.550	0.793	0.639	0.539
2.600	0.777	0.627	0.529
2.650	0.763	0.615	0.519
2.700	0.749	0.604	0.509
2.750	0.735	0.593	0.500
2.800	0.722	0.582	0.491
2.850	0.709	0.572	0.482
2.900	0.697	0.562	0.474
2.950	0.685	0.553	0.466
3.000	0.674	0.543	0.458
3.050	0.663	0.534	0.451
3.100	0.652	0.526	0.444
3.150	0.642	0.517	0.437
3.200	0.632	0.509	0.430
3.250	0.622	0.502	0.423
3.300	0.612	0.494	0.417
3.350	0.603	0.487	0.410
3.400	0.594	0.479	0.404
3.450	0.586	0.472	0.399
3.500	0.577	0.466	0.393
3.550	0.569	0.459	0.387
3.600	0.561	0.453	0.382
3.650	0.554	0.447	0.377
3.700	0.546	0.441	0.372
3.760	0.538	0.434	0.366
3.800	0.532	0.429	0.362
3.850	0.518	0.423	0.357
3.900	0.505	0.418	0.353

APPENDIX – I

HORIZONTAL SEISMIC ACCELERATION SPECTRA COEFFICIENTS (In units of 'g')

Time Period	Damping Factor (as a percentage of critical damping)		
(Sec)	2%	3%	5%
3.950	0.492	0.413	0.348
4.000	0.480	0.408	0.344

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-D. 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 :- Manufacturer :-	Manufacturing Quality Plan Item :- Rupture Disc 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	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	For Client Use:-	**Document No.:-**
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

	S/Contactor :- Manufacturer :-	Manufacturing Quality Plan Item:- CHAIN PULLY BLOCK 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**												
->	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	**W**	V	
		Functional Test	Major	Visual	100%			IR	√	P	**W**	V	
		Load Test & Over Load Test	Major	Load Test	100%			IR	√	P	**W**	V	
		Overall Dimensions	Major	Measurement	100%			IR	√	P	**W**	V	
		Visual (After Load Test)	Major	Visual	100%	IS 3832	IS 3832	IR	√	P	**W**	V	

Manufacturer / Sub Vendor	Contractor	**LEGENDS:-**	For Client Use:-	**Document No.:-**
SIGNATURES		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

	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**												
2.1	Manifold	Dimensional & Visual	Minor	Dimensional & Visual	100%	As per Mfr's Drg.	As per Mfr's Drg.	IR	√	P	V	V	** -> DPT & Hydro - Test of Manifold to be witnessed by M/s MBPL
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	Dimensional	Major	Measurement	100%	Appr. Drawing	Appr. Drawing	IR	√	P	**W**	V	**Pressure Drop across Filter Bags & Emission Level at Filter outlet shall be checked at Site**
	$-> Pneumatic Test at 1.1 times W/Pressure	Pne. test $of Manifold in Assly.	Major	Leakage by soap solution	100%	Appr. Data Sheet	No Leakage	IR	√	P	**W**	V	
		Functional Test of Pulsing System	Major	Pulse Sequence	100%	Appr. Data sheet / Testing Procedure	Appr. Data sheet / Testing Procedure	IR	√	P	**W**	V	
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.

		LEGENDS:- Records identified by √ shall be essentially included in QA documentation. TC- Test Certificate, IR - Insp. Report	For Client Use:- **Document No.:-**
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

	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	Major	Visual	100%	IS:1239 / IS:3589 / Approved Data Sheet	IS:1239 / IS:3589 / Approved Data Sheet	IR	-	P	W*	V	* -> Random 5% of offered lot irrespective of size
		Dimensional	Major	Measurement	100%			IR	√	P	W*	W*	
		Mechanical Properties	Major	Tensile, elon-gation, Bend or Flattening	IS: 4711			IR / TC	√	P / V	V	V	
		Chemical	Major	Chemical Analysis	1 per heat			TC	√	P / V	V	V	
		Hydro Test	Major	Pressure Testing	100%			IR / TC	√	P	W *	W*	
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	Contractor	**LEGENDS:-**	For Client Use:-	**Document No.:-**
SIGNATURES		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

	S/Contactor :- Manufacturer :-	Manufacturing Quality Plan Item :- Knife Gate Valve [Manual / Pneumatic] 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	**Raw Material / Bought Out's**												
1.1	Body	Chemical & Mechanical	Major	Foundary TC	1 per Heat	Relevent IS / Appr. Drg / Data Sheet	Relevent 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**												
2.1	Body, Gate	Dimensional	Major	Measurement	100%	Mfr's Drawing	In-Process Insp. Record	-		P	V	V	**# -> Test Pressure as per Data Sheet**
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**												
3.1	Assembled Valve	Dimension	Major	Measurement	100%	Approved Drg / Data Sheet	Approved Drg / Data Sheet	IR	√	P	**W**	**W**	**BHEL / MBPL/CLIENT to Witness 10 % of Quantity.**
3.2	do	Function	Major	Operation	100%	Smooth Opertaion	Smooth Opertaion	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	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 :- 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	**Raw Material / Bought Out's**												
1.1	Casing	Chemical, Mechanical, Hardness, Surface Defect	Major	Chem. Comp. Mechanical Hardness Visual	1 per Heat 1 per Heat 1 Per Heat 100 %	Relevent IS / Appr. Drg / Data Sheet	Relevent 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 %	Relevent IS / Appr. Drg / Data Sheet / ASTM E 388 for UT	Relevent 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	**In - Process Inspection**												
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:- Name & Signature of Approving Authority with Seal
SIGNATURES			**Document No.:-**

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 :-EXPANSION BELLOW 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	**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	Dimension	Major	Measurement	100%	Approved Drg.	Approved Drg.	IR	√	P	V	V	
	** For Bellows	Soundness Of Weld of L-Seam	major	DPT **(Before & After Forming)	100%	ASTM E- 165	No Cracks/ Linear Indication	IR		P	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	Major	Measurement	100%	Approved Drg	Approved Drg	IR	√	P	**W**	**W**	
		pressure	Critical	Hydraulic	100%	EJMA D.3.2.1/ Data sheet	EJMA D.3.2.1/ Approved Drg.	IR	√	P	**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:-
		Records identified by √ shall be essentially included in QA documentation. TC- Test Certificate, IR - Insp. Report	**Document No.:-**
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 :		MANUFACTURING QUALITY PLAN					Project :					
	SAIL / TISCO		Item : MS Plates & Structures		QP No. :			BHEL Ref. :					
			Sub-System :		Rev. No. : 0 Date : Page No.: 11 of 1			Contract No.: Contractor : BHEL SUB-CONTRACTOR-					
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 :					BHEL Doc. No. PE-QP-279-166-A801					Rev. 0
			1 - BHEL / CUSTOMER 2 - VENDOR 3 - Manufacturer		P - Agency Performing the Test W - Agency Witnessing the Test V - Agency Verifying the Test								
MANUFACTURER/ SUBCONTRACTOR		**CONTRACTOR**	CR - Critical Characteristics MA - Major Characteristics MI - Minor Characteristics										
SIGNATURE								REVIEWED BY		NAME & SIGNATURE OF APPROVING AUTHORITY			

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	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	For Client Use:-	**Document. No.:**
SIGNATURES		**P->Perform, V-> Verification, W-> Witness**	Name & Signature of Approving Authority with Seal	

	S/Contactor : Mfgr:- Works:-	Manufacturing Quality Plan Item :- Pyrite Hopper QAP No. LOI Nos Contractor :- M/s BHEL	Project: 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	Major	Measurement	100%	App. Drg. / Data	App. Drg. / Data	-	-	P	-	-	
		Surface Defects		Visual	100%	Sheet / IS Standard	Sheet / IS	-	-	P	-	-	
		Physical Check		TS & Elongation	1/Heat		Standard	MTC	√	P/V	V	V	
		Chemical Check		Chemical Comp.	1/Heat			MTC	√	P/V	V	V	
1.2	Spray Nozzle	Surface Defects	Major	Visual	100%	Mfr's Drg. / IS Standard	Mfr's Drg. / IS Standard	-	-	P	-	-	
		Chemical Check		Chemical Comp.	1/Lot			MTC	√	P/V	V	V	
		Dimensions		Measurement	100%			IR	√	P	V	V	
2	**In - Process Insp.**												
2.1	Welders & Welding	WPS / PQR / WPQ	Major	Procedure / Qualification	100%	ASME sec - IX	ASME sec - IX	WPS / PQR	√	P/V	V	V	Welders to be approved by BHEL
		Welding Defects		DPT on Root run	100%	ASTM E-165	ASTM E-165	IR	√	P/V	V	V	
				DPT on Final run	10%	ASTM E-165	ASTM E-165	IR	√	P/V	**W**	**W**	
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***	* -> Witness10%
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	For Client Use:-	**Document No.:-**
SIGNATURES		**P->Perform, V-> Verification, W-> Witness**	Name & Signature of Approving Authority with Seal	

	S/Contactor :-. Mfgr:-	Manufacturing Quality Plan Item :- Terminal Box 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	Major	Measurement	100%	App. Drg. / Data	App. Drg. / Data	-	-	P	-	-	
		Surface Defects		Visual	100%	Sheet / IS Standard	Sheet / IS	-	-	P	-	-	
		Physical Check		TS & Elongation	1/Heat		Standard	MTC	√	P/V	V	V	
		Chemical Check		Chemical Comp.	1/Heat			MTC	√	P/V	V	V	
2	**In - Process Insp.**												
2.1	Welders Qualification & Welding	WPS / PQR / WPQ	Major	Procedure / Qualification	100%	ASME sec - IX	ASME sec - IX	WPS / PQR	√	P/V	V	V	Welders to be approved by BHEL / KPCL
		Welding Defects	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.:-**
SIGNATURES			Name & Signature of Approving Authority with Seal	

	S/Contactor :-. 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	Major	Measurement	100%	App. Drg. / Data	App. Drg. / Data	-	-	P	-	-	
		Surface Defects		Visual	100%	Sheet / IS Standard	Sheet / IS Standard	-	-	P	-	-	
		Physical Check		TS & Elongation	1/Heat			TC	√	P/V	V	V	
		Chemical Check		Chemical Comp.	1/Heat			TC	√	P/V	V	V	
1.2	Shaft	Physical Check	Major	TS & Elongation	1/Heat	do	do	TC	√	P/V	V	V	
		Chemical Check		Chemical Comp.	1/Heat			TC	√	P/V	V	V	
		UT If Dia > 50 mm		Internal defect	100%			IR	√	P/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	Major	Procedure / Qualification	100%	ASME sec - IX	ASME sec - IX	WPS / PQR	√	P/V	V	V	Welders to be approved by BHEL / CLIENT
		Welding Defects	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	
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	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	For Client Use:-	**Document No.:-**
SIGNATURES		**P->Perform, V-> Verification, W-> Witness**	Name & Signature of Approving Authority with Seal	

	S/Contactor :-	Manufacturing Quality Plan	Project:-
	Mfgr:-	Item :- Pressure Relief Valve	Package :- Mill Rejects System
	Works:-	QAP No. :	Client :- .
		LOI Nos:-	
		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	Major	Measurement	100%	App. Drg. / Data Sheet / IS Standard	App. Drg. / Data Sheet / IS Standard	-	-	P	-	-	
		Surface Defects		Visual	100%			-	-	P	-	-	
		Physical Check		TS & Elongation	1/Heat			MTC	√	P/V	V	V	
		Chemical Check		Chemical Comp.	1/Heat			MTC	√	P/V	V	V	
2	**In - Process Insp.**												
2.1	Welders & Welding	WPS / PQR / WPQ	Major	Procedure / Qualification	100%	ASME sec - IX	ASME sec - IX	WPS / PQR	√	P/V	V	V	Welders to be approved by BHEL / KPCL
		Welding Defects	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.:-**
SIGNATURES			Name & Signature of Approving Authority with Seal	

SECTION – IA

ANNEXURES

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	
		Crompton Greaves	Ahmednagar		
		NGEF	Bangalore		Upto 15 KW
		ABB	Bangalore/Faridabad		
		Siemens	Mumbai		
		Jyoti	Baroda		
		LHP	Solapur		
		BHEL	Bhopal		
		Bharat Electric (BHEL)			
		Bharat Bijlee	Mumbai		
		KEC	Bangalore/Hubli		
2	Air Filter/Lubricator/Regulator	SHAVONORGAN	MUMBAI/BANGLORE	III	
		PLACKA	CHENNAI		
3	Annunciator	IIC	MUMBAI	III	
		Minilec	AHEMDABAD		
		PROCON	CHENNAI		
4	Solenoid Valve	Rotex	Baroda	III	
		Avcon	Mumbai		
		Asco	Chennai		
		SMC	Noida		
		Nucon	Hyderabad		
5	Pulse Jet Valves	ASCO	CHENNAI	III	
		MANIK	PUNE		
6	Cable Lug	DOWELLS	MUMBAI	III	
		BILLET (3D)	VALSAD		
		WAGO	INDIA		
		COMETT	MUMBAI		
7	Limit Switch	BCH	NEW DELHI	III	
		SIEMENS	NEW DELHI		
		JAIBALAJI	NEWDELHI		
8	Interposing Relay	ECONIX	MUMBAI	III	
		PHEONIX	DELHI		
9	ZERO SPEED SWITCHES	JAYSHREE	PUNE	III	
		PROTOCONTROL	PUNE		
		P&F	BANGALORE		
10	JUNCTION BOX	AJMERA INDUSTRIAL & ENGINEERING WORKS	SHREE NAGESH INDL. ESTATE,STATION ROAD, MUMBAI	III	FOR GALVANIZED AND FRP JUNCTION BOXES
		FLEXPRO ELECTRICALS PVT. LTD.	GIDC, Kabilpore, Navsari-Gujarat		Metal type junction box only
		K.S.INSTRUMENTS PVT.LTD.	Industrial Suburb, Yeshwanthpur Bangalore-Karnataka		
		SUCHITRA INDUSTRIES	REJAMAHALVILAS EXTN 2ND STG BANGALORE		
		Shrenik & Company,	Panchratna Industrial Estate, Sarkhej-Bavla Road Ahmedabad-Gujarat		Registered for FRP JBs AND METAL JBs.
		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		
		Schenider	INDIA		
		Allen Bradelly	INDIA		

13	VFD	ABB	INDIA	III	
		YASKAWA	INDIA		
		Toshiba	INDIA		
		Siemens	INDIA		
14	Selectror Switch	Schenider	INDIA	III	
		Siemens	INDIA		
		L&T	INDIA		
		Kaycee	INDIA		
15	Indication Lamps, PushButton, Aux. Contactor, Aux. Relays	Schenider	INDIA	III	
		Siemens	INDIA		
		ABB	INDIA		
		L&T	INDIA		
16	Timer	BCH	INDIA	III	
		EAPL	INDIA		
17	Control Transformer, Reactors	Kappa	BANGALORE	III	
		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 & INTRUMENTS (P) LTD.	NEW DELHI-		a)DISPLACEMENT TYPE TRANSMITTERS. b)PRESSURE AND DP TRANSMITTERS

		YOKOGAWA INDIA LIMITED,	HOSUR ROAD, BANGALORE,-KARNATAKA		
21	TEMPERATURE 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		
		BUDENBERG GUAGE CO.LTD.	PO BOX-5, ALTRINCHAM CHESHIRE-UK-UK		
		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-WEST BENGAL		
		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 Techtrol	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,		
27	DC BATTERY CHARGER	AMARA RAJA POWER SYSTEMS LIMITED	TIRUPTI, ANDHRA PRADESH TRIPUTI-TAMIL NADU-INDIA Phone- +91-877-2285561 Pincode : Email : amararaja@amararaja.co.in	III	
		CHHABI ELECTRICALS PVT.LTD.	MIDC , JALGAON-MAHARASHTRA		
		CHLORIDE POWER SYSTEMS & SOLUTIONS LIMITED	GARIAHAT ROAD KOLKATA-WEST BENGAL-INDIA		
		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	Khushkhera		
		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.
		INDIA ELECTRICALS SYNDICATE	Kolkata		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.
33	Cable trays and its accessories	PARMAR METALS PVT.LTD.	RAJKOT	III	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 Bareili		
		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.
		AM-TECH ENGG.SERVICES	Pune		
		INDUSTRIAL PERFORATION (I) PVT.LTD.	Kolkata		
		INDMARK FORMTECH PVT. LTD.	Pune		WORKS ADDRESSES ARE APPLICABLE FOR MANUFACTURING AND GALVANISING.
34	CABLE TRAY SUPPORT SYSTEM -BOLTABLE	PREMIER POWER PRODUCTS (CAL) PVT. LTD.	Kolkata	III	
		RATAN PROJECTS & ENGINEERING CO. PVT.LTD.	Kolkata		Galvanizing Unit located at Phas-3, E-11/1, MIDC, Pune ,
		STEELITE ENGINEERING LTD	Mumbai		
		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 (I)	DUM DUM KOLKATA-West Bengal		
		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 (CAL) PVT	Kolkata,-West Bengal		Galvanisation to be done at its own plant or from BHEL-PEM approved
		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 , ,
35	CABLE TRAY SUPPORT SYSTEM-WELDED(GALV)	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.ROAD , BIRATI KALABAGAN KOLKATA KOLKATA-WEST		HEAT SHRINKABLE TYPE ONLY.
36	CABLE TRAY SUPPORT SYSTEM-WELDED(UNGALV)	RASHTRIYA ISPAT NIGAM LIMITED	AMBAWADI AHEMDABAD-	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	BANGALORE	II	
		SIEMENS	BANGALORE		
		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
4	Ball Valve	Precision Engg	Nasik	I	
		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
		ATAM Valves	Jalandhar		
		GM ENGINEERING	Rajkot		CAST STEEL UPTO 200 MM,CLASS 150/300.
		Hawa Valves (India) Pvt. Ltd.	Navi Mumbai		
		INTERVALVE (INDIA) LTD.	Pune		FOR CARBON STEEL/STAINLESS STEEL UPTO SIZE 200NB.
		NILON VALVES PRIVATE LIMITED	Ahmedabad		
		LEADER VALVES LTD.	Jalandhar		FORGED CARBON & ALLOY STEEL BALL VALVES ,SCREWED TYPE BALL VALVES RATING 800 , SIZES UPTO 50 & CC& ALLOY STEEL BALL VALVES RATING 150 , SIZES 65 TO 200 FLANGED TYPE.
		DEMBLA VALVES LTD.	Thane		
		SURYA VALVES AND INSTRUMENTS MFG CO.	Chennai		
		UNIFLOW	Chennai		
		VALTECH INDUSTRIES	Mumbai		
		VAAS AUTOMATION	NEW DELHI		
		Belgaum Aqua Valve	Belgaum		
5	Metallic Expansion Bellow(Metallic)	METALLIC BELLOWS	CHENNAI	II	
		Flexatherm			UPTO 20 TONNES
6	Rupture Disc	BS & B SAFETY SYSTEM	CHENNAI	II	
		ARMSEL MHE PVT. LTD	Bangalore		CAPACITY UPTO 10 TONS. BOIs BHEL APP.SUB-VENDORS.
		Alpha Services	Bhiwadi		

7	Electric Hoist	CONSOLIDATED HOISTS PVT LTD	Pune	II	
		CENTURY CRANE ENGINEERS PVT. LTD.	Faridabad		
		EDDY CRANES PVT. LTD.	Mumbai		
		Grip Engineers Pvt. Ltd.,	Faridabad		
		GLOBAL TECHNOLOGIES	Hydrabad		
		HERCULES HOISTS LTD.	Khalapur		UPTO 25.0 T CAPACITY.
		LIFTING EQUIPMENTS and ACCESSORIES	Delhi		
		Mangla Hoists Pvt Ltd	Delhi		
		MEEKA MACHINERY PVT. LTD.	Ahemdabad		UPTO 15 TONNES.
		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	Horziontal/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		
11	Fittings	M.S. Fittings	Kolkata	II	
		Metal lloyds	Mumbai		
		True Forge	Faridabad		
		Tube Products	Baroda		
		NL Hazra	Kolkata		
		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
		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 1239/3589 and SAW as per IS 3589
		TATA Tube	Jamshedpur	II	Upto 150 NB ERW Pipes as per IS 1239
		PSL	Chennai/Vizag/Kutch/Dam	I	Spiral Weld SAW as per IS 3589

12	MS/GI ERW Pipes	Lalit Profile	Thane	I	Spiral Weld SAW as per IS 3589
		Samshi Pipes Industries	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 & Structure Pv	Thane	I	Spiral Weld SAW as per IS 3589
		JCO Gas Pipe	Chindwara	I	Spiral Weld SAW as per IS 3589
		Nukat Tanks and Vessels	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/Chhatr	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		Upto 400 NB ERW Pipes as per IS 1239/3589 and SAW as per IS 3589
13	Seamless Pipes	ISMT	Ahmednagar/Baramati	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		
		SURYA VALVES AND INSTR	Chennai		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)

18	CI Gate/ Globe/NRV/SRV	FLUIDLINE VALVES COMPA	Mumbai	III	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	
		ATAM VALVES PVT. LTD.	Mumbai		GUN METAL GATE/GLOBE/NRV: 15 NB TO 50 NB (UPTO PN-16.0) & 15 NB TO 50 NB (UPTO #150)
		Leader	Jalandhar		
		VALTECH INDUSTRIES			GUN METAL SCREWED END TYPE , SCREWED IN BONNET , OUT SIDE SCREW & YOKE TPE , PN 16 , SIZES UPTO 50.
		SANT VALVES PVT. LTD.	Jalandhar		UP TO SIZE 100-NB ONLY.
20	GEAR BOX	PBL	ANAND - V.V NAGAR	III	
		SHANTHI	COIMBATORE		
		PREMIUM	PUNE		
		BONFIGLIOLI	CHENNAI		
		IC	AURANGABAD		
		FLENDER			
21	COUPLINGS	ELECON	ANAND - V.V NAGAR	III	
		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		
		Hemple Paints	Singapore		
25	PLUMMER BLOCKS	WINCO	BANGALORE	III	
		MASTA	AHMEDABAD		
		COSMO	MUMBAI		
26	TRANSIMISSION CHAIN	RENOLD	KARUR	III	
27	MAINTENANCE TOOLS BOX	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 tentative 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.

CLAUSE NO.	Mandatory Spares of MRS.

Sl. No.	Item Description	Qty	Unit
	DRAG CHAIN CONVEYORS / METALLIC CONVEYOR		
(A)	**Drag Chain Conveyors / Metallic Conveyor**		
1.	Chain link with Flight assy (if applicable)-	20	Nos each type
2.	Metallic Pan assy (Meshed with Belt) (if applicable)	01	Set each type
3.	Chain Pin & Circlip (if applicable)-	20	Nos each type
4.	Sprocket (if applicable)-	01	No each type
5.	Drive & Non-drive Pulleys (if applicable)	01	No each type
6.	Carrying and return Idler assy (if applicable)	5	Nos each type
7.	Bearings	02	Nos each type
8.	Conveyor Geared Motor/Gear Box	1	No each type
9.	Shear Pin of Conveyor (if applicable)	10	Nos each type
10.	Coupling (if applicable)	1	No each type
(B)	**Vibrating Feeder assy (if applicable)**	02	Nos
(C)	**Bucket Elevator**		
1	Chain link	10	Nos
2	Shackle	10	Nos
3	Bearings	02	Nos of each type
4	Elevator Geared Motor/Gear box	1	No
5	Coupling (If applicable)	1	No of each type
6	Buckets	5	Nos
(D)	Other Items		

Sl. No.	Item Description	Qty	Unit
	Complete assembly of Valves at Pyrite Hopper inlet, outlet, emergency outlet	02	No of each type, size and rating
	Rupture Disc	05	Nos
	Metallic Expansion Bellow	5	Nos.

ANNEXURE-III

SURFACE PREPARATION & PAINTING

1.00.00 **Specification of surface preparation & painting**

1.01.00 Surface preparation methods and paint/primer materials shall be of the type specified herein. If the contractor desires to use any paint/primer materials other than that specified, specific approval shall be obtained by the contractor in writing from the employer for using the substitute material.

1.02.00 All paints shall be delivered to job site in manufacturers sealed containers. Each container shall be labelled by the manufacturer with the manufacturer's name, type of paint, batch number and colour.

1.03.00 Unless specified otherwise, paint shall not be applied to surfaces of insulation, surfaces of stainless steel/nickel/ copper/brass/ monel/ aluminum/ hastelloy/lead/ galvanized steel items, valve stem, pump rods, shafts, gauges, bearing and contact surfaces, lined or clad surfaces.

1.04.00 All pipelines shall be Colour coded for identification as per the NTPC Colour-coding scheme, which will be furnished to the contractor during detailed engineering.

1.05.00 **SURFACE PREPARATION**

1.05.01 All surfaces to be painted shall be thoroughly cleaned of oil. Grease and other foreign material. Surfaces shall be free of moisture and contamination from chemicals and solvents.

1.05.02 The following surface preparation schemes are envisaged here. Depending upon requirement any one or a combination of these schemes may be used for surface preparation before application of primer.

SP1	Solvent cleaning
SP2	Application of rust converter (Ruskil or equivalent grade)
SP3	Power tool cleaning
SP4	Shot blasting (shot blasting shall be used as surface preparation method for hot worked pipes prior to application of primer)
SP4*	Shot blast cleaning/ abrasive blast cleaning to SA21/2 (near white metal) 35-50 microns
SP5	Shot blasting/ abrasive blasting.
SP6	Emery sheet cleaning/Manual wire brush cleaning.

1.06.00 **APPLICATION OF PRIMER/PAINT**

1.06.01 The paint/primer manufacturer's instructions covering thinning, mixing, method of application, handling and drying time shall be strictly followed and considered as part of this specification. The Dry film thickness (DFT) of primer/paint shall be as specified herein.

1.06.02 Surfaces prepared as per the surface preparation scheme indicated herein shall be applied with primer paint within 6 hours after preparation of surfaces.

1.06.03 Where primer coat has been applied in the shop, the primer coat shall be carefully examined, cleaned and spot primed with one coat of the primer before applying intermediate and finish coats. When the primer coat has not been applied in the shop, primer coat shall be applied by brushing, rolling or spraying on the same day as the surface is prepared. Primer coat shall be applied prior to intermediate and finish coats.

1.06.04 Steel surfaces that will be concealed by building walls shall be primed and finish painted before the floor is erected. Tops of structural steel members that will be covered by grating shall be primed and finish painted before the grating is permanently secured.

1.06.05 Following are the Primer/painting schemes envisaged herein:

PS3 - Zinc Chrome Primer (Alkyd base) by brush/Spray to IS104.

PS3* - Zinc Chrome primer (Alkyd base) by dip coat.

PS4 - Synthetic Enamel (long oil alkyd) to IS2932.

PS5 - Red Oxide Zinc Phosphate primer (Alkyd base) to IS 12744

PS9 - Aluminum paint to IS 2339.

PS9* - Heat resistant Aluminum paint to IS-13183 Gr.-I (for temperature 400 degC – 600 degC), IS-13183 Gr.-II (for temperature 200 degC- 400 degC and IS-13183 Gr.-III (for temperature upto 200 degC)

PS13 - Rust preventive fluid by spray, dip or brush.

PS14 - Weldable primer-Deoxaluminate or equivalent.

PS16 - High Build Epoxy CDC mastic `15'.

PS17 - Aliphatic Acrylic Polyurethane CDE134, %V=40.0(min.)

PS18 - Epoxy based TiO2 pigmented coat

PS19 - Epoxy Zinc rich primer (92% zinc in dry film (min.), %VS=35.0(min.)

PS-20 - Epoxy based finish paint

1.06.06 All weld edge preparation for site welding shall be applied with one coat of wieldable primer.

1.06.07 For internal protection of pipes/tubes, VCI pellets shall be used at both ends after sponge testing and ends capped. VCI pellets shall not be used for SS components and composite assemblies.

1.06.08 SG membrane walls and other Flue gas swept pressure part surfaces shall be applied with appropriate primer for protection of surfaces during transit, storage and erection.

1.06.09 a) All un-insulated equipments, pipes, valves etc covered in sub-section A-08 (Steam Turbine & Auxiliary system) shall be painted with paint not inferior to Epoxy resin based paints with minimum DFT of 150 micron.

The paint shall be applied in three stages i.e. primer, intermediate and finish coats in following manner:

- Primer coat – Epoxy based zinc phosphate
- Intermediate - Epoxy based TiO2 pigmented coat
- Finish coat - Epoxy based finish coat/Two pack polyurethane coat

b) Equipment, pipes etc. with high temperature shall be painted with heat resistant aluminum paint (to be selected based on the service condition of component as per IS-13183). Two coats of paint shall be applied with total DFT 40 micron.

c) Surface preparation before painting shall be carried out according to requirement indicated in this sub-section and international standard

1.06.10 A) Specification for the application of Epoxy coating for internal protection of DM tank & other vessels/tanks (as applicable) shall be as follows:

Primer : One coat of unmodified epoxy resin along with polymide hardener.

Paint : Two (2) coats unmodified epoxy resin along with Aromatic adduct

hardener.

Total thickness of primer and paint should not be less than 400 microns.

B) Specification for application of chlorinated Rubber paint for external protection vessel, tanks, piping, valves & other equipments shall be as follows:

i) For Indoor vessel, tanks, piping, valves & other equipments:

(a) Surface preparation shall be done either manually or by any other approved method.

(b) Primer coat shall consist of one coat of chlorinated rubber based zinc phosphate primer having minimum DFT of 50 microns.

(c) Intermediate coat (or under coat) shall consist of one coat of chlorinated rubber based paint pigmented with Titanium dioxide with minimum DFT of 50 microns.

(d) Top coat shall consist of one coat of chlorinated rubber paint of approved shade and colour with glossy finish and DFT of 50 microns.

Total DFT of paint system shall not be less than 150 microns.

ii) For Outdoor vessel, tanks, piping, valves & other equipments:

(a) Surface preparation shall be blast cleared using non-siliceous abrasive after usual wire brushing, which shall conform to Sa 2-1/2 Swiss Standard.

(b) Primer coat shall consist of one coat of epoxy resin based zinc phosphate primer having minimum DFT of 100 microns.

(c) Intermediate coat (or under coat) shall consist of epoxy resin based paint pigmented with Titanium dioxide with minimum DFT of 100 microns.

(d) Top coat shall consist of one coat of epoxy paint suitable pigmented of approved shade and colour with glossy finish and DFT of 75 microns. Additionally finishing coat of polyurethane of minimum DFT of 25 microns shall be provided.

The paint may be applied in one coat, in case high built paint is used, otherwise two coats shall be applied.

Total DFT shall not be less than 300 microns.

1.06.11 Primer/Painting Schedule

Sl. No	Description		Surface Preparation	Primer Coat			Intermediate Coat			Finish Coats			Total Min. Painting DFT (Microns)	Colour Shade
				Type of Primer	No. of Coats	Min. DFT / coat (Microns)	Type of coating	No. Coats	Min. DFT/ Coat (Microns)	Type of coating	No. Coats	Min. DFT/ Coat (Microns)		
A) Power Cycle Piping														As per NTPC Colour shade/ coding scheme
1.	All insulated Pipings, fittings/ components, Pipe clamps, Vessels/Tanks, Equipments etc.		SP3/SP4	PS9*	1	20	-	-	-	PS9*	1	20	40	
2.	All un-insulated Pipings, fittings/ components, Pipe clamps, Vessels/Tanks, Equipment etc.	Design temperature < or equal to 60^0C	SP3/SP4	PS 5	2	25	-	-	-	PS 4	3 **$**	35 **$**	155 **$**	
		Design temperature above 60^0C-200^0C	SP3/SP4	PS 9*	1	20	-	-	-	PS9*	1	20	40	
		Design temperature > 200^0C	SP3/SP4	PS9*	1	20	-	-	-	PS9*	1	20	40	
3	Constant Load Hanger (CLH) and Variable Load Hanger (VLH)		SP4*	PS19	1	40	-	-	-	PS17	1	30	70	
4	Piping hangers / supports (other than (3) above. (un-insulated)		SP3/SP5	PS5	2	25	-	-	-	PS4	2	25	100	

	Valves												
5.	Cast/Forged	Design temperature < or equal to 60 degC #	SP3/SP5	PS5	2	35	-	-	-	PS4	2	25	120
		Design temperature above 60 degC	SP3/SP5	PS9*	1	20	-	-	-	PS9*	1	20	40
6.	All auxiliary Structural Steel components for pipe supports	Outside TG building and in SG envelope	SP4*	Inorganic Ethyl Zinc Silicate	1	75	PS18	1	75	a) Epoxy coat b) Final coat of paint PS17	2 1	35 30	250
		Within TG building	SP4*	-do-	1	35	PS18	1	35	a) Epoxy coat b) Final coat of paint PS17	2 1	25 30	150
7.	Weld Edges		SP6 (Hand cleaning by wire brushing)	PS13 (Weldable primer)	1	25	-	-	-	-	-	-	25

1. **$ -** The first 2 finished coats (total min.DFT of 70 microns) shall be done at shop and the 3rd finish coat (min.DFT 35 Microns) shall be applied at site.
2. For valves below 65NB and temperature upto and including 540 DegC, Parkerizing/zinc phosphate corrosion resistant coating as per ASTM F1137 is also acceptable in lieu of Aluminum paint.
3. For corrosion protection of threaded hanger rods and variable spring cages, electro galvanizing in full compliance to minimum Corrosion category C3 as per EN ISO12944 is also acceptable.
4. For spring cages, 2 coats of 30 µm (min) zinc-rich epoxy resin primer with zinc content> 80 weight% in dry film followed by 2 coats of 30 µm (min) top coat of Acrylic resin Co-polymerisate with a total combined minimum DFT of 120µm is also acceptable in lieu of above specified paint scheme.
5. For corrosion protection, all inner parts of the hangers (CLH/VLH) shall be at least in full compliance to Corrosion category C3 as per EN ISO12944.
6. # - For Cast/forged valves upto & including design temperature 60Deg.C, Aluminium painting as per IS-13183 Gr-3 or better with total DFT 40Micron is also acceptable.

B) Steam Generator & Auxiliaries:

1	All surfaces with temperature 95°C or less and which are insulated	SP3/SP4	PS 5	2	30	-	-	-	PS 4	2 **$**	20 **$**	100 **$**
2	All surfaces with temperature above 95°C and which are insulated	SP3/SP4	PS9*	1	20	-	-	-	PS9*	1	20	40

Note**:** **1)** SG membrane walls and other Flue gas swept pressure part surfaces shall be applied with appropriate primer for protection of surfaces during transit, storage and erection.

2) Painting specification for all other exposed steel surfaces not covered above shall be same as that given in Civil Sub-section, Part-B, Section VI for corrosion protection of steel structures.

C) LOW PRESSURE PIPING													
1	All Piping, fittings / components, valves, Equipments etc.	SP3/SP5	PS3/ PS5	2	25	PS 4	1	30	PS 4	2	35	150	As per NTPC Color shade/ coding scheme.
2	Stainless steel surface, Galvanized steel surface and gun metal surface.	No Painting											
3	On the internal surface for pipes 1000 Nb and above	A coat of primer followed by hot coal-tar enamel or coal tar epoxy painting (cold) shall be applied.											
D) Fire Detection & Protection System, Compressed air system and Air-conditioning & Ventilation System													
For Fire Detection & Protection System, Surface preparation and painting of Fire Water Storage Tanks, all Steel Surfaces (external) exposed to atmosphere (outdoor & indoor installation), Deluge Valves, Alarm Valves, Foam monitors, Water monitors, Foam Proportioning equipments, Foam makers, etc. should be as per the Part-B, Sub Section-A-18, Fire Detection & Protection System For Air Conditioning System, Surface preparation and painting of all the steel surfaces (external) exposed to atmosphere (outdoor & indoor installation), centrifugal fans – Casing etc. should be as per the Part-B, Sub Section-A-17, Air Conditioning System. For Ventilation System, Surface preparation and painting of all the steel surfaces (external) exposed to atmosphere (outdoor & indoor installation), centrifugal fans – Casing etc. should be as per the Part-B, Sub Section-A-17, Ventilation System. For compressed air system, Surface preparation and painting of all the steel surfaces should be as per the Part-B, Sub Section--A-16 compressed air system.													
E) ESP													
1	All surfaces with surface temperature 95°C or less (with or without insulation)	SP3/SP4	PS3/ PS3*	1	25	-	-	-	PS 4	1	30	55	
2	All surfaces with surface temperature above 95°C (with or without insulation)	SP3/SP4	PS5	2	30	-	-	-	-	-	-	60	

General Notes (Applicable for all above points A to E)

i) Painting specification for all surfaces with surface temperature 95°C or less (un-insulated) that are not covered above shall be same as that given in Civil Sub-section, Part-B, Section-VI for corrosion protection of steel structures.

ii) Painting specification for inside surfaces (such as inner surfaces of ducts/ tanks/ mills/ dampers/ ESP etc.) that are not covered specifically in above clauses, shall be provided with 2 coats of suitable primer i.e. PS5/ PS9 (Total DFT 60/40 micron) based on the temperature.

F) FGD System

(i) Surface preparation shall be blast cleaned conforming *to* Sa *2-1/2* Swiss Standard.

(ii) Primer coat shall consist of epoxy resin based zinc phosphate primer having minimum DFT of 100 microns.

(iii) Intermediate coat (or under coat) shall consist of epoxy resin based paint pigmented with Titanium dioxide with minimum DFT of 100 microns.

(iv) Top coat shall consist of one coat of epoxy paint suitable pigmented of approved shade and colour with glossy finish and DFT of 75 microns. Additionally finishing coat *of* polyurethane of minimum DFT of 25 microns shall be provided.

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

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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	Primary / Secondary
1	PE-V0-508-160-A101	DESIGN PHILOSPHY AND SYSTEM SIZING CALCULATION OF MILL REJECT SYSTEM (CONVEYOR TYPE)	2	**Primary**
2	PE-V0-508-160-A102	GA drawing of Pressure relief valve for MILL REJECT SYSTEM (CONVEYOR TYPE)	4	Secondary
3	PE-V0-508-160-A103	GA of Bag Filter along with data sheet for MILL REJECT SYSTEM (CONVEYOR TYPE)	4	Secondary
4	PE-V0-508-160-A104	Electrical Load List for MILL REJECT SYSTEM (CONVEYOR TYPE)	3	Secondary
5	PE-V0-508-160-A105	Flow diagram/P&ID of MILL REJECT SYSTEM (CONVEYOR TYPE)	2	**Primary**
6	PE-V0-508-160-A106	Instrument Schedule for MILL REJECT SYSTEM (CONVEYOR TYPE)	6	Secondary
7	PE-V0-508-160-A108	PG Test Procedure for MILL REJECT SYSTEM (CONVEYOR TYPE)	12	Secondary
8	PE-V0-508-160-A109	MRHS Layout drawing including air and water piping layout	4	**Primary**
9	PE-V0-508-160-A110	Sub-vendor list along with inspection category for MILL REJECT SYSTEM (CONVEYOR TYPE)	2	**Primary**
10	PE-V0-508-160-A111	WELDING PROCEDURE SPECIFICATION for MILL REJECT SYSTEM (CONVEYOR TYPE)	4	Secondary
11	PE-V0-508-160-A112	QAP OF STRUCTURAL STEEL / PLATES for MILL REJECT SYSTEM (CONVEYOR TYPE)	4	Secondary
12	PE-V0-508-160-A113	QAP OF PYRITE HOPPER, TERMINAL BOX for MILL REJECT SYSTEM (CONVEYOR TYPE)	6	Secondary
13	PE-V0-508-160-A114	QAP OF CHAIN AND CHAIN CONVEYOR for MILL REJECT SYSTEM (CONVEYOR TYPE)	6	Secondary
14	PE-V0-508-160-A115	QAP OF BUCKET ELEVATOR for MILL REJECT SYSTEM (CONVEYOR TYPE)	6	Secondary
15	PE-V0-508-160-A116	QAP of LOCAL CONTROL PANEL for MILL REJECT SYSTEM (CONVEYOR TYPE)	6	Secondary
16	PE-V0-508-160-A117	GA drawing for Pyrite Hopper with Data Sheet and civil load data & foundation location details for MILL REJECT SYSTEM (CONVEYOR TYPE)	2	Secondary
17	PE-V0-508-160-A118	QAP OF SECTOR GATE for MILL REJECT SYSTEM (CONVEYOR TYPE)	7	Secondary
18	PE-V0-508-160-A119	QAP OF KNIFE GATE for MILL REJECT SYSTEM (CONVEYOR TYPE)	7	Secondary

19	PE-V0-508-160-A120	GA drawing of chain conveyor with Data Sheet and civil load data & foundation location details for MILL REJECT SYSTEM (CONVEYOR TYPE)	3	**Primary**
20	PE-V0-508-160-A121	QAP OF RUPTURE DISC for MILL REJECT SYSTEM (CONVEYOR TYPE)	7	Secondary
21	PE-V0-508-160-A123	QAP OF EXPANSION BELLOW for MILL REJECT SYSTEM (CONVEYOR TYPE)	7	Secondary
22	PE-V0-508-160-A124	QAP OF BAG FILTER for MILL REJECT SYSTEM (CONVEYOR TYPE)	7	Secondary
23	PE-V0-508-160-A125	GAD of Bucket elevator with DS & civil load data & foundation location details for MILL REJECT SYSTEM (CONVEYOR TYPE)	4	**Primary**
24	PE-V0-508-160-A126	QAP OF GEARED MOTOR for MILL REJECT SYSTEM (CONVEYOR TYPE)	7	Secondary
25	PE-V0-508-160-A130	QAP OF VALVES for MILL REJECT SYSTEM (CONVEYOR TYPE)	7	Secondary
26	PE-V0-508-160-A132	GA drawing for Sector Gate with Data Sheet for MILL REJECT SYSTEM (CONVEYOR TYPE)	7	Secondary
27	PE-V0-508-160-A133	QAP OF INSTRUMENTS for MILL REJECT SYSTEM (CONVEYOR TYPE)	8	Secondary
28	PE-V0-508-160-A135	GA drawing for Knife gate valve along with data sheet for MILL REJECT SYSTEM (CONVEYOR TYPE)	4	Secondary
29	PE-V0-508-160-A138	GA of Metallic Expansion Bellow with data sheet for MILL REJECT SYSTEM (CONVEYOR TYPE)	4	Secondary
30	PE-V0-508-160-A139	GA of Rupture Disc with data sheet for MILL REJECT SYSTEM (CONVEYOR TYPE)	4	Secondary
31	PE-V0-508-160-A141	Block Logic Diagram/Control Scheme of the MRHS with HMI screen for MILL REJECT SYSTEM (CONVEYOR TYPE)	8	Secondary
32	PE-V0-508-160-A142	GA and data sheet of C&I Instruments for MILL REJECT SYSTEM (CONVEYOR TYPE)	10	Secondary
33	PE-V0-508-160-A143	Data sheet of Geared Motor (For All Motors)for MILL REJECT SYSTEM (CONVEYOR TYPE)	10	Secondary
34	PE-V0-508-160-A144	Technical data sheet of cable tray for MILL REJECT SYSTEM (CONVEYOR TYPE)	12	Secondary
35	PE-V0-508-160-A146	GA & interconnection wiring details for Pyrite Hopper LCP, Drag Link Chain Conveyor, Bucket Elevator, Silo LCP. for MILL REJECT SYSTEM (CONVEYOR TYPE)	12	Secondary
36	PE-V0-508-160-A148	Painting Schedule for MILL REJECT SYSTEM (CONVEYOR TYPE)	8	Secondary
37	PE-V0-508-160-A149	Pipe and valve schedule for MILL REJECT SYSTEM (CONVEYOR TYPE)	8	Secondary
38	PE-V0-508-160-A150	Cable Schedule - Signal and Control for MILL REJECT SYSTEM (CONVEYOR TYPE)	10	Secondary
39	PE-V0-508-160-A151	O & M for MILL REJECT SYSTEM (CONVEYOR TYPE)	24	Secondary
40	PE-V0-508-160-A152	QAP OF PIPES for MILL REJECT SYSTEM (CONVEYOR TYPE)	6	Secondary

41	PE-V0-508-160-A122	GAD for Silo (G.A with tentative location) with DS and civil load data & foundation location details for MILL REJECT SYSTEM (CONVEYOR TYPE)	4	**Primary**

Electrical equipment and cable tray layout drawing, Electrical equipment GA, Cable Schedule & Cable Interconnection drawings (as applicable) shall also be submitted.

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.

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.

1. 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.
2. All the drawings and documents including general arrangement drawing, data sheet, calculation etc. to be furnished to the customer during detailed engineering stage shall include / indicate the following details for clarity w.r.t. Inspection, construction, erection and maintenance etc.:-

    a) All drawings and documents shall indicate the list of all reference drawings including general arrangement.

    b) All drawings shall include / show plan, elevation, side view, cross - section, skin section, blow - up view; all major self-manufactured and bought out items shall be labeled and included in BOQ / BOM in tabular form.

    c) Painting schedule shall also be made as a part of general arrangement drawing of each equipment / items indicating at least 3 trade names.

    d) All the drawings required to be furnished to customer during detailed engineering stage shall include technical parameters, details of paints and lubrication, hardness and BOQ / BOM in tabular form indicating all major components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.

    e) Drawings/ documents to be submitted for purchasers review/ approval shall be under Revision A, B, C… etc. while drawings /documents to be submitted thereafter for customer's approval after purchaser's approval shall be under R-0, 1, 2, 3 ….etc.

    f) Drawings and documents not covered above but required to check safety of machines/ system, shall be submitted during detailed engineering stage without any commercial implication.

    g) All drawings shall include "B.O.M" and indicate quantity, material of construction, make along with IS/BS No., Technical parameters, dimensions, hardness, machining symbol and tolerance, requirement of radiography and hydraulic tests, painting details, elevation, side view, plan, skin section and blow-up view for clarity.

    h) All drawings shall be prepared as per BHEL's title block and shall bear BHEL's drawing No.

i) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's/ Customer's/ Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.

j) Bidder to follow the following the drawing submission schedule:

k) 1st submission of drawings from date of LOI as per the submission schedule.

l) Every revised submission incorporating comments – within 7 days.

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

n) BHEL /Customer Comment/Approval on subsequent revision shall be provided within 18 days of vendor's submission.

o) Primary documents shall be treated as basic Engineering documents for contractual purpose.

ANNEXURE-VI

FUNCTIONAL GUARANTEES

FUNCTIONAL GUARANTEES, LIQUIDATED DAMAGES FOR SHORTFALL IN PERFORMANCE AND GUARANTEE TESTS

The term "Performance Guarantees" wherever appears in this Sub-Section shall have the same meaning and shall be synonymous to "Functional Guarantees". Similarly the term "Performance Tests" wherever appears in this Sub-Section shall have the same meaning and shall be synonymous to "Guarantee Test(s)".

The term “BMCR” (Boiler Maximum Continuous Rating) appearing in the Technical Specification shall mean the maximum continuous steam output of Steam Generator (as defined Cl. No. 1.02.00 Sub-section A-01, Part-B) at super heater outlet at rated parameters.

The term “TMCR” (Turbine maximum continuous rating) appearing in the technical specification shall mean 800 MW electrical power output at generator terminals (power at generator terminals as per clause indicated in this sub-section) under rated steam parameters, 0% cycle make-up and 77 mmHg (abs) condenser pressure unless used in conjunction with a different cycle make-up and/or a different condenser pressure and /or a different throttle steam pressure.

1.00.00 **PERFORMANCE GUARANTEES**

1.00.01 **General Requirements**

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

b) The guaranteed performance parameters indicated/furnished by the bidder in his offer, shall be without any tolerance values whatsoever and all margins required for instrument inaccuracies and other uncertainties shall be deemed to have been included in the guaranteed figures.

c) The Contractor shall conduct performance test and demonstrate all the guarantees covered herein, during performance guarantee/acceptance test. The various tests which are to be carried out during performance guarantee/acceptance test are listed in this Sub-section. The guarantee tests shall be conducted by the Contractor at site in presence of Employer on each unit individually.

d) All costs associated with the tests including cost associated with the supply, calibration shall be included in the bid price.

e) It is the responsibility of the contractor to perform the Performance Guarantee/ Acceptance test as specified in this subsection. At all times during the Performance Tests the emissions and effluents from the Plant shall not exceed the Guaranteed Emission and Effluent Limits.

f) The Contractor shall make the plant ready for the performance guarantee tests before start of Initial Operation.

All CAT-1 Performance Guarantee tests shall be conducted along with initial operation except following

a) Coal Pulverisor Wear Parts Warranty
b) Particulate Emission/ESP Efficiency, FGD.
c) Auxiliary power consumption for Station Auxiliaries (PG Test for Station Auxiliary Power Consumption to be done along with unit#2 initial operation)
d) "PG test of Cooling Tower (IDCT) shall be carried out by the contractor within one year of successful completion of trial operation of the cooling tower and at a time when the atmospheric conditions are within limits of deviation from the design conditions as specified, preferably in the period from May to September. If Unit

trial operation falls in these months then PG test of IDCT can be clubbed with Unit trial operation.

e) PG test of A/C System (for aux. power consumption under station auxiliaries) shall be carried out by the contractor within one year of successful completion of trial operation of the respective A/C system during summer in the months of May-August. If unit#2 trial operation falls in these months then PG test of A/C system can be clubbed with unit#2 trial operation.

g) Instruments for PG test and instruments for process control of similar applications are envisaged to be of same make and model having same accuracy level. However, instruments for PG test are also acceptable as per standard and proven practice of the contractor/OEM and in such case, instruments for process control shall be as per requirements specified in Part-B of technical specifications. Instruments to be used for PG test shall be additionally supplied over and above the instruments shown in tender P&IDs. PG test equipment being supplied, installed and commissioned for each unit, shall be retained by employer after completion of PG test.

Control system loop tuning required to limit the variation of parameters during performance guarantee testing shall be completed prior to PG Test / initial operation.

All PG test process parameters shall be made available in DDCMIS.

h) Tools and tackles, instruments/devices including flow devices, matching flanges, impulse piping & valves etc. and any special equipment, required for the successful completion of the tests, shall be provided by the contractor free of cost.

i) The Performance / Acceptance test shall be carried out as per the standard procedure included in the specification. For some of the PG tests, standard PG test procedures have not been included in the specification. PG test procedure for such PG tests shall be submitted, as per latest International codes / standard meeting the specification requirements along with sample calculations & detailed activity plan of preparation (including test instrumentation), conductance and evaluation of Guarantees, within 90 days of the date of Notification of Award and finalization of the PG test procedure shall be done within 180 days from the date of Notification of Award.

1. For Cat-I Performance / Acceptance tests to be conducted along with the initial operation: After the conductance of Performance test, the test results shall be calculated in Contractor's PG test program/ software. The correction curves shall be fed/inbuilt in the PG test program/ software. Provision of manual entry of offline data which cannot be captured online (such as Relative humidity, atmospheric pressure, Coal analysis, Unburnt carbon in fly ash and bottom ash, Bottom ash / fly ash collection at various hoppers, Flue gas analysis (grid result) etc.) and necessary for calculation of PG Test result shall also be provided. The contractor shall submit the detailed test evaluation report of Performance test results to Employer promptly but not later than 7 days from the date of conductance of Performance test.

2. For Performance / Acceptance tests other than those identified at 1 above: After the conductance of Performance test, the contractor shall submit the test evaluation report of Performance test results to Employer promptly but not later than 7 (seven) days from the date of conductance of Performance test. However, preliminary test reports shall be submitted to the Employer after completing each test run.

j) The contractor shall submit for Employer's approval the detailed Performance Test procedure (except for the guarantee tests for which the standard PG test procedure is identified in technical specification) containing the following:

i. Object of the test.
ii. Various guaranteed parameters & tests as per contract.
iii. Method of conductance of test and test code.
iv. Duration of test, frequency of readings & number of test runs.
v. Method of calculation.
vi. Correction curves and respective equations for graphs to be fed for the online computation.
vii. Instrument list consisting of range, accuracy, least count, and location of instruments along with reference approved P&IDs.
viii. Scheme showing measurement points.
ix. Sample calculation.
x. Acceptance criteria.
xi. Any other information required for conducting the test.

k) In case during performance guarantee tests 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 at no extra cost to the Employer and re-conduct the performance guarantee test(s) with Employer's consent. However, if the specified performance guarantee(s) are still not met even after the above modifications/replacements within ninety (90) days or a reasonable period allowed by the Employer, after the tests have been completed Employer will have the right to the following:

i) For Category-I Guarantees

Accept the equipment/system/plant after levying Liquidated Damages as specified hereunder. The liquidated damages, for shortfall in performance indicated in clause 1.01.02 for this sub-section are on per unit basis and shall be levied separately for each unit, except for the rate indicated for auxiliary power consumption for station auxiliaries which is on station basis. The liquidated damages shall be prorated for the fractional parts of the deficiencies. The performance guarantees coming under this category shall be called 'Category - I' Guarantees.

ii) For Category-II Guarantees

In case the performance guarantee(s) are not met by the Contractor during demonstration test, the Contractor shall carry out all necessary modifications and/or replacements to comply with the guaranteed requirements at no extra cost to the Employer and re-conduct the performance guarantee test(s) with Employer's consent.

If, however, the demonstrated guarantee(s) are not met even after the above modifications / replacements within ninety (90) days, it will be concluded that, the equipment has failed to meet the guarantee(s).

In such a case, Employer shall Reject the equipment/plant/system and recover from the Contractor the payments already made. The performance guarantees under this category shall be called 'Category - II ' Guarantees. Conformance to the performance requirements under Category -II is mandatory.

iii) For Category-III Guarantees

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 the EMPLOYER. Such damages shall, however be limited to the cost of replacement of the equipment(s) / system(s) replacement of which shall remove the deficiency so as to achieve the guarantee performance. These parameters/capacities shall be termed as category - III, guarantees.

1.01.00 **GUARANTEES UNDER CATEGORY - I**

1.01.01 The performance guarantees which attract liquidated damages (LD) are as follows:

i) Unit Heat Rate at 100% TMCR load

Guaranteed Unit Heat rate in kcal/kWhr under rated steam conditions at 77 mmHg(abs) condenser pressure with zero make up at 800 MW load (i.e. 100% of rated load).

ii) Unit Heat Rate at 55% TMCR load

Guaranteed Unit Heat rate in kcal/kWhr under turbine throttle main steam pressure of 150 Kg/cm2 (abs) and rated Main Steam and Reheat Steam temperature at 77 mmHg(abs) condenser pressure with zero make up at 440 MW load (i.e. 55 % of rated load).

iii) TG Output

Continuous TG output of 840 MW unit load (i.e. 105% of rated load) under rated steam conditions at **77 mm Hg (abs) condenser pressure** with **zero** make-up.

iv) Average Condenser Pressure

Average Condenser pressure in mm Hg (abs) measured at 300 mm above the top row of condenser tubes with 840 MW output, 0% make up, design CW temperature and design CW flow.

Note: (a) The condenser pressure measurement while conducting the guarantee tests from (i) to (iv) above shall be measured at 300 mm above the top row of condenser tubes.

v) Steam Generating Capacity

Steam generating capacity in T/hr of steam at rated steam parameters at superheater outlet & rated steam temperature at reheater outlet (with any combination of mills working as per Employer's discretion) with the coal being fired from within the range specified in the table at **Annexure-IV-2,** Sub section I-B (Project information), Part A, Section VI .

vi) Coal Pulveriser Wear Parts Warranty

Life of coal pulveriser wear parts, in hours of operation, for the entire range of coal characteristics specified. (To be demonstrated as per clause 1.01.04 of this sub-section).

vii) Particulate Emission/ ESP Efficiency

Contractor shall guarantee that the particulate emission from ESP(s) shall not be more than 17 mg/ Nm^3 under guarantee point (refer clause no. 1.05.20 related to ESP sizing criteria Sub-Section–A-01, Part-B(Mechanical), Section-VI) condition at 100 %TMCR i.e. at 800 MW unit load with design coal firing. The corresponding ESP efficiency shall be worked out as per the procedure outlined in clause 1.01.06 of this Sub-section.

viii) FGD SO_2 Removal Efficiency

SO_2 removal efficiency to achieve SO_2 emission in the Chimney to less than 60 mg

per Nm^3 as per Part-B, Sub-section-A-02.

ix) Limestone Consumption Rate

Limestone consumption of FGD system in kg/hr under guarantee point conditions (refer clause no. 1.05.21.01 related to FGD sizing criteria, Sub-Section–A-01, Part-B (Mechanical), Section-VI)) shall be demonstrated.

Note:

Bids with lime stone consumption higher than 9440 kg/hr shall not be accepted and no evaluation credit shall be given for lower consumption rate.

x) Unit Auxiliary Power Consumption

Unit auxiliary power consumption comprising of all Unit Auxiliaries shall be guaranteed in line with the requirements stipulated in clause 1.01.07.01 of this sub section. Power consumption of all unit auxiliaries shall be taken for continuous unit operation at 800 MW (i.e. 100% rated load) under rated steam conditions and at condenser pressure of 77 mm Hg (abs) with 0% make-up with design coal.

xi) Auxiliary Power Consumption for Station Auxiliaries

Station auxiliary power consumption comprising of all station Auxiliaries required for continuous station operation at 2 x 800 MW (i.e. 100% rated load of all the units) under rated steam conditions and at condenser pressure of 77 mm Hg (abs) with 0% make-up with design coal shall be guaranteed in line with the requirements stipulated in clause 1.01.07.02 of this sub section.

Notes:

(a) Power consumption of each of the pump/fan/compressors/ Conveyors etc. wherever mentioned shall be measured with its own drive at the switchgear end.

xii) Cooling Tower

The cold-water temperature of 32 deg C shall be guaranteed for the design conditions of CW flow, range, ambient WBT and RH as per the performance test procedure of cooling tower elaborated elsewhere in the specification.

"Predicted cold water temperature" shall be arrived from the guaranteed cold-water temperature by correcting the same for the test conditions of range, ambient conditions and circulating water flow using the performance curves furnished by the contractor. In case the "Test cold water temperature" is higher than the "Predicted cold water temperature", Employer reserves the right to accept the tower after assessing the liquidated damages. The liquidated damages for shortfall in cold water temperature shall be worked out for all the cooling towers as per relevant clause & sub-section.

xiii) LD for 0.1% increase in APH Leakage against the shortfall (as per part-B guarantee condition description).

1.01.02 **AMOUNT OF LIQUIDATED DAMAGES APPLICABLE FOR CATEGORY-I GUARANTEES**

If the performance guarantee(s) are not met by the Contractor during PG Test, it will be concluded that, the equipment has failed to meet the guarantee(s) and action shall be taken as per the Contract Requirement. If the performance guarantee(s) specified at clause 1.01.01 are not met by the Contractor even after the modifications and/or replacements mentioned at clause 1.00.01 of this Sub-section, Employer will accept the equipment/system only after levying liquidated damages against the Contractor, at the rates listed herein, and such liquidated damages shall be deducted from the Contract Price:

S. No	Guarantee	Rate of Liquidated Damages (LD)	Limiting Value
(i)	For Increase in the Guaranteed unit heat rate in kcal/kWhr at 800 MW under rated steam conditions at 77 mmHg(abs) condenser pressure with zero make up	**US $ 605658** (US Dollar Six Lakh Five Thousand Six Hundred Fifty Eight only) per 1 kcal/kwhr increase in unit heat rate	Not more than 2081 kcal/kwhr
(ii)	For Increase in the Guaranteed unit Heat rate in kcal/kWhr under turbine throttle main steam pressure of 150 kg/cm2 (abs) and rated Main Steam and Reheat Steam temperature at 77 mmHg(abs) condenser pressure with zero make up at 440 MW load (i.e. 55 % of rated load).	**US $ 222075** (US Dollar Two Lakh Twenty Two Thousand Seventy Five only) per 1 kcal/kwhr increase in unit heat rate	Not more than 2185 kcal/kwhr
(iii)	For deficiency in Continuous TG output of 840 MW unit load (i.e. 105% of rated load) under rated steam conditions, 77 mmHg (abs) condenser pressure with 0% make-up.	**US $ 1569** (US Dollar One Thousand Five Hundred Sixty Nine only) per 1 kW shortfall in TG output	
(iv)	For deficiency in Average Condenser Pressure in mm Hg(abs) measured at 300mm above top row of condenser tube at 840 MW, 0% makeup, design CW temperature and design CW flow	**US $ 6,75,915** (US Dollar Six Lakh Seventy Five Thousand Nine Hundred Fifteen only) per 1 mm Hg increase in condenser pressure	Not more than 65 mmHg (abs)
(v)	**Steam Generator Capacity** For shortfall in the guaranteed steam generating capacity in T/h at rated steam parameters at superheater outlet & rated steam temperature at reheater outlet (with any combination of mills working as per Employer's choice) with the coal being fired from within the range specified	**US $ 2,04,387** (US Dollar Two Lakh Four Thousand Three Hundred Eighty Seven only) for every 1 T/hr short fall in steam output	Not less than 102% of the turbine VWO steam flow requirement

S. No	Guarantee	Rate of Liquidated Damages (LD)	Limiting Value
(vi)	**Coal Pulveriser Wear Parts Warranty** Life of Coal Pulveriser wear parts in hours of operation	To be calculated as per clause 1.01.04 of the Functional Guarantees subsection	Not less than 8000 hours
(vii)	**ESP Efficiency** For shortfall in guaranteed ESP efficiency in percentage points under conditions specified at clause 1.01.01 (vii) of this sub section	**US $ 14,75,463** (US Dollar Fourteen Lakh Seventy Five Thousand Four Hundred Sixty Three only) for every 0.01% point shortfall in ESP Efficiency	Not less than as worked out to limit ODB to 17 mg/Nm^3 (max.) at ESP outlet before FGD inlet.
(viii)	**FGD SO2 Removal Efficiency** For shortfall in guaranteed SO2 removal efficiency in percentage points under condition stipulated in clause 1.01.01 (viii) of this Sub Section of Technical Specification	**US $ 31,352** (US Dollar Thirty One Thousand Three Hundred Fifty Two only) for every 0.1% point shortfall in SO2 removal efficiency	SO_2 removal efficiency to achieve SO_2 emission in the Chimney to less than 60 mg per Nm^3 as per Part-B, Sub-section-A-01
(ix)	**Limestone Consumption Rate** For increase in guaranteed limestone consumption of FGD system in kg/hr/unit under condition stipulated in clause 1.01.01 (ix) of this Sub Section of Technical Specification	**US $ 3,74,272** (US Dollar Three Lakh Seventy Four Thousand Two Hundred Seventy Two only) for every 100 kg/hr increase in limestone consumption rate	Not more than **8700** kg/hr.
(x)	For increase in the Unit Auxiliary power consumption in kW for unit auxiliaries required for continuous unit operation at 100% TMCR i.e. 800 MW unit load.	**US $ 4642** (US Dollar Four Thousand Six Hundred Forty Two only) per 1 kW increase in Unit Auxiliary Power Consumption.	Not more than **42000** KW
(xi)	For increase in Station auxiliary power consumption comprising of all station Auxiliaries required for continuous station operation at 2 x 800 MW (i.e. 100% rated load of all the units).	**US $ 4642** (US Dollar Four Thousand Six Hundred Forty Two only) per 1 kW increase in Station Auxiliary Power	Not more than **20500** KW

S. No	Guarantee	Rate of Liquidated Damages (LD)	Limiting Value
		Consumption.	
(xii)	Per Cooling Tower - For every 0.2 deg. C rise in Cold Water Temperature from the guaranteed value	**US $ 7,55,054** (US Dollar Seven Lakh Fifty Five Thousand Fifty Four only) per for every 0.2 deg C rise in cold water temperature	
(xiii)	LD for 0.1% increase in APH Leakage (as per part-B guarantee condition description)	**US $ 1,40,660** (US Dollar One Lakh Forty Thousand Six Hundred Sixty only) for every 0.1% point increase from the guaranteed or specified value (whichever is lower).	The specified value

NOTE:

i) Each of the liquidated damages specified above shall be independent and these liquidated damages shall be levied concurrently as applicable.

ii) If the contract currency is other than US dollars, then the liquidated damages shall be in equivalent amount in contract currency based on Bill selling exchange rate of State Bank of India prevailing on the date of award of contract.

iii) All these liquidated damages for short fall in performance shall be deducted from the contract price as detailed in accompanying General Conditions of Contract (GCC)/ Special Conditions of Contract (SCC).

iv) Contractor's aggregate liability to pay liquidated damages for failure to attain the functional guarantee shall not exceed Fifteen percent (15%) of the Contract Price.

v) The LD values are applicable on per unit basis except for the value indicated for auxiliary power consumption for station auxiliaries, which is on station basis. The liquidated damages shall be prorated for the fractional parts of the deficiencies.

vi) Bidder not confirming about meeting the limiting values as specified for various guarantees shall not be considered and their bids shall be rejected.

1.01.03 **UNIT HEAT RATE**

Following tests for Turbine Cycle Heat Rate and Efficiency of Steam Generator shall be conducted simultaneously but independently:

a) Power consumption of ESP will be measured pass wise and for one pass (Say ESP-A) at a time with the help of energy meter in ESP MCC.

b) Energy meter reading will be taken before starting the collection efficiency test and after completion of collection efficiency test.

c) Before starting collection efficiency test, switch off all the TR sets, all hopper heaters, all insulator heaters/pent house fans (if applicable) and rapping systems serving to one pass (ESP-A) temporally and note down energy meter readings for period t1 i.e. E1. The power consumption shall be W2=E2/t1.

d) During the collection efficiency test the total energy fed in to ESP MCC of one pass (say ESP-A) will be measured during entire period of collection efficiency test i.e. E2. Total time period (t2) of test shall be noted. The power consumption shall be W2=E2/t2. During the test all hopper heaters of all ESP passes will be in ON condition and set point temperature shall be kept 5 degree Celsius above the flue gas temperature.

e) Measured power consumption for one ESP pass (say ESP-A)=(W2-W1)

f) Measured Electrostatic Precipitator power of one unit= Power of (ESP-A + ESP-B + ESP-C + ESP-D + ESP-E + ESP-F)

5. Guaranteed Unit Auxiliary Power Consumption of FGD system shall be taken by considering the additional pressure drop in the FGD system during FGD SO2 removal efficiency test at specified guarantee point conditions. For this purpose, difference of FGD system pressure drop during FGD SO2 removal efficiency test and that at Unit Auxiliary Power Consumption test shall be loaded as additional Auxiliary Power Consumption.

6. Generation from roof top solar during the test period shall be added to the total measured power consumption.

1.01.07.02 **Station Auxiliary Power Consumption**

The station auxiliary power consumption shall be calculated using the following relationship with design coal.

$P_{Stn} = Pau_{Stn} + T_{L-Stn}$

$Pau_{Stn} = SUM (P_i \times D_i)$

Where,

P_{Stn} = Power consumed by the station auxiliaries

Pau_{Stn} = Total Power Consumption, while running at 100% design load for all the auxiliaries of the station supplied by bidder.

P_i = Power consumed by each station auxiliary.

D_i = Duty factor to be considered for each station auxiliary.

T_{L-Stn} = Transformer Losses of the station transformers and that of any other transformer associated with station auxiliary power supply system (excluding those included in Unit system like GT, UT, UAT,UST etc.) and shunt reactor supplied by the bidder for meeting the station auxiliary power supply shall be included based on work test report.

Losses of transformers shall be considered based on the works test reports as per the criteria specified under Clause 1.01.07.02 (h) under the subheading Transformers.

While guaranteeing the station auxiliary power consumption the bidder shall necessarily include all the station auxiliaries running at full load with duty factors as have been defined at the ensuing para of this chapter.

The station auxiliaries that shall be running during the guarantee test for calculating **" Pau. Stn "** shall include but not be limited to the following:

(Where duty factor is not indicated the same is to be considered as 1.0)

a) Plant & Instrument air compressors & Air drying plant

Power consumption of:-

i)	Instrument Air compressor	3 Nos.	Duty Factor =0.6
ii)	Plant Air compressor	2 Nos.	Duty Factor = 0.33
iii)	Air Drying plant (Heaters) (if applicable)	3 Nos.	Duty Factor =0.5
iv)	Air Drying plant (Blowers) (if applicable)	3 Nos.	Duty Factor = 1.0

Power consumption at rated duty point for compressors to be arrived based on shop test and power consumption at rated duty point for Air Drying plant to be arrived based on site test.

b) Air Conditioning & Ventilation System

Power consumption at motor input terminals of working units (i.e. excluding stand-by) at its rated duty point of Chilling machines, Chilled water Pumps, Condenser water Pumps, Air handling unit (AHU) fans, for the Air conditioning system of main plant building, FGD control room, ESP control room of each units, AHP control room. Power consumption at motor input terminals of working units (i.e. excluding stand-by) at its rated duty point of compressor and condenser fans of air cooled condensing unit, Air handling unit (AHU) fans for the Air conditioning system of water system control building, switchyard control building, office area in control tower.

Power consumption at rated duty point for water cooled chillers & air cooled condensing units shall be based on site test and for other drives like chilled water pumps, Condenser water Pumps & AHU/centrifugal fans shall be based on shop test.

(Duty factor for power consumption of A/C equipments of office area in control tower shall be 0.5)

c) FGD System

i. Not Used

ii. Vacuum Belt Filter, Vacuum Pump and its integral auxiliaries

iii. Booster water pump

iv. Waste water pump

v. Filtrate Pump(s)

vi. Belt Filter Wash Water Pump

vii. Hydro-cyclone Waste Water Sump Pump and Waste Water Pump

viii. all other continuous running Agitators

d) Auxiliary Water System Pumps (Working Pumps)

i. Makeup (Clarified water) water pump (if applicable)

ii. AC & Ventilation make-up pumps

	(ii) Fly ash conveying vacuum pumps	1.0
9.	Transport air compressor with air drying plant (ADP)	1.0
12.	Coarse ash slurry transportation pumps	0.1875 for intermittent system & 1.0 for continuous system
13.	Transport air compressor with air drying plant (ADP) for classification system	0.40

f) **Mill Reject System**

Mill reject mechanical type Conveying system: Duty Factor 1.0

g) **Coal & Biomass Handling plant, Gypsum handling plant**

i. Total power consumption for all the equipments including auxiliaries with single stream operation at its guaranteed capacity for:

ii. Coal flow path (Direct stream) and one no. stacker-reclaimer, one no of yard conveyor (maximum of stacking / reclaiming modes)

iii. Biomass flow path

iv. Gypsum flow path

Except following.

- Lighting
- Hoists
- Coal sampling unit
- Sump Pumps
- Elevators
- DS, DE, Ventilation, SW System, Potable water system.

Duty factor for coal and Biomass handling plant shall be 0.5.

GUARANTEES UNDER CATEGORY - II

1.02.00 **Noise**

All the plant, equipment and systems covered under this specification shall perform continuously without exceeding the noise level over the entire range of output and operating frequency specified in General Technical Requirement, Part-C Section-VI of the technical specifications.

Noise level measurement shall be carried out using applicable and internationally acceptable standards. The measurement shall be carried out with a calibrated integrating sound level meter meeting the requirement of IEC 61672-1 & 2 (latest edition)

Sound pressure shall be measured all around the equipment at a distance of 1.0 m horizontally from the nearest surface of any equipment/ machine and at a height of 1.5 m above the floor level in elevation.

A minimum of 6 points around each equipment shall be covered for measurement. Additional measurement points shall be considered based on the applicable standards and the size of the equipment. The measurement shall be done with slow response on the A - weighting scale. The average of A-weighted sound pressure level measurements expressed in decibels to a reference of 0.0002 micro bar shall not exceed the guaranteed value. Corrections for background noise shall be considered in line with the applicable standards. All the necessary data for determining these corrections, in line with the applicable standards, shall be collected during the tests.

GUARANTEES UNDER CATEGORY – III

1.03.00 The parameters/capabilities to be demonstrated for various systems/ equipments shall include but not be limited to the following:

1.03.01 Not used

1.03.02 **Steam Generator and Auxiliaries**

Category-III Guarantees of this sub-section for various systems/ equipment for steam generator and auxiliaries shall be based on and demonstrated corresponding to ambient air condition of 27 deg. C temperature & 60% RH.

Mill Reject System - Continuous effective discharge and conveying at the rated capacity of the mill rejects without spillage , in the system.

APPENDIX-II

PREREQUISITES TO GUARANTEE TESTS TO BE ENSURED BY CONTRACTOR

1. Deputation of team to site to associate with the Guarantee tests,
2. Calibration of belt weigher scales and accuracy of same to be demonstrated to NTPC.
3. Arrangement of wattmeters / energymeters calibrated and sealed from approved Govt. test house or NTPC site laboratory. Arrangement of any other instrument/ accessory for the test.
4. Proper adjustment of skirt boards and belt cleaners prior to the start of tests.
5. Arrangement of calibrated equipments for measurement of vibration & noise levels.
6. Protection Relays of LT/HT switchgears and all motor feeders shall be checked.
7. Belt protection switches, local push buttons, hooters, brakes/rail clamps to be in working order.
8. Free rotation of idlers and pulleys.
9. Protection relays of LT/HT switchgears and all motors/transformer feeders to be checked.
10. Sufficient illumination.

ANNEXURE – IIA

FORMAT FOR SUBMISSION OF GUARANTEE TEST PROCEDURE

Clause No. as per LOA/ Tech. Specs.	Provision of LOA / Tech. Specs.	Name and Methodology of Test proposed by Vendor	NTPC comments on the tests proposed by vendor

APPENDIX-IV

GUARANTEE TEST PROFORMA

POWER MEASUREMENT

Project :

Package :

Date :

1. Equipment/Stream Composition :
2. Motor Description :
3. Sr. No. of meters used :
4. Date of Calibration of instrument and name of test house :
5. Multiplying factor (M.F.) of the wattmeter :
6. Wattmeter Readings (to be taken at 1 minute intervals) :

Sl. No.	Measurement Terminal Location	Time	Voltage (Volts)	Current (amps)	kw Reading M.F.		Total (W1+W2) MF kw	Remarks
					W1	W2		

APPENDIX-IV

7. **Energy meter Readings**

Sl.	Equip-Ment	Time Duration		Energy meter Readings kwHr		Equipment kw (R2-R1)/ (t2-t1)	Remarks
		Initial	Final	Initial	Final		

*Reason and duration for system trip/stop may be recorded in remarks column.

NTPC **Contractor**

APPENDIX-V

GUARANTEE TEST PROFORMA

VIBRATION LEVEL MEASUREMENTS

Project :

Package :

Date :

Time :

Details of vibration Level Meter

1. Make

2. Model & Sl.No.

3. Date of calibration with name of Test House

Sl.No.	Equipment	Pick *Point	Vibration level Amplitude/Velocity		
			Horizontal Micron/ mm/ sec.	Vertical micron/ mm/sec.	Axial Micron / mm/sec.

* Reading shall be taken at all the bearings of motor, gear box and driven equipment. In case of conveyor galleries, vibrations shall be measured at min. three locations, at midpoint of stringer between two short supports.

NTPC **Contractor**

APPENDIX-VI

GUARANTEE TEST PROFORMA

NOISE LEVEL MEASUREMENT

Project :

Package :

Date :

Details of Sound Level Meter

1. Make
2. Model
3. Date of calibration with name of Test House

Sl.No	Equipment with location	Equipment load/capacity	Measurement* point no.	Sound level dBA.	Remarks

NTPC **Contractor**

* For each equipment location, a Projected Plan Diagram shall be made and the location of measurement points shall be identified.

NTPC Limited

(A Government of India Enterprise)

LARA SUPER THERMAL POWER PROJECT
STAGE - II (2x800MW)

PART - C

GENERAL TECHNICAL REQUIREMENTS

SECTION – VI

TECHNICAL SPECIFICATION

FOR

EPC PACKAGE

BIDDING DOCUMENT NO.: CS-9587-001R-2

PART - C

GENERAL TECHNICAL REQUIREMENTS

1.00.00 **INTRODUCTION**

This part covers technical requirements which will form an integral part of the Contract. The following provisions shall supplement all the detailed technical specifications and requirements brought out in Section-VI, the Technical Specification and the Technical Data Sheets.

2.00.00 **BRAND NAME**

Whenever a material or article is specified or described by the name of a particular brand, manufacturer or vendor, the specific item mentioned shall be understood to be indicative of the function and quality desired, and not restrictive; other manufacturer's products may be considered provided sufficient information is furnished to enable the Employer to determine that the products proposed are equivalent to those named.

3.00.00 **BASE OFFER & ALTERNATE PROPOSALS**

The Bidder's proposal shall be based upon the use of equipment and material complying fully with the requirements specified herein. It is recognized that the Contractor may have standardized on the use of certain components, materials, processes or procedures different than those specified herein. Alternate proposals offering similar equipment based on the manufacturer's standard practice will also be considered, provided the base offer is in line with technical specifications and such proposals meet the specified design standards and performance requirement and are acceptable to the Employer. Sufficient amount of information for justifying such proposals shall be furnished to Employer alongwith the bid to enable the Employer to determine the acceptability of these proposals.

4.00.00 **COMPLETENESS OF FACILITIES**

4.01.00 Bidders may note that this is a EPC Package contract. Each of the plant shall be engineered and designed in accordance with the specification requirement. All engineering and associated services are required to ensure a completely engineered plant shall be provided.

4.02.00 All equipments furnished by the Contractor shall be complete in every respect, with all mountings, fittings, fixtures and standard accessories normally provided with such equipment and/or those needed for erection, completion and safe operation of the equipment and for the safety of the operating personnel, as required by applicable codes, though they may not have been specifically detailed in the respective specifications, unless included in the list of exclusions.

All same standard components/ parts of same equipment provided, shall be interchangeable with one another.

4.03.00 For the C&I systems, the Contractor shall be required to provide regular information about future upgrades and migration paths to the Employer.

5.00.00 **CODES & STANDARDS**

5.01.00 In addition to the codes and standards specifically mentioned in the relevant technical specifications for the equipment / plant / system, all equipment parts, systems and works covered under this specification shall comply with all currently applicable statutory regulations and safety codes of the Republic of India as well as of the locality where they will be installed, including the following :

a) Indian Electricity Act

b) Indian Electricity Rules

c) Indian Explosives Act

d) Indian Factories Act and State Factories Act

e) Indian Boiler Regulations (IBR)

f) Regulations of the Central Pollution Control Board, India

g) Regulations of the Ministry of Environment & Forest (MoEF), Government of India

h) Pollution Control Regulations of Department of Environment, Government of India

i) State Pollution Control Board.

(j) Rules for Electrical installation by Tariff Advisory Committee (TAC).

(k) Building and other construction workers (Regulation of Employment and Conditions of services) Act, 1996

(l) Building and other construction workers (Regulation of Employment and Conditions of services) Central Rules, 1998

(m) Explosive Rules, 1983

(n) Petroleum Act, 1984

(o) Petroleum Rules, 1976,

(p) Gas Cylinder Rules, 1981

	(q) Static and Mobile Pressure Vessels (Unified) Rules, 1981 (r) Workmen's Compensation Act, 1923 (s) Workmen's Compensation Rules, 1924 (t) NTPC Safety Rules for Construction and Erection (u) NTPC Safety Policy (v) Any other statutory codes / standards / regulations, as may be applicable.
5.02.00	Unless covered otherwise in the specifications, the latest editions (as applicable as on the date of bid opening), of the codes and standards given below shall also apply: a) Bureau of Indian standards (BIS) b) Japanese Industrial Standards (JIS) c) American National Standards Institute (ANSI) d) American Society of Testing and Materials (ASTM) e) American Society of Mechanical Engineers (ASME) f) American Petroleum Institute (API) g) Standards of the Hydraulic Institute, U.S.A. h) International Organization for Standardization (ISO) i) Tubular Exchanger Manufacturer's Association (TEMA) j) American Welding Society (AWS) k) National Electrical Manufacturers Association (NEMA) l) National Fire Protection Association (NFPA) m) International Electro-Technical Commission (IEC)/ European Norm (EN) n) Expansion Joint Manufacturers Association (EJMA) o) Heat Exchange Institute (HEI) p) IEEE standard

	q) JEC standard
5.03.00	Other International/ National standards such as DIN, VDI, BS, GOST etc. shall also be accepted for only material codes and manufacturing standards, subject to the Employer's approval, for which the Bidder shall furnish, adequate information to justify that these standards are equivalent or superior to the standards mentioned above. In all such cases the Bidder shall furnish specifically the variations and deviations from the standards mentioned elsewhere in the specification together with the complete word to word translation of the standard that is normally not published in English.
5.04.00	As regards highly standardized equipments such as Steam Turbine and Generator, National /International standards such as JIS, DIN, VDI, ISO, SEL, SEW, VDE, IEC & VGB shall also be considered as far as applicable for Design, Manufacturing and Testing of the respective equipment. However, for those of the above equipment not covered by these National / International standards, established and proven standards of manufacturers shall also be considered.
5.05.00	In the event of any conflict between the codes and standards referred to in the above clauses and the requirement of this specification, the requirement of Technical Specification shall govern.
5.06.00	Two (2) English language copies of all national and international codes and/or standards used in the design of the plant and equipment shall be provided by the Contractor to the Employer within two calendar months from the date of the Notification of Award.
5.07.00	In case of any change in codes, standards & regulations between the date of bid opening and the date when vendors proceed with fabrication, the Employer shall have the option to incorporate the changed requirements or to retain the original standard. It shall be the responsibility of the Contractor to bring to the notice of the Employer such changes and advise Employer of the resulting effect.
5.08.00	A detailed list of standards apart from those mentioned in the respective detailed specifications in other parts of Section-VI to which all equipment/systems/civil works should conform as indicated in this Part C and elsewhere in the specification.
6.00.00	**EQUIPMENT FUNCTIONAL GUARANTEE**
6.01.00	The functional guarantees of the equipment under the scope of the Contract is given in Section-VI Part - A & B of Technical Specifications. These guarantees shall supplement the general functional guarantee provisions covered under Defect liabilities Section-IV, General Conditions of Contract.

6.02.00 Liquidated damages for shortfall in meeting functional guarantee(s) during the performance and guarantee tests shall be assessed and recovered from the Contractor as specified elsewhere in this specification.

7.00.00 **DESIGN OF FACILITIES/ MAINTENANCE & AVAILABILITY CONSIDERATIONS**

7.01.00 **DESIGN OF FACILITIES**

All the design procedures, systems and components proposed shall have already been adequately developed and shall have demonstrated good reliability under similar conditions elsewhere.

The Contractor shall be responsible for the selection and design of appropriate equipments to provide the best co-ordinated performance of the entire system. The basic requirements are detailed out in various clauses of the Technical Specifications. The design of various components, assemblies and subassemblies shall be done so that it facilitates easy field assembly and dismantling. All the rotating components shall be so selected that the natural frequency of the complete unit is not critical or close to the operating range of the unit.

7.02.00 **MAINTENANCE AND AVILABILITY CONSIDERATIONS**

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

Bidder shall state in his offer the various maintenance intervals, spare parts and man-hour requirement during such operation. The intervals for each type of maintenance namely inspection of the furnace, inspection of the entire hot gas path, turbine & equipments, inspection of the steam path and the minor and major overhauls shall be specified in terms of fired hours, clearly defining the spare parts and man-hour requirement for each stage.

Lifting devices i.e. hoists and chain pulley jacks, etc. shall be provided by the contractor for handling of any equipment or any of its part having weight in excess of 500 Kgs during erection and maintenance activities.

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

8.00.00 **DOCUMENTS, DATA AND DRAWINGS TO BE FURNISHED BY CONTRACTOR**

8.01.00 Bidders may note that this is an **EPC Package contract**. Each of the plant and equipment shall be fully integrated, engineered and designed to perform in accordance with the technical specification. All engineering and technical services required to ensure a completely engineered plant shall be provided in respect of mechanical, electrical and power systems, control & instrumentation, civil & structural works as per the scope.

Each main and auxiliary equipment/item of the plant including instruments shall be assigned a unique tag number. The assignment of tag numbers shall be in accordance with KKS system. In all drawings/documents/data sheet etc. KKS tag number of the equipment/item/instrument etc. shall be indicated.

The Contractor shall furnish engineering data /drawings in accordance with the schedule of information as specified in Technical Data Sheets and Technical Specification.

A comprehensive engineering and quality coordination procedure shall be finalized with the successful bidder covering salient features as described in this section of specifications.

8.02.00 The number of copies/prints/CD-ROMs/manuals to be furnished for various types of document is given in **Annexure-VI** to this Part-C, Section-VI of the Technical Specification.

8.03.00 The documentation that shall be provided by the Contractor is indicated in the various sections of specification. This documentation shall include but not be limited to the following:

8.03.01 A) **BASIC ENGINEERING DOCUMENTATION**

Prior to commencement of the detailed engineering work, the Contractor shall furnish a Plant Definition Manual within 12 weeks from the date of the Notification of Award. This manual shall contain the following as a minimum:

i) System description of all the mechanical, electrical, control & instrumentation & civil systems.

ii) Technology scan for each system / sub-system & equipment.

iii) Selection of appropriate technology / schemes for various systems/ subsystems including techno-economic studies between various options.

iv) Optimization studies including thermal cycle optimization.

v) Sizing criteria of all the systems, sub-systems/ equipments/ structures/ equipment foundations alongwith all calculations justifying and identifying the sizing and the design margins.

vi) Schemes and Process & Instrumentation diagrams for the various systems/ sub-system with functional write-ups.

vii) Water Balance diagram.

viii) Operation Philosophy and the control philosophy of the Main Plant and other plants.

ix) General Layout plan of the power station incorporating all facilities in Bidder's as well as those in the Employer's scope. This drawing shall also be furnished in the form of CD-ROMs to the Employer for engineering of areas not included in bidder's scope.

x) Basic layouts and cross sections of the main plant building (various floor elevations), boiler, fuel oil area, transformer yard, switchyard and other areas included in the scope of the bidder.

xi) Documentation in respect of Quality Assurance System as listed out elsewhere in this specification.

The successful bidder shall furnish within three (3) weeks from the date of Notification of Award, a list of contents of the Plant Definition Manual (PDMs) including techno-economic studies, which shall then be mutually discussed & finalised with the Employer.

B) **DETAILED ENGINEERING DOCUMENTS**

i) General layout plan of the station.

ii) Layouts, general arrangements, elevations and cross-sections drawings for all the equipment and facilities of the plant.

iii) Flow diagram, Process and Instrumentation diagrams along with write up and system description.

iv) Start-up curves for boiler and both turbines and boiler combined together as a unit for various start-ups, viz. Cold, Warm and Hot start up.

v) Piping isometric, composite layout and fabrication drawings, design philosophy & design parameter selection for each piping system, Pressure drop calculation & flash tank sizing calculation.

vi) Piping engineering diagrams, pipe and fittings schedules, System-wise or P&ID wise prepared pipe schedule, valve schedule, insulation schedule, hanger and support schedule and Piping isometric / fabrication isometric drawings for pipe size 65mm NB and above with BOM, Painting schedule. Hanger / support arrangement drawing with BOM, Valve GA drawings, Layout drawings for site routed piping (i.e. for pipe sizes below 65NB) along with BOM (and submission of the same to the employer / project manager before start of work) and System wise stress analysis / dynamic analysis report (including input) along with stress isometric drawing / sketch marked with node points. Also As-Built drawing for information & Records: (i) Piping fabrication isometric drawing (ii) composite piping layout drawing (iii) Hanger / Support arrangement drawing.

vii) Technical data sheets for all bought out and manufactured items. Contractor shall use the Employer's specifications as a base for placement of orders on their sub vendors.

viii) Detailed design calculations for components, system, piping etc., wherever applicable including sizing calculations for all auxiliaries like Mills, Fans, BFPs, CEPs, Heaters/ Deaerators, Water cooled Condensers, Vacuum pumps etc.

ix) Boiler pressure part schedule and sizing calculations. Boiler performance data and boiler design dossier.

x) Transient, hydraulic and thermal stress analysis of piping and system wherever applicable & input and output data alongwith stress analysis isometrics showing nodes.

xi) Thermal cycle information (heat balance diagrams, boiler performance calculations, condenser, design ramp rates of SG and TG and heat exchanger thermal calculations etc.).

xii) Characteristic Curves/ Performance Correction Curves. Hydraulic & Mechanical design calculations for condensers & heaters.

xiii) Comprehensive list of all Terminal Points which interface with Employer's facilities, giving details of location, terminal pressure, temperature, fluid handled & end connection details, forces, moments etc.

xiv) Power supply single line diagram, block logics, control schematics, electrical schematics, etc.

xv) Protection system diagrams and relay settings.

xvi) Cables schedules and interconnection diagrams.

xvii) Cable routing plan.

xviii) Instrument schedule, measuring point list, I/O list, Interconnection & wiring diagram, functional write-ups, installation drawings for field mounted instruments, logic diagrams, control schematics, wiring and tubing diagrams of panels and enclosures etc. Drawings for open loop and close loop controls (both hardware and software). Motor list and valve schedule including type of actuator etc.

xix) Alarm and annunciation/ Sequence of Event (SOE) list and alarms & trip set points.

xx) Sequence and protection interlock schemes.

xxi) Type test reports, insulation co-ordination study report and power system stability study report.

xxii) Control system configuration diagrams and card circuit diagrams and maintenance details.

xxiii) Detailed DDCMIS system manuals.

xxiv) Detailed flow chart for digital control system.

xv) Mimic diagram layout, Assignment for other application engg.

xxvi) Civil and Structural works drawings and documents for all structures, facilities, architectural works, foundations underground and overground works and super-structural works as included in the scope of the bidder civil calculation sheets including structural analysis and design alongwith output results.

xxvii) Underground facilities, levelling, sanitary, land scaping drawings.

xxviii) Geotechnical investigation and site survey reports (if and as applicable).

xxix) Model study reports wherever applicable.

xxx) Functional & guarantee test procedures and test reports.

xxxi) Documentation in respect of Quality Assurance System, and Documentation in respect of Commissioning, as listed out elsewhere in this specification.

xxxii) BOP documents such as P&IDs, Sizing calculations for various equipment's, performance curves, datasheet etc. (For CHP, AHP, PU, Water System etc.) shall be as per MDL.

xxxiii) Bidder shall submit all tabulated design calculations/ data (e.g. Pipe schedule, valve schedule, etc.), in both EXCEL format as well as in PDF format to enable NTPC for fast review /approval.

8.03.02 **INSTRUCTION MANUALS**

The Contractor shall submit to the Employer, draft Instruction Manuals for all the equipments covered under the Contract by the end of one year from the date of his acceptance of the Letter of Award. The Instruction manuals shall contain full details required for erection, commissioning, operation and maintenance of each equipment. The manual shall be specifically compiled for this project. After finalisation and approval of the Employer the Instruction Manuals shall be submitted as indicated in **Annexure-IV.** The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals have been supplied to the Employer. The Instruction Manuals shall comprise of the following.

A) ERECTION MANUALS

The erection manuals shall be submitted at least three (3) months prior to the commencement of erection activities of a particular equipment/system. The erection manual should contain the following as a minimum.

a) Erection strategy.

b) Sequence of erection.

c) Erection instructions.

d) Critical checks and permissible deviation/tolerances.

e) List of tools, tackles, heavy equipments like cranes, dozers, etc.

f) Bill of Materials

g) Procedure for erection and General Safety procedures to followed during erection/installation.

h) Procedure for initial checking after erection.

i) Procedure for testing and acceptance norms.

j) Procedure / Check list for pre-commissioning activities.

k) Procedure / Check list for commissioning of the system.

l) Safety precautions to be followed in electrical supply distribution during erection.

B) OPERATION & MAINTENANCE MANUALS

a) The manual shall be a two rim PVC bound stiff sided binder able to withstand constant usage or where a thicker type is required it shall have locking steel pins, the size of the manual shall not be larger than international size A3. The cover shall be printed with the Project Name, Services covered and Volume / Book number Each section of the manual shall be divided by a stiff divider of the same size as the holder. The dividers shall clearly state the section number and title. All written instructions within the manual not provided by the manufacturers shall be typewritten with a margin on the left hand side.

b) The arrangement and contents of O & M manuals shall be as follows:

1) Chapter 1 - Plant Description: To contain the following sections specific to the equipment/system supplied

(a) Description of operating principle of equipment / system with schematic drawing / layouts.

(b) Functional description of associated accessories / controls. Control interlock protection write up.

(c) Integrated operation of the equipment alongwith the intended system. (This to be given by the supplier of the Main equipment by taking into account the operating instruction given by the associated suppliers).

(d) Exploded view of the main equipment, associated accessories and auxiliaries with description. Schematic drawing of the equipment alongwith its accessories and auxiliaries.

(e) Design data against which the plant performance will be compared.

(f) Master list of equipments, Technical specification of the equipment/ system and approved data sheets.

(g) Identification system adopted for the various components, (it will be of a simple process linked tagging system).

(h) Master list of drawings (as built drawing - Drawings to be enclosed in a separate volume).

2) Chapter 2.0 - Plant Operation: To contain the following sections specific to the equipment supplied

(a) Protection logics provided for the equipment alongwith brief philosophy behind the logic, Drawings etc.

(b) Limiting values of all protection settings.

(c) Various settings of annunciation/interlocks provided.

(d) Startup and shut down procedure for equipment alongwith the associated systems in step mode.

(e) Do's and Don'ts related to operation of the equipment.

(f) Safety precautions to be taken during normal operation. Emergency instruction on total power failure condition/lubrication failure/any other conditions.

(g) Parameters to be monitored with normal value and limiting values.

(h) Equipment isolating procedures.

(i) Trouble shooting with causes and remedial measures.

(j) Routine testing procedure to ascertain healthiness of the safety devices alongwith schedule of testing.

(k) Routine Operational Checks, Recommended Logs and Records

(l) Change over schedule if more than one auxiliary for the same purpose is given.

(m) Preservation procedure on long shut down.

(n) System/plant commissioning procedure.

3) Chapter 3.0 - Plant Maintenance- To contain the following sections specific to the equipment supplied.

(a) Exploded view of each of the equipments. Drawings alongwith bill of materials including name, code no. & population.

(b) Exploded view of the spare parts and critical components with dimensional drawings (In case of Electronic cards, the circuit diagram to be given) and spare parts catalogue for each equipment.

(c) List of Special T/ P required for Overhauling /Trouble shooting including special testing equipment required for calibration etc.

(d) Stepwise dismantling and assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained etc. Clearance to be maintained etc.

(e) Preventive Maintenance schedules linked with running hours/calendar period alongwith checks to be carried out.

(f) Overhauling schedules linked with running hours/calendar period alongwith checks to be done.

(g) Long term maintenance schedules

(h) Consumables list alongwith the estimated quantity required during normal running and during maintenance like Preventive Maintenance and Overhauling.

(i) List of lubricants with their Indian equivalent, Lubrication Schedule including charts showing lubrication checking, testing and replacement procedure to be carried daily, weekly, monthly & at longer intervals to ensure trouble free operation and quantity required for complete replacement.

(j) Tolerance for fitment of various components.

(k) Details of sub vendors with their part no. in case of bought out items.

(l) List of spare parts with their Part No, total population, life expediency & their interchangeability with already supplied spares to NTPC.

(m) List of mandatory and recommended spare list along with manufacturing drawings, material specification & quality plan for fast moving consumable spares.

(n) Lead time required for ordering of spares from the equipment supplier, instructions for storage and preservation of spares.

(o) General information on the equipment such as modification carried out in the equipment from its inception, equipment population in the country / foreign country and list of utilities where similar equipments have been supplied.

8.03.03 After finalization and approval of the Employer, the O & M Manuals shall be submitted as indicated in Annexure-VI. The Contract shall not be considered to be completed for purposes of taking over until the final Instructions manuals (both erection and O & M manuals have been supplied to the Employer.

If after the commissioning and initial operation of the plant, the instruction manuals (Erection and /or O &M manuals) require modifications/additions/ changes, the same shall be incorporated and the updated final instruction manuals shall be submitted by the Contractor to the Employer for records and number of copies shall be as mentioned in Annexure-VI.

8.03.03 **PLANT HANDBOOK AND PROJECT COMPLETION REPORT**

8.03.03.01 **PLANT HANDBOOK**

The Contractor shall submit to the Employer a preliminary plant hand book preferably in A-4 size sheets which shall contain the design and performance data of various plants, equipments and systems covering the complete project including

i) Design and performance data.

ii) Process & Instrumentation diagrams.

iii) Single line diagrams.

iv) Sequence & Protection Interlock Schemes.

v) Alarm and trip values.

vi) Performance Curves.

vii) General layout plan and layout of main plant building and auxiliary buildings

viii) Important Do's & Don't's

The plant handbook shall be submitted within twelve (12) months from the date of award of contract. After the incorporation of Employer's comments, the final plant handbook complete in all respects shall be submitted three (3) months before start-up and commissioning activities.

8.03.03.02 **PROJECT COMPLETION REPORT**

The Contractor shall submit a Project Completion Report at the time of handing over the plant.

8.03.04 **DRAWINGS**

a) i) All the plant layouts shall be made in computerized 3D modelling system. The Employer reserves the right to review the 3D model at different stages during the progress of engineering. The layout drawings submitted for Employer's review shall be fully dimensioned and extracted from 3D model after interference check.

ii) All documents submitted by the Contractor for Employer's review shall be in electronic form (soft copies) along with the desired number of hard copies as per **Annexure-VI** of Part-C. The soft copies shall be uploaded by the vendors in C-folders, a Web-based system of NTPC ERP, for which a username and password will be allotted to the new vendor by NTPC.

Similarly, the vendor can download the drawings/documents, approved/ commented by NTPC, through above site.

The soft copies of identified drawings/documents shall be in pdf format, whereas the attachments/reply to the submitted document(s) can be in .doc, .xls, .pdf, .dwg or .std formats.

iii) Final copies of the approved drawings along with requisite number of hard copies shall be submitted as per **Annexure-VI** of Part-C.

iv) Contractor shall prepare the model of all the facilities located within plant boundary covering facilities in Main Plant Block area and Balance of plant (BOP) area in an integrated & intelligent 3D software solution. Main Plant Block area shall include Transformer Yard, TG building (including all facilities), Boiler area, ESP area, chimney area, FGD area and any other facility located in main plant block. BOP area shall include all facilities pertaining to AHP, CHP, LHP, GHP, DM PT plant, pipe & cable racks and any other facility located within plant boundary.

All piping layouts, equipment layouts, floor plans, ducting layout (Air/flue gas, A/C, Ventilation etc.), General Arrangement drawings and RCC layout of major buildings and structural arrangement

drawings shall necessarily be extracted from the aforesaid 3D model and submitted for employer's review along with the 3D review model to enable NTPC to review and approve these drawings.

Contractor shall prepare and provide 3D design review model (network ready, which shall include visual interference check, walk-through animation, video simulation for major equipment placement and removal, visual effect, photo realism etc.), which is extracted from intelligent 3D model and shall make a presentation of the same every 3 months from LOA to enable NTPC to review the progress of engineering or as & when required by employer.

The complete 3D data (editable model) which shall be utilised for all future detailed engineering related to maintenance, operation, R&M, efficiency improvement of the project etc. Complete 3D model along with as built GADs, layout, isometrics, reports extracted and 3D models for all disciplines , with any other document generated from 3D model and naming conventions with as-built updates along with complete reference databases, component catalogues for all the size range shall be handed over to owner. Apart from the 3D Model, all drawings like GADs, Isometrics etc. extracted from the model shall also be submitted by the Contractor in Electronic form. 3D model along with complete Project databases shall be submitted at each model review stage and as final as-built. The contractor shall also submit all the configuration files, customization files, templates and all referenced databases.

All input files of software used for design of Equipments / Piping like CAESAR2 files, input files for Pressure vessel design, datasheets etc., shall be handed over to NTPC as per NTPC specifications for handover of Engineering Information.

Further, two Licenses of the used 3D Modelling Software (One for Engineering View and One for Site View) shall be provided along with compatible Hardware for possible review and study of the Model Files being submitted by the Bidder Time to time.

All software provided shall necessarily include cost for perpetual license(s) for use on all the machines and an Annual maintenance contract (AMC) which shall include software upgrades as & when released by the software agency for a period of three years after warranty/guarantee period .

Handover Plan: There shall be continuous handover of documents and data at various stages of the project including rules and trigger points for handover of data to NTPC shall be at 30%, 60% and 90 % of 3D

model stage.

Database backup shall be taken every month and handed over to NTPC.

b) All documents/text information shall be in latest version of MS Office/MS Excel/PDF format as applicable.

c) All drawings submitted by the Contractor including those submitted at the time of bid shall be in sufficient detail indicating the type, size, arrangement, weight of each component for packing and shipment, the external connection, fixing arrangement required, the dimensions required for installation and interconnections with other equipments and materials, clearance and spaces required between various portions of equipment and any other information specifically requested in the drawing schedules.

d) Each drawing submitted by the Contractor (including those of sub-vendors) shall bear a title block at the right hand bottom corner with clear mention of the name of the Employer, the system designation, the specifications title, the specification number, the name of the Project, drawing number and revisions. If standard catalogue pages are submitted the applicable items shall be indicated therein. All titles, notings, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

e) The drawings submitted by the Contractor (or their subvendors) shall bear Employer's drawing number in addition to contractor's (their sub-vendor's) own drawing number. Employer's drawing numbering system shall be made available to the successful bidder to enable him to assign Employer's drawing numbers to the drawings to be submitted by him during the course of execution of the Contract.

Similarly, all the drawings/ documents submitted by the Contractor during detailed engineering stage shall be marked "FOR APPROVAL" or "FOR INFORMATION" prior to submission **in line with suggestive MDL**.

Further, space shall be identified on each drawing for Approval stamp and electronic signature.

f) The furnishing of detailed engineering data and drawings by the Contractor shall be in accordance with the time schedule for the project. The review of these documents/ data/ drawings by the Employer will cover only general conformance of the data/ drawings/ documents to the specifications and contract, interfaces with the equipments provided by others and external connections & dimensions which might affect plant layout. The review by the Employer should not be construed to be a thorough review of all dimensions, quantities and details of the equipments, materials, any devices or items indicated or the accuracy of the information submitted. The review and/ or

approval by the Employer/ Project Manager shall not relieve the Contractor of any of his responsibilities and liabilities under this contract.

g) After the approval of the drawings, further work by the Contractor shall be in strict accordance with these approved drawings and no deviation shall be permitted without the written approval of the Employer.

h) All manufacturing, fabrication and execution of work in connection with the equipment / system, prior to the approval of the drawings, shall be at the Contractor's risk. The Contractor is expected not to make any changes in the design of the equipment /system, once they are approved by the Employer. However, if some changes are necessitated in the design of the equipment/system at a later date, the Contractor may do so, but such changes shall promptly be brought to the notice of the Employer indicating the reasons for the change and get the revised drawing approved again in strict conformance to the provisions of the Technical Specification.

i) Drawings shall include all installations and detailed piping layout drawings. Layout drawings for all piping of 65 mm and larger diameter shall be submitted for review/ approval of Employer prior to erection. Small diameter pipes shall however be routed as per site conditions in consultation with site authority/ representative of Employer based on requirements of such piping indicated in approved/ finalised Flow Scheme/ Process & Instrumentation Diagrams and/or the requirements cropping up for draining & venting of larger diameter piping or otherwise after their erection as per actual physical condition for the entire scope of work of this package.

Assessing & anticipating the requirement and supply of all piping and equipment shall be done by the contractor well in advance so as not to hinder the progress of piping & equipment erection, subsequent system charging and its effective draining & venting arrangement as per site suitability.

j) As Built Drawings

After final acceptance of individual equipment / system by the Employer, the Contractor will update all original drawings and documents for the equipment / system to “as built” conditions and submit no. of copies as per **Annexure VI**.

k) Drawings must be checked by the Contractor in terms of its completeness, data adequacy and relevance with respect to Engineering schedule prior to submission to the Employer. In case drawings are found to be submitted without proper checking by the Contractor, the same shall not be reviewed and returned to the Contractor for re-submission. The contractor shall make a visit to site to see the existing facilities and understand the layout

completely and collect all necessary data/ drawings at site which are needed as an input to the engineering. The contractor shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Employer's scope and submit all necessary drawings/ documents for the same.

l) The Contractor shall submit adequate prints of drawing / data / document as per Annexure-VI. The Employer shall review the drawings and return soft copy to the Contractor authorizing either to proceed with manufacture or fabrication or marked to show changes desired. When changes are required, drawings shall be re-submitted promptly, with revisions clearly marked, for final review. Any delays arising out of the failure of the Contractor to submit/rectify and resubmit in time shall not be accepted as a reason for delay in the contract schedule.

m) All engineering data submitted by the Contractor after final process including review and approval by the Project Manager/ Employer shall form part of the contract documents and the entire works covered under these specification shall be performed in strict conformity with technical specifications unless otherwise expressly requested by the Project Manager in writing.

8.03.05 **e-Learning Package:**

e-learning packages shall be supplied for the equipment / system for the following Steam Turbine Generator & auxiliaries and Steam Generator & auxiliaries along with associated electrical and C&I system.

8.03.05.01 Steam Turbine Generator & Auxiliaries

Steam Turbine including stop valves, control valves, overload valves and cross over piping. Steam Turbine Auxiliary Systems including Quick Closing and Ordinary NRVs, Turbine gland sealing system, Lubricating oil system and its purification system, Centralized oil storage and its purification system, Control fluid and its purification system, governing and protection system, exhaust hood spray cooling system, drainage and vent system, turbine preservation system, HP/LP Bypass system.

Generator and Auxiliary System including Generator, complete hydrogen cooling, carbon dioxide and nitrogen gas systems as applicable, complete seal oil system, complete water cooling system where applicable and complete excitation system.

Condensing Plant including Condenser, Condenser air evacuation system and Condenser on load tube cleaning system as applicable etc.

Drip Pump along with all accessories as applicable, Condensate Extraction Pumps along with all accessories, Deaerator level Control Station, Feed Water Heating Plant including Drain Cooler, low pressure heaters, deaerator and feed storage tank,

high pressure heaters and associated accessories, Boiler Feed Pumps along with all accessories, Drive Turbine for Boiler Feed Pump along with all accessories, Feed regulating station, Make up system to Condenser, Gland Steam Condenser Recirculation System, Turbine Hall EOT Cranes and EOT Crane for Boiler Feed Pump as applicable.

8.03.05.02 **Steam Generator & Auxiliaries**

Furnace/evaporator, separator & drain collection vessel, superheater, reheater, economiser, startup recirculation & drain system, desuperheating spray system, safety valves, soot blowing system, draft plant including FD & ID fans, PA fan, air preheaters, SCAPH, coal preparation and firing system including raw coal feeder and pulverisers, coal burners, fuel oil system and oil burners, Electrostatic precipitator, NOx control system and Flue gas desulphurisation system, Aux. PRDS system.

8.03.05.03 These packages shall be installed on the Learning Management Server (LMS) of Power Management Institute (PMI), NTPC located at Noida. The Engineer- In-Charge (EIC) for the e-learning modules shall be from PMI.

1. The objective of the e-Learning package consisting of courses for erection, commissioning, operation and maintenance of equipment / system as specified above is to facilitate the employees to have first hand information / requirement with respect to above activities for the supplied equipment / system .

2. The bidder shall submit e-learning courses each for erection, commissioning, operation and maintenance of each of the equipment / system supplied as above.

a. The erection course(s) should include instructions on pre-checks, prerequisites, erection strategy, erection procedure etc.

b. The commissioning course(s) should include instructions on pre-commissioning, commissioning, initial operation etc.

c. The operation course(s) should include instructions on the permissive, interlocks, physical check-ups, start-up, shutdown and protections etc.

d. The maintenance course(s) should include instructions on predictive, preventive, breakdown and overhauling.

Depth of coverage of above courses shall be as specified for **"Instruction Manuals"** in above clauses. A literature on caution / safety while handling equipment / system for the above modules shall follow the description of the said equipment /system.

3. The e-Learning packages on equipment / system shall be installed by the vendor and shall be successfully test run in the presence of EIC or

representative before acceptance by NTPC. The vendor will also give the master copy in form of Flash Drive/CD/DVD. The respective module for erection & commissioning shall be delivered and successfully test run at least three months before the scheduled start of the corresponding activity at site.

The respective module for operation & maintenance shall be delivered and successfully test run at least three months before scheduled first synchronization of first unit.

4. e-Learning course broad requirements:

a. The courses shall be web based and mobile based Application type. It shall run on all possible versions of web browser like Internet Explorer, Google Chrome, Firefox etc. on Laptop/Desktop and shall be Smartphone/Tablet/Mobile responsive. The Mobile responsive courses shall run on Android, Windows Mobile, Blackberry, iOS etc.

b. The courses shall support liquid/fluid page layout so that the entire screen gets adjusted to PC, Laptop, Smartphone/Mobile, Tablet and any other display devices.

c. Course content text shall be in English language and be associated with a voiceover in English language with Indian accent.

d. Courses shall be SCORM (Sharable Content Object Reference Model) compliant, version 1.2 which is compatible with LMS at PMI.

e. Each course shall have every physical and functional detail of the equipment / system supplied.

f. Each of the e-Learning course shall be based on multiple web pages and mobile pages with multiple modules.

g. There shall be option for self-assessment test after every course. In case the user doesn't opt for self-assessment test the user shall be able to go to the next course. There shall be no restriction in no. of times for repeating the assessments. All correct answers along with the answers marked by the users shall be displayed at the end of test/quiz.

h. If Java and Flash, as applicable are not available in the system to run the package, then there shall be a prompt message for updation of the same.

i. Each course shall have a self-running interactive content with navigation buttons containing forward, backward, pause, bookmark and menu options in the course window.

j. The course shall contain chapter titled 'Introduction/overview' that explains the purpose of the course.

k. The course content shall contain descriptive text shall be factual, specific, terse, clearly worded, and simply illustrative, so that the user can understand it.

l. The system shall provide the user with the ability to select the information with a Cursor.

m. The course menu should contain table of content linked to concerned pages. The user shall be given the capability to access all of the functions available on the system through a menu system. This shall consist of active buttons, which shall control a hierarchy of pull down/pop-up menus. Menu shall appear quickly and exist only while a selection is being made. The user shall be given the capability to position the cursor or pointer on the menu item and use pointer device such as mouse to activate the function.

n. Every course shall contain the 3D design/drawing/exploded view/360^0 turn around view of the equipment/system, textual description of the equipment/system and its functionality with video (as applicable), animation and audio.

o. The users shall be able to control audio sound level associated with the courses.

p. Drawings / text in the courses shall be scalable (Zoom In/ Out).

q. The user shall have the capability to record a **bookmark** to mark displayed information for later recall, whenever he accesses the same course next time.

Notes:

1. e-learning Package of an equipment / system shall include e-learning courses for each of erection, commissioning, operation and maintenance of that equipment / system.
2. e-learning courses on erection, commissioning, operation and maintenance of an equipment / system shall include e-learning lessons/chapters/modules (as required) for erection, commissioning, operation and maintenance respectively of that equipment / system.
3. The vendor shall get the approval of one sample course from EIC before proceeding for further courses.

8.04.00 Provision for Fail Safe operation of vital Equipments

All the Plant and equipments / Systems supplied under the contract shall be designed following “Fail Safe” concept. In case of failure of Power supply like Electric power, Hydraulic pressure, Pneumatic pressure, Vacuum etc. the system should be designed in such a way that the equipment/Valves/dampers etc. shall always move/remains (as applicable) to safest position as per system requirement to ensure safety of Man and Machinery.

8.05.00 Engineering Co-ordination Procedure

8.05.01 The following principal coordinators will be identified by respective organizations at time of award of contract:

	NTPC Engineering Coordinator (NTPC EC): Name : Designation : Address : a) Postal : b) Telegraphic / e-Mail : c) FAX : TELEPHONE : Contractor's/ Vendor's Engineering Coordinator (VENDOR EC): Name : Designation : Address : a) Postal : b) Telegraphic / e-Mail : c) FAX : TELEPHONE :
8.05.02	All engineering correspondence shall be in the name of above coordinators on behalf of the respective organizations.
8.05.03	Contractor's/Vendor's Drawing Submission and Approval Procedure: a) All data/information furnished by Vendor in the form of drawings/ documents/catalogues or in any other form for NTPC's information/ interface and or review and approval are referred by the general term "drawings". b) Not used c) All drawings (including those of subvendor's) shall bear at the right hand bottom corner the 'title plate' with all relevant information duly filled in. The Contractor shall furnish this format to his sub-vendor along with his purchase order for sub-vendor's compliance. d) Not used

e) The contractor shall make a visit to site to see the existing facilities and understand the layout completely and collect all necessary data / drawings at site which are needed as an input to the engineering. The contractor shall do the complete engineering including interfacing and integration of all his equipment, systems & facilities within his scope of work as well as interface engineering & integration of systems, facilities, equipment & works under Employer's scope and submit all necessary drawings/ documents for the same.

f) **Drawings must be checked by the Contractor in terms of its completeness, data adequacy and relevance with respect to engineering schedule prior to submission to the Employer. In case drawings are found to be submitted without proper endorsement for checking by the Contractor, the same shall not be reviewed and returned to the Contractor for re-submission.**

g) The Contractor shall submit drawing / data / document for Employer's review and approval. The drawings submitted by the Contractor/vendor shall be reviewed by NTPC and their comments shall be forwarded within three (3) weeks of receipt of drawings. Upon review of each drawing, depending on the correctness and completeness of the drawing, the same will be categorized and approval accorded in one of the following categories:

CATEGORY- I: Approved

CATEGORY- II Approved, subject to incorporation of comments/ modification as noted. Resubmit revised drawing incorporating the comments.

CATEGORY –III Not approved. Resubmit revised drawings for approval after incorporating comments/ modification as noted.

CATEGORY -IV For information and records.

h) After Rev 0 comments, the drawing will be locked in the system. Contractor will review the Rev 0 comments within 7 days & furnish the Comment Reply Sheet (CRS) to NTPC as an agenda point for TCM. TCM shall be conducted with Contractor on non-agreed comments of CRS. System will not allow Contractor to submit approval category drawings before the scheduled submission date. However, documents may be unlocked on case to case basis. Based on resolution of all comments and agreements, the document will be approved in TCM itself. The contractor will revise the document based on the resolutions and certify that all the resolutions has been taken care of. Based on this certification, the document will be opened and submitted by contractor in the system for approval as Rev 01 within 10 days of TCM.

i) In case, the Contractor/ Vendor does not agree with any specific comment, he shall furnish the explanation for the same to NTPC for consideration. In all such cases the Contractor shall necessarily enclose explanations along with the revised drawing (taking care of balance comments) to avoid any delay and/or duplication in review work.

j) It is responsibility of the Contractor/ Vendor to get all the drawings approved in the Category I & IV (as the case may be) and complete engineering activities within the agreed schedule. Any delay arising out of submission and modification of drawings shall not alter the contract completion schedule.

k) If Contractor/ Vendor fails to resubmit the drawings as per the schedule, construction work at site will not be held up and work will be carried out on the basis of comments furnished on previous issues of the drawing.

l) These comments will be taken care by the contractor while submitting the revised drawing.

The contractor shall use a single transmittal for drawings. Submission. This shall include transmittal numbers and date, number of copies being sent, names of the agencies to whom copies being sent, drawing number and titles, remarks or special notes if any etc.

8.06.00 **ENGINEERING PROGRESS AND EXCEPTION REPORT**

8.06.01 The Contractor shall submit every month an Engineering progress and Exception Report giving the status of each engineering information including

a) A list of drawings/engineering information which remains unapproved for more than four (4) weeks after the date of first submission

b) Drawings which were not submitted as per agreed schedule.

8.06.02 The draft format for this report shall be furnished to the Employer within four (4) weeks of the award of the contract, which shall then be discussed and finalised with the Employer.

9.00.00 **TECHNICAL CO-ORDINATION MEETING**

9.01.00 The Contractor shall be called upon to organise and attend monthly Design/ Technical Co-ordination Meetings (TCMs) with the Employer/Employer's representatives and other Contractors of the Employer during the period of contract. The Contractor shall attend such meetings at his own cost at NEW DELHI / NOIDA or at mutually agreed venue as and when required and fully co-operate with such persons and agencies involved during the discussions.

9.02.00	The Contractor should note that Time is the essence of the contract. In order to expedite the early completion of engineering activities, the comments of the Employer shall be discussed across the table during the above Technical Co-ordination Meeting (s) wherein best efforts shall be made by both sides to ensure the approval of the drawing.
9.02.01	The Contractor shall ensure availability of the concerned experts / consultants/ personnel who are empowered to take necessary decisions during these meetings. The Contractor shall be equipped with necessary tools and facilities so that the drawings/documents can be resubmitted after incorporating necessary changes and approved during the meeting itself.
9.02.02	Should any drawing remain unapproved for more than six (6) weeks after it's first submission, this shall be brought out in the monthly Engineering Progress and Exception Report with reasons thereof.
9.03.0	Any delays arising out of failure by the Contractor to incorporate Employer's comments and resubmit the same during the TCM shall be considered as a default and in no case shall entitle the Contractor to alter the Contract completion date.
10.00.00	**DESIGN IMPROVEMENTS** The Employer or the Contractor may propose changes in the specification of the equipment or quality thereof and if the parties agree upon any such changes the specification shall be modified accordingly. If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any changing the price and/or schedule of completion before the Contractor proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.
11.00.00	**EQUIPMENT BASES** A cast iron or welded steel base plate shall be provided for all rotating equipment which is to be installed on a concrete base, unless otherwise specifically agreed to by the Employer. Each base plate shall support the unit and its drive assembly, shall be of a neat design with pads for anchoring the units, shall have a raised lip all around, and shall have threaded drain connections.
12.00.00	**PROTECTIVE GUARDS** Suitable guards shall be provided for protection of personnel on all exposed rotating and/or moving machine parts. All such guards shall be designed for easy installation and removal for maintenance purpose.

13.00.00	**LUBRICANTS, SERVO FLUIDS AND CHEMICALS**
13.01.00	All the first fill and one year's topping requirement of consumables such as greases, oils, lubricants, servo fluids / control fluids, gases (excluding H_2, CO_2 and N_2 for Generator) etc. which will be required to put the equipment covered under the scope of specifications into successful commissioning/initial operation and to establish completion of facilities shall be supplied by the contractor. Suitable standard lubricants as available in India are desired. Efforts should be made to limit the variety of lubricants to minimum. Bidder scope shall include supply of H_2, CO_2 and N_2 as applicable for the Generator till successful commissioning of Generator. Bidder shall supply a quantity not less than 10% of the full charge or one (1) year topping requirement mentioned above (Whichever is higher) of each variety of lubricants, servo fluids, gases etc. (as detailed above) used which is expected to be utilized during the first year of operation. This additional quantity shall be supplied in separate containers.
13.02.00	As far as possible lubricants marketed by the Indian Oil Corporation shall be used. The variety of lubricants shall be kept to a minimum possible. However, the lube oil for Main Turbine, Drive Turbine, TDBFP and MDBFP shall be kept same in view of ease of operation and maintenance. Detailed specifications for the lubricating oil, grease, gases, servo fluids, control fluids, chemicals etc. required for the complete plant covered herein shall be furnished. On completion of erection, a complete list of bearings/ equipment giving their location and identification marks shall be furnished to the Employer alongwith lubrication requirements.
14.00.00	**LUBRICATION**
14.01.00	Equipment shall be lubricated by systems designed for continuous operation. Lubricant level indicators shall be furnished and marked to indicate proper levels under both standstill and operating conditions.
15.00.00	**MATERIAL OF CONSTRUCTION**
15.01.00	All materials used for the construction of the equipment shall be new and shall be in accordance with the requirements of this specification. Materials utilised for various components shall be those which have established themselves for use in such applications.
16.00.00	**RATING PLATES, NAME PLATES & LABELS**

16.01.00	Each main and auxiliary item of plant shall have permanently attached to it in a conspicuous position, a rating plate of non-corrosive material upon which shall be engraved manufacturer's name, equipment, type or serial number together with details of the ratings, service conditions under which the item of plant in question has been designed to operate, and such diagram plates as may be required by the Employer.
16.02.00	Each item of plant shall be provided with nameplate or label designating the service of the particular equipment. The inscriptions shall be approved by the Employer or as detailed in appropriate section of the technical specifications.
16.03.00	Such nameplates or labels shall be of white non-hygroscopic material with engraved black lettering or alternately, in the case of indoor circuit breakers, starters, etc. of transparent plastic material with suitably coloured lettering engraved on the back.
16.04.00	Items of plant such as valves, which are subject to handling, shall be provided with an engraved chromium plated nameplate or label with engraving filled with enamel. The name plates for valves shall be marked in accordance with MSS standard SP-25 and ANSI B 16.34 as a minimum.
16.05.00	Hanger/ support numbers shall be marked on all pipe supports, anchors, hangers, snubbers and restraint assemblies. Each constant and variable spring support shall also have stamped upon it the designed hot and cold load which it is intended to support.
16.06.00	Valves, steam traps and strainers shall be identified by Employer's tag number of a metal tap permanently attached to non-pressure parts such as the yoke by a stainless steel wire. The direction of flow shall also be marked on the body.
16.07.00	Safety and relief valves shall be provided with the following: a) Manufacturer's identification. b) Nominal inlet and outlet sizes in mm. c) Set pressure in Kg/cm^2 (abs). d) Blowdown and accumulation as percentage of set pressure. e) Certified capacity in Kg of saturated steam per hour or in case of liquid certified capacity in litres of water per minute.
16.08.00	All such plates, instruction plates, etc. shall be bilingual with Hindi inscription first, followed by English. Alternatively, two separate plates one with Hindi and the other with English inscriptions may be provided.

16.09.00 All segregated phases of conductors or bus ducts, indoor or outdoor, shall be provided with coloured phase plates to clearly identify the phase of the system.

17.00.00 **TOOLS AND TACKLES**

The Contractor shall supply with the equipment one complete set of all special tools and tackles and other instruments required and other instruments for the erection, assembly, disassembly and proper maintenance of the plant and equipment and systems (including software). These special tools will also include special material handling equipment, jigs and fixtures for maintenance and calibration / readjustment, checking and measurement aids etc. A list of such tools and tackles shall be submitted by the Bidder alongwith the offer.

The price of each tool / tackle shall be deemed to have been included in the total bid price. These tools and tackles shall be separately packed and sent to site. The Contractor shall also ensure that these tools and tackles are not used by him during erection, commissioning and initial operation. For this period the Contractor should bring his own tools and tackles. All the tools and tackles shall be of reputed make acceptable to the Employer.

18.00.00 **WELDING**

18.01.00 If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipments to be performed by others the requirements shall be submitted to the Employer in advance of commencement of erection work.

19.00.00 **COLOUR CODE FOR ALL EQUIPMENTS/ PIPINGS/ PIPE SERVICES**

19.01.00 All equipment/ piping/ pipe services are to be painted by the Contractor in accordance with Employer's standard colour coding scheme, which will be furnished to the Contractor during detailed engineering stage.

20.00.00 **PROTECTION AND PRESERVATIVE SHOP COATING**

20.01.00 **PROTECTION**

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either metallic or a non-metallic protection device. All ends of all valves and piping and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. All primers/paints/coatings shall take into account the hot humid, corrosive & alkaline, subsoil or over ground environment as the case may be. The requirements for painting specification shall be complied with as detailed out in Part-A & B of the Technical Specification.

20.02.00 **PRESERVATIVE SHOP COATING**

	All exposed metallic surfaces subject to corrosion shall be protected by shop application of suitable coatings. All surfaces which will not be easily accessible after the shop assembly, shall be treated beforehand and protected for the life of the equipment. All surfaces shall be thoroughly cleaned of all mill scales, oxides and other coatings and prepared in the shop. The surfaces that are to be finish-painted after installation or require corrosion protection until installation, shall be shop painted as per the requirements covered in the relevant part of the Technical Specification. Transformers and other electrical equipments, if included shall be shop finished with one or more coats of primer and two coats of high grade resistance enamel. The finished colors shall be as per manufacturer's standards, to be selected and specified by the Employer at a later date.
20.03.00	Shop primer for all steel surfaces which will be exposed to operating temperature below 95 degrees Celsius shall be selected by the Contractor after obtaining specific approval of the Employer regarding the quality of primer proposed to be applied. Special high temperature primer shall be used on surfaces exposed to temperature higher than 95 degrees Celsius and such primer shall also be subject to the approval of the Employer.
20.04.00	All other steel surfaces which are not to be painted shall be coated with suitable dust preventive compound subject to the approval of the Employer.
20.05.00	All piping shall be cleaned after shop assembly by shot blasting or other means approved by the Employer. Lube oil piping or carbon steel shall be pickled.
20.06.00	Painting for Civil structures and equipment/system covered under this package shall be done as specified under technical requirements on civil works in relevant part of this specifications.
21.00.00	**QUALITY ASSURANCE PROGRAMME**
21.01.00	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 Employer’s site or at any other place of 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 Employer/authorised representative after discussions before the award of the contract. The QA programme shall be generally in line with ISO-9001/IS-14001. 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) Quality System Manual

c) Design Control System

d) Documentation Control System

e) Qualification data for Bidder's key Personnel.

f) 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.

g) System for shop manufacturing and site erection control including process controls and fabrication and assembly controls.

h) Control of non-conforming items and system for corrective actions.

i) Inspection and test procedure both for manufacture and field activities.

j) Control of calibration and testing of measuring testing equipments.

k) System for Quality Audits.

l) System for indication and appraisal of inspection status.

m) System for authorising release of manufactured product to the Employer.

n) System for handling storage and delivery.

o) System for maintenance of records, and

p) 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 .Formats for the same will be shared along with QA Coordination procedure.

22.00.00 **GENERAL REQUIREMENTS - QUALITY ASSURANCE**

22.01.00 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 Employer. The detailed Quality Plans for manufacturing and field activities shall be drawn up by the Bidder and will

	be submitted to Employer for approval. Schedule of finalisation of such quality plans will be finalised before award on enclosed format No. QS-01-QAI-P-1/F3-R0. Monthly progress reports shall be furnished.
22.02.00	Manufacturing Quality Plan will detail out for all the components and equipment,various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's/ Sub-contractor's/ sub-supplier's Quality Control Organisation, 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. The Quality Plan shall be submitted on electronic media through C-folders, a web based system of NTPC ERP, for review and approval.
22.03.00	Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Contractor's "Site Quality Control Organisation", during various stages of site activities starting from receipt of materials/equipment at site.
22.04.00	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 Employer's approval without which manufacturer shall not proceed. These approved documents shall form a part of the contract. In these approved Quality Plans, Employer shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the Employer's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Employer in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Employer along with technical justification for approval and dispositioning.
22.05.00	The contractor shall submit to the Employer Field Welding Schedule for field welding activities in the format enclosed at **Annexure-V.** The field welding schedule shall be submitted to the Employer along with all supporting documents, like welding procedures, heat treatment procedures, NDT procedures etc. at least ninety days before schedule start of erection work at site.
22.06.00	The contractor shall have suitable Field Quality Organization with adequate manpower at Employer's site, to effectively implement the Field Quality Plan (FQP) and Field Quality Management System for site activities. The contractor shall submit the details of proposed FQA setup (organizational structure and manpower) for employer's approval. The FQA setup shall be in place at least one month before the start of site activities.

22.07.00	No material shall be despatched from the manufacturer's works before the same is accepted by Employer's Project Manager/Authorised representative and duly authorised for despatch by issuance of Material Dispatch Clearance Certificate (MDCC / CHP Clearance).
22.08.00	All material used for equipment manufacture including casting and forging etc. shall be of tested quality as per relevant codes/standards. Details of results of the tests conducted to determine the mechanical properties; chemical analysis and details of heat treatment procedure recommended and actually followed shall be recorded on certificates and time temperature chart. Tests shall be carried out as per applicable material standards and/or agreed details
22.09.00	All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section IX/BS-4870 or other International equivalent standard acceptable to the Employer. All welding/brazing procedures shall be submitted to the Employer or its authorized representative prior to carrying out the welding/brazing.
22.10.00	All brazers, welders and welding operators employed on any part of the contract either in Contractor's/his sub-contractor's works or at site or elsewhere shall be qualified as per ASME Section-IX or BS-4871 or other equivalent International Standards acceptable to the Employer. All welding / brazing procedures qualified / used at shop, will be made available to NTPC during audit / inspection. Procedures to be qualified at site will be submitted to NTPC for approval.
22.11.00	Not Used.
22.12.00	For all IBR pressure parts and high pressure piping welding, the latest applicable requirements of the IBR (Indian Boiler Regulations) shall also be essentially complied with. However, other piping shall be as per relevant code. Similarly, any other statutory requirements for the equipment/systems shall also be complied with. On all back-gauged welds MPI/LPI shall be carried before seal welding
22.13.00	All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.
22.14.00	No welding shall be carried out on cast iron components for repair.
22.15.00	Unless otherwise proven and specifically agreed with the Employer, welding of dissimilar materials and high alloy materials shall be carried out at shop only.
22.16.00	All non-destructive examination shall be performed in accordance with written procedures as per International Standards, The NDT operator shall be qualified as per SNT-TC-IA (of the American Society of non-destructive examination). NDT shall be recorded in a report, which includes details of methods and equipment used, result/evaluation, job data and identification of personnel employed and details of co-relation of the test report with the job.

In general all plates of thickness greater than 40mm & for pressure parts plates of thickness equal to or greater than 25mm shall be ultrasonically tested otherwise as specified in respective equipment specification. All bar stock/Forging of diameter equal to or greater than 40 mm shall be Ultrasonically tested.

22.17.00 The Contractor shall list out all major items/ equipment/ components to be manufactured in house as well as procured from sub-contractors (BOI).

All the sub-vendors proposed by the Main contractor for procurement of major bought out items including castings, forgings, semi-finished and finished components/equipment etc., list of which shall be drawn up by the Contractor and finalised with the Employer, shall be subject to Employer's approval on enclosed format as Annexure-III.

List of NTPC approved sub vendors against similar Pkg/items is attached as Section-VI, Part-B ,Chapter E-60 Indicative sub-vendor list.

The contractor's proposal for any new sub vendor for any of the items identified in indicative sub-vendor list shall necessarily be furnished in the sub vendor questionnaire & main Contractor Evaluation report format attached as Annexure- VII with all relevant documents and main contractor's own assessment report assessed as per their quality management system for NTPC review and acceptance .

New sub vendor proposal will only be considered for NTPC review, provided the proposal is received sufficiently in time: 90 days prior to ordering date of a Bought-Out Items/Start of Manufacturing so as not to impede the progress of the contract.

Major checks and quality requirements as mentioned below shall necessarily be assessed by main contractor and complied with documentary support in case the same is not the part of their Quality management system.

i. Duly Filled Main supplier Evaluation Report.
ii. Duly Filled Sub-Supplier Questionnaire.
iii. Factory Registration Certificate.
iv. Overall Organization Chart with Manpower details (Design, Manufacturing, Quality etc.)
v. Supply reference list of the Sub-Supplier indicating similar product supply order reference no., customer name, rating of product, date /year of supply, date / year of commissioning.
vi. List of Manufacturing Equipment available with sub vendor.
vii. List of Testing Equipment available with sub vendor.
viii. Manufacturing process execution plan with flow chart indicating various stages of manufacturing from raw material to finished product including outsourced process, if any.
ix. Details of Outsourced Manufacturing Processes, if any.
x. Quality control exercised during receipt, in-process & final inspection.
xi. Compliance of Statutory requirements (As applicable)

After first submission of proposal to NTPC , In absence of relevant documents/ Incompleteness of the proposal, The main contractor will be given a period of maximum 10 days to submit the compliance of the NTPC comments. In case of noncompliance it will be

	presumed that main contractor is not serious about pursuing the proposal & the proposal will be foreclosed. The proposed Sub vendor will be assessed broadly on following criteria i) Quality Management System Compliance including raw material/BOI control, traceability & control over outsources process ii) Design Capabilities (As applicable) iii) Manufacturing, Testing & Storage Facility iv) Processing Capabilities v) Supply Experience vi) Safety Aspect In case of major observations or non-compliance observed during sub vendor works visit (Jointly with the main contractor) with respect to the submitted documents, proposed sub vendor will not be considered for acceptance and Main contractor will be solely responsible in such cases. Monthly progress reports on sub-vendor detail. Submission / approval shall be furnished preferably on enclosed format at Annexure-IV. Such vendor approval shall not relieve the contractor from any obligation, duty or responsibility under the contract.
22.18.00	For components/equipment procured by the contractors for the purpose of the contract, after obtaining the written approval of the Employer, the contractor's purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the sub-contractor shall set out, during the various stages of manufacture and installation, the quality practices and procedures followed by the vendor's quality control organisation, the relevant reference documents/standards used, acceptance level, inspection of documentation raised, etc. Such quality plans of the successful vendors shall be finalised with the Employer and such approved Quality Plans shall form a part of the purchase order/contract between the Contractor and sub-contractor. Within two (2) weeks of the release of the purchase orders /contracts for such bought out items /components, a copy of the same without price details but together with the detailed purchase specifications, quality plans and delivery conditions shall be furnished to the Employer on the monthly basis by the Contractor along with a report of the Purchase Order placed so far for the contract.
22.19.00	Employer reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub-contractor's quality management and control activities. The contractor shall provide all necessary assistance to enable the Employer carry out such audit and surveillance.
22.20.00	The contractor shall carry out an inspection and testing programme during manufacture in his work and that of his subcontractor's and at site to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identity and acceptability of all materials parts and equipment. Contractor shall carry out all tests/inspection required to establish that the items/equipment conform to requirements of the specification and

	the relevant codes/standards specified in the specification, in addition to carrying out tests as per the approved quality plan.
22.21.00	Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Employer to reject the equipment if it does not comply with the specification when erected or does not give complete satisfaction in service and the above shall in no way limit the liabilities and responsibilities of the Contractor in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc.
22.22.00	For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.
22.23.00	Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Employer/ authorised representative.
22.24.00	**Environmental Stress Screening** Environmental stress screening test process / procedure for eliminating infant mortile components for DDCMIS / PLC based system & for other systems having substantial electronics components (as determined by employer) like Electronic transmitter, CCTV components, PA systems etc. shall be furnished for NTPC acceptance
22.25.00	The Contractor / Sub-contractor shall carry out routine test on 100% item at contractor / sub-contractor's works. The quantum of check / test for routine & acceptance test by employer shall be generally as per criteria / sampling plan defined in referred standards. Wherever standards have not been mentioned quantum of check / test for routine / acceptance test shall be as agreed during detailed engineering stage.
22.26.00	**Software Reliability / Quality Certification** Certification from OEM's authorized signatory that software offered with DDCMIS, PLC, CCTV, PA, Pyrometer, CEMS, AAQMS, EQMS, BHMS etc. declaring that the all the offered software(s) had gone through the established software quality test and offered software is not of β-version and offered software is also free from all known bugs as on date of approval of systems documents by NTPC as a part of quality documentation review and approval process during detail engineering.
23.00.00	**QUALITY ASSURANCE DOCUMENTS**
23.01.00	The Contractor shall be required to submit the QA Documentation in soft copies, as identified in respective quality plan with tick (✓)mark.
23.01.01	Each QA Documentation shall have a project specific Cover Sheet bearing name & identification number of equipment and including an index of its contents with page control on each document.

The QA Documentation file shall be progressively completed by the Supplier's sub-supplier to allow regular reviews by all parties during the manufacturing.

The final quality document will be compiled and issued at the final assembly place of equipment before despatch. However, **soft copies will be furnished** not later than two (2) weeks.

23.02.00 Typical contents of QA Documentation is as below:-

(a.) Quality Plan

(b.) Material mill test reports on components as specified by the specification and approved Quality Plans.

(c.) Manufacturer / works test reports/results for testing required as per applicable codes and standard referred in the specification and approved Quality Plans.

(d.) Non-destructive examination results /reports including radiography interpretation reports. Sketches/drawings used for indicating the method of traceability of the radiographs to the location on the equipment.

(e.) Heat Treatment Certificate/Record (Time- temperature Chart)

(f.) All the accepted Non-conformance Reports (Major/Minor)/deviation, including complete technical details / repair procedure).

(g.) CHP / Inspection reports duly signed by the Inspector of the Employer and Contractor for the agreed Customer Hold Points.

(h.) Certificate of Conformance (COC) wherever applicable.

(i.) MDCC

23.03.00 Similarly, the contractor shall be required to submit soft copies containing QA Documentation pertaining to field activities as per Approved Field Quality Plans and other agreed manuals/ procedures, prior to commissioning of individual system.

23.04.00 Before despatch / commissioning of any equipment, the Supplier shall make sure that the corresponding quality document or in the case of protracted phased deliveries, the applicable section of the quality document file is completed. The supplier will then notify the Inspector regarding the readiness of the quality document (or applicable section) for review.

(a.) If the result of the review carried out by the Inspector is satisfactory, the Inspector shall stamp the quality document (or applicable section) for release.

(b.) If the quality document is unsatisfactory, the Supplier shall endeavor to correct the incompleteness, thus allowing to finalize the quality document (or applicable section) by time compatible with the requirements as per contract documents. When it is done, the quality document (or applicable section) is stamped by the Inspector.

(c.) If a decision is made for despatch, whereas all outstanding actions cannot be readily cleared for the release of the quality document by that time, the supplier shall immediately, upon shipment of the equipment, send a copy of the quality document Review Status signed by the Supplier Representative to the Inspector and notify of the committed date for the completion of all outstanding actions & submission. The Inspector shall stamp the quality document for applicable section when it is effectively completed. The submission of QA documentation package shall not be later than two (2) weeks after the despatch of equipment.

23.05.00 **TRANSMISSION OF QA DOCUMENTATION**

On release of QA Documentation by Inspector, one set of quality document shall be forwarded to Corporate Quality Assurance Department and other set to respective Project Site of Employer.

For the particular case of phased deliveries, the complete quality document to the Employer shall be issued not later than two (2) weeks after the date of the last delivery of equipment.

24.00.00 **PROJECT MANAGER'S SUPERVISION**

24.01.00 To eliminate delays and avoid disputes and litigation, it is agreed between the parties to the Contract that all matters and questions shall be referred to the Project Manager and without prejudice to the provisions of 'Arbitration' clause in Section GCC, the Contractor shall proceed to comply with the Project Manager's decision.

24.02.00 The work shall be performed under the supervision of the Project Manager.

The scope of the duties of the Project Manager pursuant to the Contract, will include but not be limited to the following:

(a.) Interpretation of all the terms and conditions of these documents and specifications

(b.) Review and interpretation of all the Contractor's drawing, engineering data, etc.

(c.) Witness or his authorised representative to witness tests and trials either at the manufacturer's works or at site, or at any place where work is performed under the contract

(d.) Inspect, accept or reject any equipment, material and work under the contract

(e.) Issue certificate of acceptance and/or progressive payment and final payment certificates

(f.) Review and suggest modifications and improvement in completion schedules from time to time, and

(g.) Supervise Quality Assurance Programme implementation at all stages of the works.

25.00.00 **INSPECTION, TESTING AND INSPECTION CERTIFICATES**

25.01.00 The word 'Inspector' shall mean the Project Manager and/or his authorised representative and/or an outside inspection agency acting on behalf of the Employer to inspect and examine the materials and workmanship of the works during its manufacture or erection.

25.02.00 The Project Manager or his duly authorised representative and/or an outside inspection agency acting on behalf of the Employer shall have access 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 Project Manager 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.

25.03.00 The Contractor shall give the Project Manager/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account except for the expenses of the Inspector's. The Project Manager/Inspector, unless the witnessing of the tests is virtually waived and confirmed in writing, will attend such tests within fifteen (15) days of the date on which the equipment is noticed as being ready for test/inspection failing which the contractor may proceed with test which shall be deemed to have been made in the inspector's presence and he shall forthwith forward to the inspector duly certified copies of test reports in two (2) copies.

25.04.00	The Project Manager 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. 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 inform in writing to the Project Manager/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.
25.05.00	When the factory tests have been completed at the Contractor's or subcontractor's works, the Project Manager /Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Project Manager /Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Project Manager /Inspector. Failure on the part of Project Manager /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 Employer to accept the equipment should it, on further tests after erection be found not to comply with the contract.
25.06.00	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, material, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Project Manager /Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Contractor and shall give facilities to the Project Manager/Inspector or to his authorised representative to accomplish testing.
25.07.00	The inspection by Project Manager / Inspector and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed Quality Assurance Programme forming a part of the contract.
25.08.00	To facilitate advance planning of inspection in addition to giving inspection notice as specified at clause no. 25.03.00 - of this chapter, the Contractor shall furnish quarterly inspection programme indicating 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.
25.09.00	All inspection, measuring and test equipment used by contractor shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Contractor shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by NTPC. Wherever asked specifically, the contractor shall re-calibrate the measuring/test equipment in the presence of Project Manager / Inspector.

25.10.00	**ASSOCIATED DOCUMENT FOR QUALITY ASSURANCE PROGRAMME**
25.10.01	List of items requiring quality plan and sub supplier approval. Format No.: QS-01-QAI-P-01/F3-R0 **(Annexure-III).**
25.10.02	Status of items requiring Quality Plan and sub supplier approval. Format enclosed at **Annexure-IV.**
25.10.03	Field Welding Schedule Format enclosed at **Annexure-V.**
25.11.00	**TESTING OF MAJOR DESIGN FEATURES:** The major design features of the system shall be demonstrated by the Contractor at the Contractor's works or any other place mutually agreed within Six months from the date of LOA. These are the system function tests, which have a major impact on the detailed system design & finalization of important engineering documents like configuration, functional grouping, BOM etc., but do not require a fully engineered system for conductance. Bidder shall identify these features & include detailed test procedures in the bid, which shall be finalized during discussions with the bidder before award. The developments and any augmentation of standard features undertaken by the Bidder to fulfill the various specification requirements, shall be also be tested during these major design tests. This shall include but not be limited to the following. a) System accuracy tests of DDCMIS for the various type of inputs identified in Part-B. b) Loop reaction time for sample loops/ logics. c) SOE functionality tests. d) Server changeover. e) Various response times, having serious implication on operation & maintenance philosophy. f) Duty cycle of controller/ HMIPIS with simulated load, representative of the final engineered load. g) Connectivity of Switchgear DDCMIS with Switchgear Relay Network. The results of the above tests, after its acceptance by the Employer, shall be properly documented and submitted to Employer. **If any of the envisaged tests have been carried out by Bidder in a previous NTPC project, then the same need not be specifically conducted by the Bidder**

for this project, provided it is clearly established by the Bidder & accepted by the Employer that there is no difference between the system offered for this project & the previous NTPC project with respect to the test. However, even in such a case, test report of the previous project shall be submitted by the Bidder as a part of MDFT (Major Design Feature Test) test report.

25.12.00 **DEMONSTRATION OF APPLICATION ENGINEERING**

25.12.01 Contractor shall prepare and submit typical implemented scheme in their system (Control system & HMI) on sample basis. The typical cases to be covered shall include but not be limited to the following.

(i) Logics/Loops:

a) Drive logics implementation for each type of binary drive along with its display in HMI.

b) Sequence implementation along with its display in HMI.

c) Single non-cascade controller implementation.

d) Cascade loop implementation.

e) Master slave implementation with different slave combination.

f) Temperature & pressure compensation for flow signals & pressure compensation for level signals as applicable.

(ii) HMI Functions:

a) LVS Annunciation.

b) Graphics.

c) HSR

d) Logs/Reports.

e) Calculations (Basic & Performance Calculations).

25.12.02 The above typical cases shall be finalized with the Employer through Technical Co-ordination meetings.

After review and finalization of the typical cases, the implementation of each logic & control loop shall be carried out by the Contractor. After implementation of these logics & loops, the Contractor shall test each logic /loop and record the observations and demonstrate to Employer at Employer premises during engineering finalization. Any modifications as a result of the demonstration shall be done and documented as

part of the test report along with the final scheme. Similarly, HMI functions shall also be demonstrated by the Contractor at Employer premises & the results shall be documented as part of test report.

25.12.03 During the integrated testing at the Contractor's works, only sample checks shall be done by the Employer for the items covered in above application engineering demonstration.

26.00.00 **PRE-COMMISSIONING AND COMMISSIONING FACILITIES**

26.01.00 (a) As soon as the facilities or part thereof has been completed operationally and structurally and before start-up, each item of the equipment and systems forming part of facilities shall be thoroughly cleaned and then inspected jointly by the Employer and the Contractor for correctness of and completeness of facility or part thereof and acceptability for initial pre-commissioning tests, commissioning and start-up at Site. The list of pre-commissioning tests to be performed shall be as mutually agreed and included in the Contractor's quality assurance programme as well as those included in Part-D, Section-VI and elsewhere in the Technical Specifications.

(b) The Contractor's pre-commissioning/ commissioning/start-up engineers, specially identified as far as possible, shall be responsible for carrying out all the pre-commissioning tests at Site. On completion of inspection, checking and after the pre-commissioning tests are satisfactorily over, the commissioning of the complete facilities shall be commenced during which period the complete facilities, equipments shall be operated integral with sub-systems and supporting equipment as a complete plant.

(c) All piping system shall be flushed, steam blown, air blown as required and cleanliness demonstrated using acceptable industry standards. Procedures to accomplish this work shall be submitted for approval to the Employer six months prior to the respective implementations. The Employer will approve final verification of cleanliness.

(d) The time consumed in the inspection and checking of the units shall be considered as a part of the erection and installation period.

(e) The check outs during the pre-commissioning period should be programmed to follow the construction completion schedule. Each equipment/system, as it is completed in construction and turned over to Employer's commissioning (start-up) Engineer(s), should be checked out and cleaned. The checking and inspection of individual systems should then follow a prescribed schedule to be agreed by Employer.

(f) The Contractor during initial operation and performance testing shall conduct vibration testing to determine the 'base line' of performance of all plant

rotating equipment. These tests shall be conducted when the equipment is running at the base load, peak load as well as lowest sustained operating condition as far as practicable.

26.01.00 Contractor shall furnish the commissioning organization chart for review & acceptance of employer at least eighteen months prior to the schedule date of synchronization of 1st unit. The chart should contain:

(1.) Biodata including experience of the Commissioning Engineers.
(2.) Role and responsibilities of the Commissioning Organisation members.
(3.) Expected duration of posting of the above Commissioning Engineers at site.

26.02.00 **Initial Operation**

(a) On completion of all pre-commissioning activities/ tests and as a part of commissioning the complete facilities shall be put on 'Initial Operation' during which period all necessary adjustments shall be made while operating over the full load range enabling the facilities to be made ready for the Guarantee Tests.

(b) The 'Initial Operation' of the complete facility as an integral unit shall be conducted for 720 continuous hours. During the period of initial operation of 720 hours, the unit shall operate continuously at full rated load for a period not less than 72 hours with demonstration of the capability of the machine to raise load upto 105% of full rated load.

The Initial Operation shall be considered successful, provided that each item/ part of the facility can operate continuously at the specified operating characteristics, for the period of Initial Operation with all operating parameters within the specified limits and at or near the predicted performance of the equipment/ facility.

The Contractor shall intimate the Employer about the commencement of initial operation and shall furnish adequate notice to the Employer in this respect.

(c) Any loss of generation due to constraints attributable to the Employer shall be construed as Deemed Generation.

(d) An Initial Operation report comprising of observations and recordings of various parameters to be measured in respect of the above Initial Operation shall be prepared by the Contractor. This report, besides recording the details of the various observations during initial operation shall also include the dates of start and finish of the Initial Operation and shall be signed by the representatives of both the parties. The report shall have sheets, recording all the details of interruptions occurred, adjustments made and any minor repairs done during the Initial Operation. Based on the observations, necessary modifications/repairs to the plant shall be carried out by the Contractor to the full satisfaction of the Employer to enable the latter to accord permission to carry out the Guarantee tests on the facilities. However, minor defects which do not endanger the safe operation of the

equipment, shall not be considered as reasons for with- holding the aforesaid permission.

26.03.00 **Guarantee Tests**

a) The final test as to prove the Functional Guarantees shall be conducted at Site by the Contractor in presence of the Employer. To conduct such tests, the contractor's Commissioning, start-up Engineer shall make the unit ready (including tuning and all other enabling activities as required for PG tests) before start of initial operation. Such test shall be conducted along with the Initial Operations.

b) These tests shall be binding on both the parties of the Contract to determine compliance of the equipment with the functional guarantee.

c) For performance/ demonstration tests instrumentations, of accuracy class shall be as per specified test codes. The numbers and location of the instruments shall be as per the specified test codes. In addition the values of parameters shall be logged from the information system provided under Employer's Distributed Digital Control Monitoring and Information system. Test will be conducted at specified load points.

d) Any special equipment, tools and tackles required for the successful completion of the Guarantee Tests shall be provided by the Contractor, free of cost.

e) The Guarantee tests and specific tests to be conducted on equipments have been brought out in detail elsewhere in the specifications.

26.04.00 Before start of commissioning of critical equipment, Commissioning Clearance Certificate (CCC) to be submitted by Main contractor. List of the critical equipments **and CCC format will be provided along with QA Coordination procedure.**

27.00.00 **TAKING OVER**

Upon successful completion of Initial Operations and all the tests conducted to the Employer's satisfaction, the Employer shall issue to the Contractor a Taking over Certificate as a proof of the final acceptance of the equipment. Such certificate shall not unreasonably be withheld nor will the Employer delay the issuance thereof, on account of minor omissions or defects which do not affect the commercial operation and/or cause any serious risk to the equipment. Such certificate shall not relieve the Contractor of any of his obligations which otherwise survive, by the terms and conditions of the Contract after issuance of such certificate.

28.00.00 **TRAINING OF EMPLOYER'S PERSONNEL**

28.01.00 The scope of service under training of Employer’s engineers shall include a training module covering the areas of Operation & Maintenance.

Such training should cover the following areas as a minimum in order to enable these personnel to individually take the responsibility of operating and maintaining the power station in a manner acceptable to the Employer:

(a) Training for Steam Generator & ESP Equipment, TG & Auxiliaries and related equipments.

(b) Training for Electric Systems including VFD and Electric power supply system.

(c) Training for other SG/TG related C&I systems/equipments including training on Flame Monitoring System, Furnace and Flame Viewing System , Turbine Supervisory System (TSS) including vibration analyzer, vibration monitoring system axial shift, eccentricity measurements etc. for Main Turbine, BFP Turbine etc. Burner management study, control loop study, misc. system for SG C&I, EHTC, Turbine stress control system, Turbine protection system, ATRS, instrumentation etc.

c1: Training on Engineering, Model building,pre-testing, Post -test fine tuning of Advance process control systems with faculty having experience of atleast 5 years in Model Process Control.

(d) Training for special packages specified elsewhere in Technical Specification, Section-VI.

(e) Training for various C&I systems/equipment supplied includes the following:

i) DDCMIS - Human Machine Interface – Hardware & Operating System

ii) DDCMIS-Human Machine Interface System Engineering & Application Software.

iii) DDCMIS – Control System Hardware and Control system Application Software.

iv) DDCMIS – Operator Training : Use of the system at Works + at site.

v) DDCMIS – Specialized Network security.

(f) Training for power cycle piping/critical piping.

(g) Training for UPS systems Annunciation system, SWAS, PA system, flue gas analyzers, CCTV and 24 VDC system.

(h) Training on following aspects of fieldbus (i) Hardware & Software features (ii) System design, diagnostic and testing (iii) maintenance, troubleshooting and fault analysis.

(i) Training on Non-Intrusive hardwired Electric Actuator and Fieldbus based Electric Actuator along with detail training on Foundation Fieldbus/ Profibus interface used in actuator

(k) Training for numerical relays & networking systems supplied under MV & LT switchgear system.

(l) Training courses on offered PLC system in the following areas:

(a.) Operator training

(b.) Hardware Maintenance training

(c.) Software training

(d.) Any other specialized training as required for system operation and maintenance.

(m) Training for Ash Handling System & Coal Handling Plant Equipment and Auxiliaries

Area	Topics	Mandays
Ash Handling Plant	Product design - Basic design features - Theory & principle of operation - Latest technological trends in Ash handling plant and design Plant Visit - Operational feedback - O&M history/problems related to Ash handling plant Visit to Manufacturer's Work - Manufacturing process of Ash handling equipments - Testing facilities Operation & Maintenance of Plant - Trouble shooting and fault analysis - Familiarization of special maintenance techniques - Special tool and tackles familiarization	300
Coal Handling Plant	Product design - Basic design features - Theory & principle of operation - Latest technological trends in Coal handling plant and design Plant Visit - Operational feedback - O&M history/problems related to Coal handling plant Visit to Manufacturer's Work - Manufacturing process of Coal handling equipments - Testing facilities Operation & Maintenance of Plant - Trouble shooting and fault analysis - Familiarization of special maintenance techniques - Special tool and tackles familiarization	150

n) Training for UF Membranes, RO membranes, Zero Liquid Discharge (ZLD) Chlorine Di-Oxide (ClO_2) generation & dosing system, Condensate Polishing Plant (CPU) and CW Treatment System.

Area	Topics	MANDAYS
UF Membranes	**Product design** -Basic design features -Theory & principle of operation -Latest technological trends in Ultrafiltration membranes and design -CIP & CEB of UF system **Plant Visit** -Operational feedback -O&M history/problems related to UF membranes **Visit to Manufacturer's Work** -Manufacturing process of UF membranes and equipment -Testing facilities **Operation & Maintenance of Plant** -Trouble shooting and fault analysis -Familiarization of special maintenance techniques -Special tool and tackles familiarization	**7**

Area	Topics	MANDAYS
RO membranes	**Product design** -Basic design features -Theory & principle of operation -Latest technological trends in RO membranes and design -Failure analysis, types of failures, causes & its evaluation, remedies -CIP of RO system	**7**

	Plant Visit -Operational feedback -O&M history/problems related to RO membranes **Visit to Manufacturer's Work** -Manufacturing process of RO membranes and equipment -Testing facilities **Operation & Maintenance of Plant** -Trouble shooting and fault analysis -Familiarization of special maintenance techniques -Special tool and tackles familiarization	
Zero Liquid Discharge (ZLD)	**System Design** - Plant water optimization and Scheme to achieve the ZLD - Basic design features - Latest technological trends for ZLD in Thermal Power Plant **Plant Visit** - Operational feedback - O&M history/problems related to plant	**5**
Chlorine Di-Oxide (ClO_2) generation & dosing system	**System/Product Design** - Basic design features - Theory & principle of operation - Latest technological trends in Chlorine Di-Oxide (ClO2) generation & dosing system and design aspects & Selection criteria. **Plant Visit** - Operational feedback - O&M history/ problems related to ClO2 plant **Performance Test of generator** - Generator capacity performance testing. **Operation & Maintenance of Plant** -Trouble shooting and fault analysis	**5**

	-Familiarization of special maintenance techniques -Special tool and tackles familiarization	
Condensate Polishing Plant (CPU)	**System/Product Design** - Basic design features including Pre-filters - Theory & principle of operation - Latest technological trends in CPU & Pre-filters and design aspects & Selection criteria. **Plant Visit** - Operational feedback - O&M history / problems related to CPU plant **Visit to Manufacturer's Work** -Manufacturing process of pre-filters and major equipment -Testing facilities **Operation & Maintenance of Plant** -Trouble shooting and fault analysis -Familiarization of special maintenance techniques -Special tool and tackles familiarization	**3**
CW Treatment System	**System/Product Design** - Basic design features - Theory & principle of operation - Latest technological trends and design aspects & Selection criteria. **Operation & Maintenance of Plant** - Operational feedback - O&M history / problems related to plant - Trouble shooting and fault analysis Familiarization of special maintenance techniques - Special tool and tackles familiarization	**3**
Note: One week shall constitute of five (5) man days.		

(o) Training for Electrical System

Area	Topics	MANDAYS
Generator	Product design -Design aspects of associated auxiliary systems - Familiarisation with cooling medium and arrangements, winding and core support systems Plant Visit -Operational feedback -O&M history/problems related to Insulation system Visit to Manufacturer's Work -Manufacturing process of core, winding bars, Assembly -Testing facilities Operation & Maintenance (Site) -Trouble shooting and fault analysis - Storage and Familiarization of special maintenance techniques -Special tool and tackles familiarization	60 (15+15+30)

Excitation systems including AVR	System Design - Design features of various sub systems, Exciter PMG - Excitation transformers, Controllers and different limiters - PSS and associated system studies Plant Visit - Operational feedback - O&M history/problems related to Excitation systems - Familiarization with various equipment functioning at reference plant Visit to Manufacturer's Work -Manufacturing process for various equipment of excitation systems -Testing facilities Operation & Maintenance (At site) -Trouble shooting and fault analysis -Familiarization of special maintenance techniques -Special tool and tackles familiarization Performance Test of generator - Generator capacity performance testing.	60 (15+15+30)
MV VFD (If applicable)	System/Product Design - Basic design features - Theory & principle of operation Plant Visit - Operational feedback - O&M history/ problems related to VFD - Familiarization with various equipment functioning at reference plant Operation & Maintenance (At Site) -Trouble shooting and fault analysis - Familiarization of special maintenance techniques -Special tool and tackles familiarization	90(15+15+60)
MV and LT switchgear	System/Product Design - Basic design features. - Relay configurations and hands on practices of logics and settings preparation - Preparation of CID/ICD/SCD files through	150 (45+15+90).

	relay software tools and Goose configurations. - Interfacing/communication of relay with software. - Secondary injection testing of protection functions. - Familiarisation of IMCC and Interface with DCS Plant Visit - Operational feedback - O&M history / problems Visit to Manufacturer's Work -Manufacturing process of equipment -Testing facilities Operation & Maintenance (At site) -Trouble shooting and fault analysis -Familiarization of Switchgear, IMCC and interface with DCS, relays and interfacing software. -Special tool and tackles familiarization	
MDBFP, CW and BMCP Motors	System/Product Design - Basic design features of stator core and rotor core, winding insulation and cooling arrangements - Theory & principle of operation - Study of forces and Vibration. - Diagnostic and testing Plant Visit - Operational feedback - O&M history / problems Visit to Manufacturer's Work -Manufacturing process of equipment -Testing facilities Operation & Maintenance (At site) - O&M practices Familiarization of special maintenance techniques - Special tool and tackles familiarization	45 (15+15+15)

Relays and Substation Automation System	System/Product Design - Basic design features. - Relay configurations and hands on practices of logics and settings preparation - Preparation of CID/ICD/SCD files through relay software tools and Goose configurations. - Interfacing/communication of relay with software. - Secondary injection/ Sampled value testing of protection functions. - Familiarisation of SAS and Cyber security Features. Plant Visit - Operational feedback - O&M history / problems Operation & Maintenance (At site) -Trouble shooting and fault analysis -Familiarization of relay configuration, settings and interfacing software. -Familiarization of SAS Hardware, software and Application software. - Secondary injection/ Sampled value testing of protection functions. - Familiarisation of cyber security features	75 (30+15+30)
AIS and bay equipment's	Operation & Maintenance (At site) -Erection, Storage and handling of bay equipment -Familiarization of special maintenance techniques -Special tool and tackles familiarization	30 (0+15+15)
Note: One week shall constitute of five (5) man days.		

(p) Training on Erection methodologies for all the Sub-packages, System and Equipments associated with the EPC Package, including a visit to power plant construction site.

The exact details, extent and schedule for training shall be as finalized during detailed engineering and shall be subject to Employer's approval.

28.03.00	The scope of services under training shall also necessarily include training of Employer's Engineering personnel covering entire scope for the package. This shall cover all disciplines viz, Mechanical, Electrical, C&I , QA etc. and shall include all the related areas like Design familiarization, training on product design features and product design software of major equipment and systems, engineering, manufacturing, erection, commissioning, training on operating features of equipment, quality assurance and testing, plant visits and visits to manufacturer's works, exposure to various kinds of problems which may be encountered in fabrication, manufacturing erection, welding etc.
28.04.00	Contractor shall also arrange for training of Employer's personnel in respect of fire detection and protection systems and other Balance of Plant equipments.
28.05.00	Contractor shall provide training on application of PAUT (Phased array ultrasonic testing) and TOFD (Time of flight diffraction) techniques for two weeks (at least 80 Hours). The training shall be arranged at least six months prior to the start of erection works of SG & TG works.
28.06.00	Exact details, extent of training and the training schedule shall be finalized based on the Bidder's proposal within two (2) months from placement of award.
28.07.00	In all the above cases, the lodging and boarding of the Employer's personnel shall be at the cost of Bidder. The Bidder shall make all necessary arrangements towards the same.
28.08.00	Take off prices (product wise) should be indicated by the Bidder in the Bid Proposal Sheets. Employer reserves the right to include or exclude these item(s) during placement of Award. **Note**: 1. For training purposes, one (1) man month implies 30 working days (excluding all intervening holidays) per person. 2. The total man months in each area shall be divided into suitable number of modules which shall be discussed and finalized during post award stage. 3. Duration of each module shall not be less than 10 (ten) working days out of which 20 % shall be for plant/manufacturers' works visits and 80% shall be classroom training. 4. A) Location of classroom training for engineering shall be at Design/Engineering office. B) Classroom training for erection/O&M shall be at location of Manufacturers' works.