

UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LTD.

PROJECT: 1 X 660MW PANKI THERMAL POWER EXTENSION

**TECHNICAL SPECIFICATION
FOR
MILL REJECT SYSTEM
(Pneumatic conveying type)**

SPECIFICATION NO.: PE-TS-426-160-A001



**BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT
PPEI BUILDING, NOIDA (U.P.)-INDIA**



**1X660 MW PANKI EXTN
TECHNICAL SPECIFICATION
FOR
MILL REJECT SYSTEM
(PNEUMATIC TYPE)**

SPECIFICATION No: PE-TS-426-160-A001

PACKAGE: MILL REJECT SYSTEM (PNEUMATIC TYPE)

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SCOPE OF ENQUIRY / INTENT OF SPECIFICATION

- 1.1 This specification includes, but not limited to, design, engineering, manufacturing, inspection and testing, painting, supply/delivery duly packed at project site including freight, unloading, storage and handling at site, erection and commissioning, trial run at site, performance guarantee test and handing over to the customer in line with drawings/ documents/ test procedures approved by BHEL/Customer for **Mill Reject System** including mandatory spares, erection and commissioning spares and tools and tackles.
- 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 responsibility of providing such facilities to complete the supply, erection and commissioning.
- 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 supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing.
- 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 / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under Section-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

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stringent requirement as per interpretation of Purchaser/Customer shall prevail and shall be complied by the bidder without any commercial implication on account of the same. Further in case of any missing information in the specification not brought out by the prospective bidders as part of pre-bid clarification, the same shall be furnished by Purchaser/Customer as and when brought to their notice either by the bidder or by purchaser/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication.

- 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 deviation schedule along with cost of withdrawal; otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification. If no cost of withdrawal is given against the deviation, it will be presumed that deviation can be withdrawn without any cost to BHEL/its customer.
- 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, 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.
- 1.12 Apart from specific design requirement for mill reject system, design of various systems/ Sub-systems and all equipment will also strictly meet the stipulations of Customer's Technical Specification.
- 1.13 The standard quality plan is included in this specification to enable the bidder to understand the extent of inspection and testing requirements to execute this job. The successful bidder has to follow the quality plan as minimum requirement during manufacturing and testing.

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SPECIFIC TECHNICAL REQUIREMENTS-MECHANICAL

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PROJECT INFORMATION

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CHAPTER 2 : GENERAL PROJECT INFORMATION**1.0 PROJECT INFORMATION**

1.1	Owner	:	UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LIMITED, LUCKNOW	
1.2	Project Title	:	Panki Thermal Power Station (1x660MW)	
1.3	Owner's Engineer	:	DEVELOPMENT CONSULTANTS PVT. LTD	
1.4	Project Site Location	:	Place	Panki
		:	District	Kanpur
		:	State	Uttar Pradesh
		:	Country	India
1.5	Latitude & Longitude of project site	:	North	N26 ⁰ 28'20"
		:	East	E 80 ⁰ 14'32"
1.6	Nearest Railway Station	:	Panki	5 km
1.7	Nearest Town	:	Kanpur	16km
1.8	Nearest Highway	:	National Highway - 25	
1.9	Nearest Airport	:	Kanpur	25 km
		:	Lucknow	80 Km
1.10	Nearest Commercial Airport	:	Delhi	140 km
1.11	Nearest Water Body	:	Lower Ganga Canal, adjacent to site	
1.12	Land	:	Land is in possession of UPRVUNL.	
1.13	Station Graded Level Elevation from Mean sea level (MSL)	:	Plant FGL → RL(+) 126.0M → El(-) 0.500M Plant FFL → RL(+) 126.5M → El(+/-) 0.000M	
1.14	Water	:		
1.14.1	Nearest Water Source	:	Lower Ganga Canal system running adjacent for project site	
1.14.2	Water Requirement for station	:	~ 1927 m ³ /hr considering closed cooling cycle with NDCT. Additional 700m ³ /hr for ash slurry preparation during emergency ash disposal to ash dyke.	
1.14.3	Raw Water Analysis from Upper Ganga Canal	:	Refer Appendix - I	
1.15	Site Ambient Condition	:		
1.15.1	Monthly mean (DBT)	:	Maximum	44.4 °C
		:	Minimum	3.8 °C
1.15.2	Extreme Recorded (DBT)	:	Maximum	47.3 °C
		:	Minimum	-0.9 °C
1.15.3	Monthly mean (WBT)	:	Maximum	27.3 °C
		:	Minimum	9.2 °C
1.15.4	Relative Humidity	:	Maximum	84 %
		:	Minimum	28 %
1.15.5	Average relative humidity	:	Annual Average	65 %
1.15.6	Rainfall	:	Annual average	832.6 mm



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			Heaviest fall recorded in 24 hrs	247.4 mm
1.15.7	Basic Wind Speed	:	47.00 m/s	As per IS: 875 part – III
			For wind resistance design of structure & equipment refer relevant civil section	
1.15.8	Climatic condition	:	For detailed information refer attached Climatological data as published by IMD for Kanpur station.	
1.16	Seismic data	:	Zone – III	As per IS: 1893
			For earthquake resistance design of structure & equipment refer relevant civil section	
1.17	Fuel Data			
1.17.1	Coal Source	:	Coal requirement for this stage of the project is estimated as 2.99 million tones/annum considering 660 MW capacity, GCV of blended coal 4030 kcal/kg, Heat Rate as 2317 kcal/kwh and 90% PLF as per CERC operative norms effective from 1/4/2009.	
1.17.2	Coal Transportation	:	Thru BOXN wagons of Indian Railways System	
1.17.3	Coal Analysis	:	Refer Appendix – II	
1.17.4	Support Fuel (HFO / LDO) transportation	:	Support fuel will be transported by road tankers or by Railway system. Start-up / support fuel for the proposed project will be LDO/HFO.	
1.17.5	Support Fuel (HFO / LDO) analysis	:	Refer Appendix - II	

Appendix – I: Raw Water Analysis (Source - Lower Ganga Canal)

S. No.	Description	Unit	Parameter
1	Physical characteristics		
	pH at 25°C	-	8.00
	Turbidity	Silica Scale	500
	Total Suspended solids	ppm	250
	Total Dissolved solids	ppm	241
	Colour	Hazen	< 5
2	Cations		
	Calcium Hardness	ppm as CaCO ₃	80
	Magnesium Hardness	ppm as CaCO ₃	40
	Sodium + Potassium	ppm as CaCO ₃	36
	Iron	ppm as CaCO ₃	1.5
	Total Cations	ppm as CaCO ₃	157.5
3	Anions		
	Bicarbonate	ppm as CaCO ₃	100
	Carbonate	ppm as CaCO ₃	0.95



S. No.	Description	Unit	Parameter
	Hydroxyl	ppm as CaCO ₃	0.05
	Chlorides	ppm as CaCO ₃	20
	Sulphate	ppm as CaCO ₃	36
	Nitrate	ppm as CaCO ₃	0.5
	Total Anions	ppm as CaCO ₃	157.5
4	Carbon Di-oxide as CO ₂	ppm	1.97
5	Dissolved Silica	ppm as SiO ₂	10.0
6	Colloidal Silica	ppm as SiO ₂	0.5
7	Organic Matter	ppm as O2	4.0

Appendix – II : Coal Quality Parameter

Sl.N o.	Particulars	Unit	Performance / Design Fuel	Worst Fuel	Best Fuel
1.0.	Proximate Analysis (As Received Basis)	By Weight			
1.1.	Moisture	%	10.5	12	12
1.2.	Ash	%	35	43	32
1.3.	Volatile Matter	%	26	19	27
1.4.	Fixed Carbon	%	28.5	26	29
1.5.	Total	%	100	100	100
1.6.	Gross Calorific Value	kcal/kg	3700	3200	4200
2.0.	Ultimate Analysis (As Received Basis)				
2.1.	Moisture	%	10.5	12	12
2.2.	Ash	%	35	43	32
2.3.	Carbon	%	42	33.5	44
2.4.	Hydrogen	%	2.0	2.4	2.77
2.5.	Nitrogen	%	1.6	1.3	1.5
2.6.	Sulfur	%	0.46	0.45	0.5
2.7.	Oxygen	%	8.44	7.35	7.23
2.8.	Total	%	100	100	100
3.0.	Hard Groove Index		53	50	55
4.0.	Ash Fusion Range				
a)	Initial Deformation Temperature	⁰ C	1200	1154	1165
b)	Hemispherical Temperature	⁰ C	1350	1300	>1350



Sl.No.	Particulars	Unit	Performance / Design Fuel	Worst Fuel	Best Fuel
c)	Fusion Temperature	°C	>1400	>1400	>1400

Source: Saharpur Jamarpani Coal Mine, Jharkhand
Imported Coal

Sl. No.	Item	Unit	Design Coal
1.	Gross heating Value	Kcal/kg	5500

Source: Indonesia / South African coal

Appendix – III : Light Diesel Oil (LDO)
As per IS: 1460-2000

S.No.	Property	Unit	Value
1.0	Ash content (max)	% by mass	0.02
2.0	Carbon residue (Rams Bottom) max	% by mass	0.2
3.0	Cetane number (Min)	-	-
4.0	Pour Point (max)		
	a) Winter	°C	12
	b) Summer		21
5.0	Flash Point (min)		
	a) Abel	°C	--
	b) Pensky0Martens		68
6.0	Kinematic Viscosity at 38 deg	Cst	2.5 to 15.7
7.0	Sediments (max)	% by mass	0.1
8.0	Sulphur Content (max)	% by mass	1.8
9.0	Water Content (max)	% by volume	
10.0	Gross Calorific Value (GCV), approx	kCal/kg	10,000
11.0	Density at 15°C	Kg/m ³	850 to 870

Appendix – IV : Heavy Fuel Oil (HFO)
As per IS: 1593-1982

S.No.	Property	Unit	Value
1.0	Viscosity at 50 °C	Cst	370
2.0	Density at 15°C (approx)	Kg/m ³	890 to 950
3.0	Flash Point (min)	°C	66
4.0	Pour Point (max)	°C	20
5.0	Water Content (max)	% by volume	1
6.0	Sediments (max)	% by weight	0.25
7.0	Sulphur Content (max)	% by weight	4.5
8.0	Ash content (max)	% by weight	0.1
9.0	Gross Calorific Value (GCV), approx	kCal/kg	10,000

2.0 Access to Site

The nearest town Kanpur is about 16 km from site. It is easily accessible by Railway/Road.



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Dedicated railway link is available for the transportation of coal and fuel oil for the power plant. No problem is envisaged in accessibility and transportation of heavy equipment to site by road or rail.

3.0 Plant Rating, Capacity, Availability, PLF

Plant continuous rating will be 660 MW at generator terminals based on the following site conditions.

- Ambient air temperature
- Condenser cooling water inlet temperature of 33°C and 10°C temperature rise across the condenser.
- Generator power factor of 0.85 (zero point eight-five).
- Fuel specification as given elsewhere.
- Design temperature for electrical equipment is 50°C.

The VWO capacity of the steam turbine 660 MW will be 105% or 693 MW and the Boiler maximum Continuous Rating (MCR) will be established to match the steam requirement at VWO conditions. The capacity of the unit is selected so as to deliver the rated output even after ageing that will occur between overhauls, as a result of deposition of salts in turbine blades, wear and tear etc.

4.0 Power Evacuation

The power generated from the proposed project will be evacuated over the 400 KV through a 400 KV open switchyard. Further to Switchyard distribution will be by UPTRANSCO. Interconnection of proposed 400 KV Switchyard with existing 220 kV switchyard shall be done as specified elsewhere in specification.



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SPECIFIC TECHNICAL REQUIREMENTS**

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SECTION – I

SPECIFIC TECHNICAL REQUIREMENTS

SUB-SECTION IA – Specific Technical Requirement (Mechanical)

SUB-SECTION IB – Specific Technical Requirement (Electrical)

SUB-SECTION IC – Specific Technical Requirement (C&I)

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1.0 SCOPE OF WORK

Design, engineering, manufacture, inspection and testing at vendor's/ sub-vendor's works, painting, forwarding, proper packing, shipment and delivery at site, unloading, handling & transportation at site, Erection & Commissioning, structural work, minor civil works as required, trial run, Performance Guarantee test and handing over of Mill Reject Handling System including supply of mandatory spares, erection and commissioning spares and tools & tackles as per details in different sections of this specification.

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

1.1 SCOPE OF SUPPLY

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

- a) Stack up assembly of pyrite hopper and conveying vessel below each mill shall comprise of following items.
 - 1 no. pneumatic cylinder operated knife gate valve with solenoid valve, open and close limit switches at mill outlet/pyrite hopper inlet.
 - 1 no. of pyrite hoppers complete with sizing grid, flexible/expansion joint at its inlet, rupture disc, by pass chute, oversize material chute, water spray nozzles & supporting structures.
 - Requisite sets of RF Type Level probes for Pyrite Hopper High / Permissive.
 - Requisite nos. of Temperature Switches for Pyrite hoppers.
 - 1 no. of manually operated knife gate valve at pyrite hopper outlet. If pneumatic valve is required at the outlet as per design of supplier, same shall be provided in addition to manual valve.
 - 1 no. of pneumatically operated knife gate valve at oversize discharge chute of pyrite hopper provided with solenoid valve, open & close limit switches for interlock with pyrite hopper inlet knife gate valve.
 - 1 no. of pneumatically operated knife gate valve at by pass chute of pyrite hopper provided with solenoid valve, open & close limit switches for interlock with pyrite hopper inlet knife gate valve.
 - 1 no. of transporter vessel complete with pneumatically operated inlet valve, Alloy CI outlet bend, local control panel etc.
 - 1 set of MS ERW pipe for mill reject conveying from transporter vessel to Mill Reject Storage bunker with all accessories like bends, fixtures, flange joints, structural steel supports, anchors/ inserts/ trestles, walkways etc. as required.
 - 1 lot of Alloy CI bends
 - 1 lot of Local Control Panel/pneumatic panels/JBs (1 set. for each pyrite hopper) properly mounted on rack along with required Stainless steel impulse/pneumatic tubing.



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- b) Terminal boxes (qty. as per layout) with up stand on bunker top for terminating the reject conveying pipes.
- c) 2 nos. mill reject bunkers, i.e., one no. mill reject bunkers per mill bay along with structure, liner (straight & conical) and motor operated bunker discharge gate with canvas chute at bunker outlet, staircase up to mill reject bunker roof top, operating & maintenance platform, hand railing, bag filter, level transmitter, pressure relieve valve, Electric Hoist and monorail arrangement etc. Each silo shall have an effective storage capacity of twenty-four (24) hours considering each mill in the bay rejecting @ 2.0% of mill capacity corresponding to unit operation at 100% BMCR with worst coal firing.
- d) 2 nos. (1 working + 1 standby) oil free screw type air compressors with drive motor, local control panel, instruments and all other accessories.
- e) 1 no. air receiver per mill bay complete with drain traps, safety relief valve, instruments and all accessories.
- f) 1 lot of piping, fittings, valves & instruments for conveying air, instrument air, cooling water for transporter vessel inlet valve top plate (if applicable), cooling water quenching in the pyrite hopper, cooling water for air compressor etc. for complete station.
- g) 1 lot of insulation & cladding, if required, to maintain surface temperature of pyrite hopper within 60° C
- h) All structures including pipe cum cable rack required for supporting of various pipes in bidder's scope. Bidder may take support from existing mill bunker bay structures wherever possible.
- i) All insert plates, embedment plates, anti-vibration pads below conveying vessel if applicable foundation bolts/ anchor bolts etc. required for bidder's equipment.
- j) Hangers and supports for all the piping as per the requirement shall be in bidder's scope.
- k) Charge of all lubricants and fluids as per GTR
- l) Electrical and C&I scope as per enclosure elsewhere in the specification.
- m) One (1) set of Mandatory Spares as per the list attached in specification.
- n) One (1) set of erection & commissioning spares as required for the complete system.
- o) One (1) set of Maintenance tools and tackles as per the list attached in specification.
- p) All counter- flanges with nuts, bolts and gaskets at all the terminal points.
- q) Finish paints for touch up painting of equipments after erection at site in sealed container.
- r) Monitoring gadgets, instruments and equipments required for maintenance (till PG test and plant handover).
- s) Relevant scope of supply as per GTR, GCC & SCC.
- t) Any other instrument, item required for making the installation complete in all respect within battery limits and for satisfactory operation of the system, unless specifically EXCLUDED from scope under Clause No. 2.0 below.

1.2 SCOPE OF SERVICES

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Scope of services shall include but not necessarily limited to following:

- a) Unloading, Storage, handling and transportation at site.
- b) Minor civil work like penning, chipping of foundation, grouting etc.
- c) Pre-Commissioning work such as flushing, hydraulic testing etc. Necessary instrumentation for pre-commissioning, trial run, and performance guarantee test shall be arranged by the successful bidder at their own cost.
- d) Erection & Commissioning of Mill Reject Handling System.
- e) Inspection & testing, trial run, performance guarantee & handing over to end client. All personnel required during commissioning and PG Test.
- f) Painting of all equipment within the battery limit.
- g) Electrical scope of services as per enclosure elsewhere in the specification
- h) Preparation of Civil input drawings & documents for foundation details (including load data, GA, foundation pocket details etc.) of storage bunkers, compressors, air receivers, pipe rack and pit / trench details for transporter vessel and reject conveying pipes.
- i) Review of Civil drawings prepared by BHEL based on civil input drawing furnished by the successful bidder.
- j) Relevant scope of services as per GTR, GCC, ECC & SCC.
- k) 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. 2.0 below.

2.0 EXCLUSION

- a) Civil work for Mill Reject Handling system including
 - i) Road approach for various facilities related to Mill Reject Handling System.
 - ii) Transporter vessel foundation
 - iii) Pit & Trench as required in mill bay
 - iv) Foundation of Mill reject compressor & air receiver
 - v) Mill Reject bunker foundation
 - vi) Various cable trenches, pipe pedestals & pipe rack foundation.

However, location, sizing and loads and any other input related to above as applicable for above shall be given by the successful bidder within 8 weeks of placement of LOI.

- b) Fire Protection system for compressor house.
- c) Lighting of Mill bay, compressor house & bunker area.
- d) Electrical exclusion as per Electrical scope sheet enclosed in the specification
- e) Relevant exclusion as per GTR, GCC, SCC & ECC.
- f) Local control room

3.0 SERVICES TO BE PROVIDED BY THE CUSTOMER

As per Utility Requirement – Section III.

4.0 TERMINAL POINT



**1X660 MW PANKI EXTN
TECHNICAL SPECIFICATION
FOR
MILL REJECT SYSTEM (PNEUMATIC TYPE)**

SPECIFICATION No: PE-TS-426-160-A001

**PACKAGE: MILL REJECT SYSTEM
(PNEUMATIC TYPE)**

SECTION-I

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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 bunker outlet with canvas chute and discharge gate is by bidder.
Mill Reject bunker outlet towards road tanker	Mill reject bunker outlet with canvas chute. Bidder shall terminate his work with the canvas chute and lever operated discharge gate.
Equipment cooling Water, Instrument Air and Service Water tapings	As mentioned in Utility Requirement – Section III

5.0 PERFORMANCE / DEMONSTRATION GUARANTEES

(Refer Annexures)

6.0 ERECTION, PRE-OPERATIONAL TESTING/STARTUP & COMMISSIONING PROCEDURE

This shall be as furnished by the successful bidder during detail engineering for customer's review and acceptance.

7.0 PAINTING/CORROSION PROTECTION REQUIREMENT (Refer Annexure of Painting Specification)

Successful bidder shall furnish detailed Painting Schedule for Mill Reject System (based on painting specification attached with specification) for customer / client approval during detail engineering.

8.0 LAYOUT REQUIREMENTS

Piping 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).

9.0 EQUIPMENT DESIGN CRITERIA

9.0.1 The minimum design criteria to be followed for various equipment shall be as per requirements indicated under specific and standard technical specifications for Mill Reject Handling System.

In case of *any contradictory requirement* in specification of particular equipment, the requirement given in section I shall prevail over those indicated in Section-II. Further, in case of any contradictory requirement within the same section and clarifications not having been sought by the bidders w.r.t. the same within the stipulated period, the most stringent requirement as per interpretation of the customer will prevail. Successful bidder will furnish detailed data sheets/ specifications/design calculations for various equipment for customer/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.

PART OF SPECIFICATION PE-TS-426-160-A001



**1X660 MW PANKI EXTN
TECHNICAL SPECIFICATION
FOR
MILL REJECT SYSTEM (PNEUMATIC TYPE)**

SPECIFICATION No: PE-TS-426-160-A001

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

10.0 QUALITY PLANS, INSPECTION & TESTING PROCEDURE (Reference Annexures)

All QPs / CLs 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.

11.0 DRAWINGS/DOCUMENTS REQUIRED WITH THE BID (Refer Section-III)

The drawings and documents to be submitted with the bid shall strictly be the list. Any document other than those indicated therein will not be reviewed and will not form part of contract.

12.0 DRAWINGS/DOCUMENTS REQUIRED DURING DETAIL ENGINEERING (Refer Annexures)

The tentative list of drawings and documents required during detail engineering shall be as per the list. The list, however, will be finalized with the successful bidder prior to start of detail engineering.

13.0 DRAWING/DOCUMENT DISTRIBUTION SCHEDULE (Refer Annexures)

Drawing/document distribution schedule shall be as per Annexures enclosed elsewhere in the specification.

14.0 DRAWINGS ENCLOSED WITH THE SPECIFICATION (Refer Annexures)

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

15.0 OTHER REQUIREMENTS

i) Site Visit before submission of offer

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

ii) Technical Requirements

- 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.
- 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.

PART OF SPECIFICATION PE-TS-426-160-A001

	1X660 MW PANKI EXTN TECHNICAL SPECIFICATION FOR MILL REJECT SYSTEM (PNEUMATIC TYPE)	SPECIFICATION No: PE-TS-426-160-A001	
		PACKAGE: MILL REJECT SYSTEM (PNEUMATIC TYPE)	
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- Mill Reject System design shall also consider the presence of occasional burning coal particles along with the rejects, which would increase the reject temperature.
- 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.
- Civil works will be provided by BHEL / customer. Hence, bidder has to furnish the civil inputs in time. **Bidder has to carry out the rectification in the civil works in the event of any changes in the civil input data furnished by them or delay in submission of input data by them.** Bidder to furnish the civil foundation drawing along with the loading data for approval during detailed engineering stage showing / indicating the followings :-
 - a) Scope of work by BHEL / customer and bidder shall be indicated with different legend or in the form of note.
 - b) Civil loads shall be furnished showing detailed calculation.
 - c) Details of pockets as required for anchor bolts.
- 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.
- All the drawings which are required to be furnished to BHEL during detailed engineering stage shall include technical parameters, details of paints, BOQ / BOM etc in tabular form indicating all components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.
- All drawings and documents including general arrangement drawing, data sheet, calculation etc. shall be furnished to BHEL during detailed engineering stage and shall include / indicate the following details for clarity w.r.t. inspection, construction, erection and maintenance etc.:-
 - d) All drawings and documents shall bear BHEL's title block and drawing / document number.
 - e) All drawings and documents shall indicate the list of all reference drawings including general arrangement.
 - f) 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.
- Bar chart, list of drawings and documents including data sheet, manual calculation, quality plan, field quality plan, performance guarantee test procedure, list of sub – vendors (mechanical, C & I and erection and commissioning), technical specification and material of construction, painting specification / schedule, dispatch schedule etc. of various items as required by BHEL / customer / consultant shall be submitted to BHEL / customer / consultant during detail engineering stage for approval and the approved drawings / documents shall be adhered by the bidder without any commercial implication.



**1X660 MW PANKI EXTN
TECHNICAL SPECIFICATION
FOR
MILL REJECT SYSTEM (PNEUMATIC TYPE)

SPECIFIC TECHNICAL REQUIREMENTS-
MECHANICAL**

SPECIFICATION No: PE-TS-426-160-A001

**PACKAGE: MILL REJECT SYSTEM
(PNEUMATIC TYPE)**

SECTION-I

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SUB-SECTION – IA

CUSTOMER SPECIFICATION

- CUSTOMER SPECIFICATION FOR MILL REJECT SYSTEM**
- CUSTOMER SPECIFICATION-GENERAL TECHNICAL REQUIREMENTS**
- CUSTOMER SPECIFICATION-CLEANING, PROTECTIVE COATING & PAINTING REQUIREMENTS**
- CUSTOMER SPECIFICATION-LOW PRESSURE PIPING**

PART OF SPECIFICATION PE-TS-426-160-A001

CHAPTER 20 : MILL REJECT HANDLING SYSTEM**20.1 System Description**

20.1.1 The scope of Mill Reject System shall include collection of mill rejects from mills on continuous basis and transportation of the same to storage bunker through dense phase pneumatic conveying system. Each mill reject discharge hopper shall be fitted with a positive pressure conveying vessel, which shall discharge the mill rejects through pipe line to a storage silo. The transmitting vessel shall operate on level probe with timer back-up. From storage silo the mill rejects shall be disposed off in trucks.

20.1.2 The scope of supply includes the following:

- One (1) no. pyrite hopper with discharge chute, emergency chute, discharge chute for oversized rejects work etc for each mill as required.
- **One (1) no. pneumatically operated isolation gate complete with compressed air pipework, solenoid valves & supporting arrangement, at inlet of each pyrite hopper.**
- **One (1) no. expansion bellow at inlet pipe to pyrite hopper.**
- **One (1) no. pneumatically actuated material (mill reject) handling valve complete with compressed air pipework, solenoid valves & supporting arrangement at inlet of each Mill reject/ transport vessel.**
- One (1) no. pneumatically actuated Plate valve at By Pass chute of Pyrite hoppers complete with compressed air pipework, solenoid valves & supporting arrangement.
- One (1) no. pneumatically actuated Plate valve at over size discharge chute of Pyrite Hoppers complete with compressed air pipework, solenoid valves & supporting arrangement.
- Requisite sets of RF Type Level probes for Pyrite Hopper High / Permissive.
- Requisite nos. of Temperature Switches for Pyrite hoppers.
- Requisite nos. of Denseveyor complete with inlet isolation/ Dome valve, Outlet bond, Pneumatic Panel.
- Conveying pipework from individual mill reject handling equipment to the reject storage silos with all accessories like bends, fixtures, flange joints, structural steel supports, anchors/ inserts/ trestles, walkways etc. as required.
- Two (2) nos. Mill Reject silos, one (1) no. for each mill bay shall be provided for the proposed side mill arrangement.
Each silo shall have an effective storage capacity of twenty four (24) hours considering each mill in the bay rejecting @ 2.0% of mill capacity corresponding to unit operation at 100% BMCR with worst coal firing. Necessary supporting steel structures, platforms, staircase,



manual operated unloading gate, Terminal Box with Up-stand, Bag Filter on Bunker top with associated instruments, 3mm thk SS plate liners covering straight length portion and conical portion of mill reject storage hoppers (bunkers), RF Type level probe, air relief devices etc shall be provided.

- The storage silo shall be designed to provide a clear access of 4.5 m for trucks to come under the silo and receive the rejects using suitable chute work.

Suitable spray quenching, to cool the mill reject in pyrite hoppers. Quenching water shall be provided from the service water pump discharge.

- Two (2) nos air receivers, each of adequate capacity, with all accessories, interconnecting pipework, support etc shall be provided.
- Two (2) nos. (1W + 1S) oil free screw compressors, with drives & accessories, to cater to the **conveying** air requirements of mill reject handling system. Compressors shall be located in the main compressor House.
- 1 Lot of Pipe work for conveying Air, Instrument Air, Cooling Water for Dome Valve top plate, Cooling water for Quenching in Pyrite Hopper, Cooling water for air compressor etc. complete with valves, fittings, temperature / pressure gauges, pressure switches and other instruments.
- Necessary lifting devices of adequate capacity to handle the mill reject handling equipment.
- ~~Complete control & instrumentation as indicated in Volume V.~~
- Necessary electrical equipment as required.
- ~~Civil structural works associated with mill reject handling system including foundation bolts, pockets, grouting, underpinning etc.~~
- ~~One (1) no. drain sump of 5 cum capacity shall be provided for each mill bay.~~
- ~~One (1) no. fixed type sump pump of 10 cum/hr capacity for each mill bay shall be provided.~~

20.1.3

Each mill shall be provided with collection and transportation equipment comprising of one (1) pyrite hopper with water spray arrangement, valves at inlet and outlet and one (1) mill reject vessel. Each mill reject vessel shall be connected to storage silo through conveying pipeline of MS conforming to IS: 1239/3589 ERW heavy grade. Storage silo shall be of MS construction with SS liners and shall be provided with discharge gate at its outlet to discharge rejects into a truck. The SS liner shall be 3 mm thick SS 304 material. Two (2) (1W+1S), oil free, rotary, screw air compressors shall be provided for conveying mill rejects from **reject/transport vessel** to storage bunker. The instrument air required for operation of various pneumatic valves shall be drawn from plant instrument air header. The water required for cooling of valves and for spraying in pyrite hoppers shall be drawn from service water pump. Radio Frequency (RF) type level probes shall be provided in pyrite hopper to start/stop evacuation cycle or for indication.

The conveying velocity of reject shall not be more than 6.0 meters/sec and number of cycles shall not be more than 6 per hour.

20.2 Equipment Description

20.2.1 Pyrite Hopper

One (1) pyrite hopper shall be provided below each pulveriser. The pyrite hopper shall be made of minimum 10 mm thick steel plates conforming to IS: 2062. The pyrite hopper shall be provided with one **pneumatic** cylinder operated plate valve on upstream which will be normally kept in open position. Grid shall be provided in the hopper to prevent passage of over size material to mill reject vessel. One (1) cylinder operated plate valve shall be provided to remove oversized rejects collected on the grid. Pyrite hopper shall be provided with by pass chute with cylinder operated plate type valve to unload the pyrite hoppers on the ground in case of emergency. Pyrite hopper shall be provided with manual operated plate valve on downstream side which is normally kept in open position, **as it is a maintenance valve**. Pyrite hopper shall be provided with level probes and temperature switches. Each pyrite hopper shall be provided with two level probes; one to start the operating sequence and the other to indicate that pyrite hopper is full and the grid is choked. **RF type level probe in the Pyrite hopper shall pick up the signal when the hopper is full to a preset level.** Arrangement of nozzles to spray water **by operating the solenoid valve in the spray water line** shall be provided when temperature goes beyond the preset value.

20.2.2 Mill Reject/transport Vessel

One (1) mill reject vessel shall be provided for each pyrite hopper to transport mill rejects to storage bunker by means of dense phase conveying system. Transport vessel shall be provided with one **pneumatic** cylinder operated inlet valve (**material handling valve**), outlet valve (optional) and air inlet valve. **Level probe in Pyrite hopper is set to pick up the signal when mill rejects reach a preset level (evacuation cycle start permissive level) in the hopper generally kept equal to Vessel volume. Whenever such a signal is picked up by the probe, the inlet/ material handling valve is actuated to open and allow gravity feed of rejects into the Reject/transport vessel.** After lapse of predetermined time, the **material handling/inlet** valve closes and compressed air is injected through air inlet valve and the vessel gets pressurized. At predetermined pressure, the outlet valve of reject/transport vessel, if provided, opens and rejects are **conveyed** to reject silo/storage bunker through pipeline. **As evacuation proceeds, vessel pressure drops and at a predetermined pressure, air inlet valve and outlet valve closes and the system gets ready for the next batch evacuation, commencement of which is signaled by level probe in the pyrite hopper. As a backup to this, a timer provision shall also be made in control system. This cycle goes on repeat with convey of mill rejects continuing till high level is sensed in the reject silo/storage bunker. Henceforth further conveying to bunker is stopped till bunker is evacuated manually as detailed hereafter.**

20.2.3 Reject Silo/Storage Bunker

In consideration to the proposed side mill arrangement, two (2) nos. mills reject silos; one (1) no. for each mill bay shall be provided. Effective capacity

of each silo shall be as mentioned under cl. no. 20.1.2. The storage bunker shall be provided with stainless steel liners on inner walls. Adequately sized bag filter to vent the transport air to atmosphere, terminal boxes, level probe and pressure relief valve shall be provided on the top of storage bunker. Manual operated discharge gate shall be provided at outlet of storage bunker to unload the rejects into trucks. If necessary, adequately rated chute vibrators shall be furnished to ensure easy unloading of rejects.

20.2.4 Air Compressors

Two (2) - oil free, multistage, rotary screw type air compressors, one working and one standby shall be provided to supply air required for conveying mill rejects from transport vessel to storage bunker. The compressors shall be of continuous indoor duty complete with air coolers, necessary valves with vent pipe work ducted to a safe discharge outlet. For compressor sizing purpose simultaneous operation of two conveying vessels from the two mills shall be considered for the working compressor. The air pipe work shall be of ERW pipes to IS: 3589/1239 heavy quality construction. At least 50% margin shall be provided on compressor capacity over and above the maximum flow requirement.

For technical requirements of screw compressors refer Chapter 23: **Compressed Air System**, Volume III.

20.2.5 Air Receiver

Two (2) nos Air receiver (of adequate capacity each) shall be provided for mill rejects handling system. Air receivers shall be designed in accordance with ASME Section-VIII or IS: 2825 IS: 7938 or approved equivalent. Corrosion allowance of 3 mm shall be considered for the design. The air receiver shall be of vertical cylindrical design with dished ends.

The air receiver shall be designed for 1.5 times the compressor discharge pressure.

The air receiver shall have inlet/outlet connections, safety relief valves, fusible plugs, pressure gauges, pressure switch, temperature gauge, flanged pipe connections, inspection manholes with automatic drain traps. Pressure gauges shall be provided at each air inlet line and on air receiver. The air receiver shall have structural platforms for maintenance of safety relief valves and instruments.

For technical requirements of air receivers refer chapter 23, Volume III.

20.2.6 Mill Rejects Conveying Pipeline

Rejects conveying pipeline shall be MS ERW heavy grade to IS: 1239/3589. Pipes shall be joined by welding and all fittings, bends etc shall be alloy cast iron and the radius of bends shall be not less than 3D.

20.2.7 General margin on selection of all equipment shall be 10%.

20.2.8 Instrument Air

Instrument air at 7 bar (g) required for operation of pneumatic cylinder operated valves, inlet / plate/ dome valve actuator, Insert Seal of inlet / plate



/ dome valve and for bag filter may be sourced from main Plant IA compressors. Pneumatic air cylinders of MRHS shall be designed to perform with Instrument air pressure of 4 to 5 bar (g).



DATA SHEET FOR MILL REJECT HANDLING SYSTEM

S. No.	Item	Units	Description
1.0	MILL REJECT SYSTEM		
a	Duty		Continuous
b	Max Lump size of mill rejects	mm	(-) 40*
c	Operation condition		BMCR with worst coal firing
d	Rate of Rejects Generated per mill	TPH	2.0% of mill capacity or maximum actual whichever is higher
e	Total No. of Coal Mills	Nos.	As specified by Boiler/ Mill manufacturer [minimum eight (8) nos.]
f	Temperature of Mill Rejects	Deg C	As specified by Boiler/ Mill manufacturer
g	Storage Required for mill rejects	Nos.	One no. for each mill bay (for the proposed side mill arrangement)
h	Bulk Density of mill rejects		
	i) for volume considerations	T/m ³	1.6
	ii) for structural considerations	T/m ³	2.4
2.0	MILL REJECT/ MATERIAL HANDLING VALVES		SS 410
a	Type		Dome valve
b	Material of construction		
	i) Body		Cast Iron 225 BHN
	ii) Plate/ Disc		10 mm Thk 300 – 350 BHN SS
	iii) Seat		Replaceable type alloy CI or SS smooth finished with 250 BHN hardness
c	Method of operation		Solenoid operated pneumatically actuated with provision for manual override facility
d	Emergency** discharge chute with knife edge gate valves		Yes
e	Sizing Grid		Yes (To separate oversize rejects/ to give control feed to crushers, if proposed)
3.0	MILL REJECT/ TRANSPORT VESSEL		
a	Location/ Quantity		Below Pyrite hopper
b	Type		Suitable for dense phase conveying
c	Material of Construction		Fabricated out of MS plate construction will be as per ASME code for unfired pressure vessels or IS 2825
d	Conveying Pipes		IS: 1239/ IS:3589 Heavy Grade
e	Bends/ Fittings/ Laterals		Alloy cast iron, 500 BHN
4.0	REJECT SILO/ STORAGE BUNKER		
a	Quantity		One no. for each mill bay (for the proposed side mill arrangement)
b	Construction		Steel Construction 10 mm Thk(MS IS 2062)with 3mm Thk SS 304 lining in conical as well as vertical portion

S. No.	Item	Units	Description
c	Accessories		a. One (1) number Continuous/ RF Type Probe b. One (1) number pressure relief Valve
d.	Discharge gate		Hand lever operated twin Sector gates Cast Iron IS 210/ FG 260/ MS to IS 2062 with TISCRA/SAIL HARD liner
e.			1.
5.0	AIR COMPRESSOR		
a	Type		Oil Free Screw type
b	Service		Mill Reject Conveying Air
c	Cooling		Water Cooled (DMCW)
d	Quantity		2 nos (1W+1S)
	For other technical details of screw compressor refer Chapter 23, Volume III.		
6.0	BAG FILTER		
a	Location/ Quantity		1 no. per silo
b	Type		Reverse pulse jet type
c	Material of Bags		suitable for prolonged operational temperature of 200 deg. C.
d	Air to cloth ratio	m/min	1.5 with isolation of 10% bags
e	Filter bag cage		MS, IS 2062, Gr.A, 3 mm thick, Galvanised
f	Filter housing		MS
g	SMP level of vent air from bag filter		Less than 50 mg/NM3
	Conveying air piping		MS ERW as per IS 1239 Heavy Grade upto 150 NB and IS 3589 above 150 NB.

NOTE:

1. *In case the bidder expects higher size from pyrite hopper outlet, then suitable capacity crusher shall be provided to bring down size of reject to (-) 40mm for pneumatic type system offered, which shall be included in the base offer.
2. ** The wearing parts of all the valves shall be provided with abrasion resistant material of hardness of 350-400 BHN.
3. The capacity/ capacities specified herein are the minimum requirements and any increase in the capacity/ capacities during detail engineering shall be taken care of by the bidder without any price implication to UPRVUNL.

23.6 Design & Construction:

The minimum requirements of design and construction features of various components of compressed air system are described below.

The motor drives shall be as per electrical specification.

23.6.1 Air Compressors

Compressors shall be multi stage oil free screw type.

Multiple compression chambers shall be designed to ensure minimum unbalance and arranged in compact manner suitable for easy accessibility and maintenance of the compressors.

The compression chamber, housing two precision made screw type rotors, for each stage shall be designed with large port for fast filling and low velocities.

The stator (casing) shall be of Cast- Iron (IS- 210 grade) construction with integral jacket cooling. Suitable arrangement for cleaning of the cooling jackets during maintenance of compressor shall be provided.

The Rotors and shaft shall be of single piece of construction made of forged steel (AISIC 1141 or equivalent) Rotors shall be dynamically balanced, design with asymmetric profile, to keep leakage losses to a minimum and ensure high efficiency.

Highly precise timing gears to maintain rotors in correct relative position shall be shaft mounted, oil lubricated and designed to counteract the axial forces incurred in compression.

Bearing shall be high precision antifriction type IS-25 Grade 84. The axial thrust load shall be minimized by dividing the axial load of compression on the main and auxiliary bearings through suitable balancing arrangement and minimum operating life of 40000 running hours.

Shaft seals of floating restrictive ring type design to prevent air and oil leakage along the shaft into the elements. The shaft seals rings and retainers shall be of stainless steel construction and be free for radial self-adjustment on the rotor shafts.

The safety valves shall be provided on low pressure and high pressure stages to safeguard low pressure & high pressure circuit. Inlet throttle valve shall be provided to throttle the incoming air during idling period.

A direct shaft driven positive displacement type oil pump or a separate motor driven oil pump shall be provided. The lubrication system shall consist of lube oil reservoir, lube oil pumps, suction strainers for pumps, supply & return system, oil cooler and twin two full-flow (2 x 100%) of



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filters, required instruments etc. the filters with replacement and re-pressurizing during operations.

The motor rating (at the design ambient temperature specified for the electric drive in the electrical specification) shall be sized as specified in the electrical volume.

Couplings shall be of non-lubricated flexible element spacer type and coupling guards shall be provided.

The inlet air filter & silencer shall be located at the downstream of discharge blow off valve.

The instrumentation controls and panels shall conform to the requirements specified in the control & instrumentation volume.

The intercoolers, after coolers, oil coolers shall conform to the requirements specified in subsequent clauses of this chapter.

Each compressor shall be provided with name plate, base plate, anchor bolts and shim packs, anti-vibration pads, eye bolts, operation & maintenance tools.

The material of construction of compressors shall be as per the enclosed datasheet.

23.6.2 Lubrication System

The compressor package shall include a lubricant management system which shall lubricate the bearings and seal and the compressor chamber (screw rotor housing) shall be totally separated from bearing/ gear chamber.

The lubricant pump shall be shaft driven. An auxiliary motor driven pump shall be provided, if required by the manufacturer to supply pre start and shut down system. All lube oil pumps shall be rotary positive displacement type, having stainless steel rotors and steel casing. The pump discharge system shall be protected by a relief valve.

The heat exchanger of the lube oil cooler shall be water cooled. The heat exchanger shall be located within the compressor skid.

The fouling factors shall be considered as per recommendation of TEMA.

The lube oil cooler shall be designed for a heat duty corresponding to the peak power demand of the compressors.

The cooler shall be designed in accordance with the requirement of IS 2825.

Due consideration for the differential expansion of shell and tube shall be given in the design of the coolers.



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23.6.3 Gear Box

Speed increasing gears between the motor and compressor stages shall consist of a common helical gear driving pinion of each stage. Helical timing gears shall be mounted on the rotor shafts to maintain accurate relative rotor position. Gears shall have rating of AGMA-12 rating or equivalent.

23.6.4 Intercoolers, Aftercoolers & oil Coolers

Intercoolers, aftercoolers and oil coolers shall be of water cooled & shell and tube type with water on the tube side. Intercoolers & aftercoolers shall be designed in accordance with Section VIII of ASME code or equivalent.

Outlet temperature of air from intercooler shall be suitable to suit the equipment and outlet temperature of air from compressor house outlet header shall be limited to 45 Deg C. However, the instruments or the pneumatic devices requires air temperature less than 45 Deg C, the same shall be achieved at the outlet header.

Coolers shall be provided with removable tube bundle design in accordance with design code TEMA Class C and shall be constructed with removable shell cover.

The coolers shall be constructed and arranged to allow removal of tube bundles without dismantling piping or compressor components.

Oil coolers shall be equipped with vent & drain connections on oil and water sides. Oil temperature control valve with manual override feature or bypass construction shall be provided to maintain constant temperature. Vent & drain connections for intercoolers and after coolers shall be provided.

Design pressure shall be 8 kg/cm²(g) based on shut off head of DMCW pumps.

The coolers shall be designed for maximum heat load and at least 10% design margin shall be provided in the number of tubes.

Adequately sized safety valves shall be provided for both intercoolers and after coolers.

Each intercooler and after cooler shall be provided with moisture separator units with suitable baffling. Moisture separator units shall be equipped with a level gauge with isolating cock.

Electrically operated automatic drain trap stations with bypass and isolating valves shall be provided for moisture separators for automatically draining of condensed moisture. The drain trap may be of full bore ball valve operated by capacitance type level switch. Manual draining facility shall also be provided in the drain trap.



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Cooler shells, channels and covers shall be of steel (SA 285 Gr or Equivalent). Tube sheet shall be of Brass or SS and the tubes shall be of admiralty brass or Aluminium brass or Copper or SS 304.

23.6.5 Air Receivers

There shall be one air receiver for each compressor near compressor house, one instrument air receiver for DM Plant (min. 2 cum) and two unit instrument air receiver near main plant (min 10 cum capacity, each).

Capacity of each of the air receivers in the compressor house shall be of minimum 15 cum (nominal). The capacity of the unit instrument air receiver near main plant shall be min 10NM³ or to suit emergency storage requirement, whichever is higher.

Receivers other than unit air receivers shall be outdoor located and vertical cylindrical vessels with dished ends.

The design pressure and temperature shall be minimum 10 kg/cm²(g) and 50 Deg C respectively. Receivers shall be designed in accordance with Section VIII, Division 1 of ASME code or equivalent.

Air receivers are to be provided with gasketed inspection manhole of minimum 500 mm diameter with cover plate, lifting handle, davit cap etc. Opening shall not pierce any seam & shall be as far as possible away from any welded seam.

Receivers shall be of welded construction with minimum number of joints. Longitudinal seam in adjacent sections shall not be in same line. Welding shall be as per relevant codes. Filler material to have composition and structure as that of the material welded. Welding electrodes shall be approved by owner. Electrodes to be dried before use.

Relief valves shall be provided to suit compressor capacity and set pressure of the same shall be at least 10% above working pressure. The spring in relief valve shall not reset for any pressure more than 10% above or below the design set pressure.

Each air receiver shall be provided with drain connection with electrically operated automatic drain trap arrangement with isolation and bypass valve.

The material of construction of shell, dished ends, flanges etc. of the air receivers shall be of carbon steel as per IS 2062 or equivalent.

23.6.6 Intake Air Filter & Silencer

Filters with multiple elements and quick removal type for easy cleaning to be provided at suction of each air compressor and shall also be of heavy duty dry type.



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The filters shall be complete with integral silencers. Separate silencers, if specified shall be provided and all other accessories. The filtering elements shall be easily removable for cleaning or for replacement.

The filters shall be designed for an efficiency of not less than 99% for particles 2 microns and larger.

The silencer shall be of very high efficiency type to adequately dampen the operating noise as per the requirement.

Pulsation dampener of approved design shall be provided on the compressor suction and discharge manifold.



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23.6.9 Moisture Separator

Moisture separator shall be of high efficiency design and provided with vent nozzle and auto drain trap system.

23.6.10 Solenoid Valves & Multiway Valves

The solenoid valve shall be of approved make. The solenoid valves shall have heavy duty, double impregnated tropicalised coils (single or double solenoid as required) and shall be suitable for the operating temperature and for operation continuously energised in a tropical climate.

The solenoid valves shall be of bronze body with stainless steel trim. The coil shall be of continuous duty and of epoxy moulded type, Class F. The enclosure shall be water tight, dust tight weather proof and shall conform to NEMA 4X standard. The valves shall be suitable for mounting in any position. Solenoid coils shall be Class H high temperature construction and shall be suitable for continuous operation. Type of operation and electrical ratings shall be subject to owner's approval.

23.7.0 Control Philosophy**23.7.1 General**

The minimum requirements are specified herein and the same shall be elaborated by the bidder. The bidder shall include controls & instrumentation to facilitate safe, reliable and efficient operation of the system. The controls, protection, interlock and instrumentation system offered by the bidder shall be subjected to approval of the owner during post award engineering stage. For details of Control & Instrumentations, refer to Volume – V.

Any of the compressor and air drying plant may be selectable for "shutdown", "working" or "standby" duty.



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On tripping of working equipment the standby equipment shall come into operation automatically in case of very low air pressure in the system.

All abnormal conditions used for tripping the compressor or any other equipment shall be provided with pre-trip audio visual indication/annunciation in the control panel.

An electrically operated automatic valve shall be provided on cooling water supply line of each compressor & dryer (if applicable) which will automatically shut off the cooling water supply in case any of the compressor/ dryer is not running for more than the set time duration. Suitable interlock shall also be provided for opening the valve before starting of any of the compressor.

The following indications shall be made available in the control panels for repeating the same in main plant control system/ panels.

- a. Status of each compressor
- b. Instrument air pressure low/ high
- c. Service air pressure low/ high
- d. Dew point of instrument air
- e. Status of each ADP

Lube oil pressure and temperature on the oil circuit of compressor shall be automatically controlled.

Unless otherwise mentioned in the relevant electrical volume, automatic motor overload control system shall be included to permit continuous operation of compressors at minimum ambient air without exceeding the name plate rating of the motor.

23.7.2 Screw Compressors

23.7.2.1 Each compressor shall be in the control panel to operate either in base duty (Auto Load/ unload) or Standby duty (Auto On – Off) mode.

23.7.2.2 In "Base duty", whenever air supply from compressors exceeds the demand, control system shall operate the load-unload circuit at a predetermined set pressure, throttle the inlet valve and open the blow off valve. The compressor shall run in unload condition. When system pressure drops due to more demand, the load – unload circuit shall operate again to bring the compressor to 100% load after closing the blow off valve.

23.7.2.3 In "Standby" mode the compressor shall automatically assist base load compressors during periods of peak air demand. When air pressure in the system reaches a preset lower limit, the compressor shall be started in unloaded condition and the compressor shall be fully loaded. When the pressure in the system rises to preset high value, the compressor shall be unloaded and shall run in idling mode for a specific period (set by timer). The compressor may be loaded to full load in case of drop in system pressure or compressor may be stopped in case the system pressure does not drop and compressor continues to idle for more than a preset time.



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- 23.7.2.4 The control system shall provide warning to the operator that a hot start condition exists for the motor driver and adequate cool down period has not occurred after the motor was shut down.
- 23.7.2.5 The alarms and shutdown scheme mentioned below are suggestive and shall be provided as per manufacturer's standard practice meeting the safe operational requirement of the equipment/ system of each compressor :
- a. "Air temperature high" at inlet stage - Alarm & trip
 - b. Low Lube Oil Pressure - Alarm & trip
 - c. High Lube Oil Supply temperature - Alarm & trip
 - d. High Oil filter differential pressure - Alarm & trip
 - e. Low Lube oil level in lube oil sump - Alarm & trip
 - f. High inlet air filter differential pressure - Alarm & trip
 - g. Low cooling water flow to air compressors - Alarm & trip



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DATA SHEET-A**SCREW TYPE AIR COMPRESSOR AND AUXILIARIES**

SR. NO.	ITEM		DETAIL
1.0	PERFORMANCE DATA		
1.1	Free Air Delivery	:	Bidder to compute and indicate as per guidelines specified in this section.
1.2	Capacity	:	PLEASE REFER DATA SHEET OF MRS
1.3	Noise level near compressors	:	Noise level shall not exceed 85 dBA when measured at a distance of 1.0 meter from the compressor. Acoustic enclosures as required shall be provided to meet the above condition.
1.4	Vibration limit (measured at top and bottom of main bearing)	:	40 microns
1.5	Guaranteed Power consumption at motor input terminals at rated condition	:	Bidder to indicate
2.0	CONSTRUCTION FEATURES		
2.1	Location	:	Indoor
2.2	Number of compressors	:	PLEASE REFER DATA SHEET OF MRS
2.3	Type	:	Oil-free, dry screw type, water cooled, horizontal, two (2) stage, rotary screw compressors
2.4	Service	:	PLEASE REFER DATA SHEET OF MRS
2.5	Duty	:	Continuous
2.6	Type of Drive	:	Electric Motor
2.7	Design ambient temperature for drive	:	50°C
2.8	Number of starts per hour	:	8 (equally spreaded)
2.9	Type of transmission	:	Gear
2.10	Ant vibration arrangement required	:	Yes



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SR. NO.	ITEM	DETAIL
2.11	Maximum temperature for any step during the cycle	: Bidder to indicate
2.12	Type of control	: Dual i.e. both load-unload and auto start/ stop
2.13	Type of Annunciation	: Audio-visual
2.14	Flange standard	: ANSI B-16.5/equivalent
3.0	MATERIALS OF CONSTRUCTION	
3.1	Compressor chamber	: Cast iron coated with corrosion resistant material
3.2	Rotors	: Forged carbon steel coated with corrosion resistant material, 2 nd stage Stainless steel
3.3	Bearing	: Oil lubricated Antifriction type suitable for at least 40,000 running hours.
3.4	Timing Gear	: Low alloy steel
3.5	Base Plate	: MS
3.6	Inlet throttle valve & housing	: Aluminium / Stainless steel
3.7	Shaft seals	: Stainless Steel
3.8	Safety valves	: Brass
3.9	Water separator	: Cast Iron
3.10	Blow off valve	: Stainless Steel
3.11	Unloading Cylinder header	: Aluminium
3.12	Tube of oil cooler	: Stainless Steel type SS-304
3.13	Outer casing of coolers	: Carbon Steel / SG Iron
3.14	Non Return Valve (NRV)	: Stainless steel spring loaded type.
3.15	Gear Box	: Cast Iron GGG 40 (DIN 1693) /SG Iron
3.16	Gears	: Alloy Steel
4.0	SUPPLY OF ACCESSORIES & SERVICES	
4.1	Intake air filters with silencers	: Yes



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SR. NO.	ITEM		DETAIL
4.2	Intercoolers	:	Yes
4.3	After coolers with moisture separators	:	Yes
4.4	All instruments as specified, as shown in tender drawing and as required for safe and trouble- free operation of the system	:	Yes
4.5	Coupling guards	:	Yes
4.6	Air receivers	:	Yes
4.7	Foundation bolts, nuts, sleeves, inserts etc.	:	Yes
4.8	All interconnecting air and cooling water piping, complete with valves, fittings as shown in relevant tender drawings and as required for reliable and smooth operation of the system	:	Yes
4.9	Eye bolts, lifting tackle, tools, etc.	:	Yes
4.10	Control panels complete with all accessories	:	Yes
4.11	Instrument gauge panels complete with all accessories	:	Yes
5.0	DM COOLING WATER DATA		
5.1	Quality	:	DM Water
5.2	Design inlet temperature	:	38°C (maximum
5.3	Design pressure	:	Bidder to indicate. Shall not be less than the shut off head of DMCW pump.
5.4	Normal inlet pressure	:	Bidder to indicate. Shall be equal to the rated TDH of DMCW pump
5.5	pH value	:	8.5 to 9.5
5.6	Maximum pressure drop allowable between inlet and outlet points	:	6.0 to 8.0 MWC
6.0	TESTING AND INSPECTION		
6.1	Material Testing and identification	:	Required
6.2	Dye Penetration test	:	Yes



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SR. NO.	ITEM		DETAIL
6.3	Type of performance test to be conducted	:	Routine test/Type test as per relevant clause
6.4	Bend Test as per BS 5169	:	Yes
6.5	Field performance test	:	Yes
6.6	Shop performance test	:	Yes
6.7	MPI and UT tests	:	Yes
6.8	Spot Radiography for all circumferential and longitudinal butt joints	:	Yes
6.9	All other specific tests as specified in relevant Clause of this section		Yes
7.0	DRIVE MOTOR		
7.1	Electric motor	:	Drive motor for compressor shall comply with the requirements of relevant Clause of this section and concerned electrical volume of this Specification.
8.0	COMPRESSOR ACCESSORIES		
8.1	INTAKE AIR FILTER	:	
8.1.1	Numbers required	:	One (1) with each compressor
8.1.2	Location	:	Indoor, at the suction of each air compressor
8.1.3	Type	:	Dry type
8.1.4	Silencer	:	Yes
8.1.5	Air flow rate	:	To suit compressor rating
8.1.6	Particle removing efficiency	:	99.9% up to particle size of 2 Micron
8.1.7	Maximum allowable pressure drop at stated air flow rate in new condition of filter (viscosity of air at normal ambient temperature)	:	150 mm WG
8.1.8	Test requirement	:	No separate test. Compressor performance testing shall include the filters in test set up. Capacity, pressure drop and efficiency shall be measured.



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SR. NO.	ITEM		DETAIL
8.2	AIR RECEIVER		
8.2.1	Numbers required	:	PLEASE REFER DATA SHEET OF MRS
8.2.2	Installation	:	Outdoor
8.2.3	Type	:	Vertical cylindrical with torispherical dished ends.
8.2.4	Design pressure / Temperature	:	Minimum 1.5 times compressor discharge pressure (or 12.75 kg/cm ² (g) minimum) / 80° C (minimum)
8.2.5	Hydraulic test Pressure	:	150 % design pressure.
8.2.6	Design code	:	ASME Sec-VIII or IS-2825/IS-7938/ Approved equal
8.2.7	Capacity of each air receiver	:	PLEASE REFER DATA SHEET OF MRS
8.2.8	Material of construction of shell	:	MS to IS-2062
8.2.9	Material of construction of dished ends	:	MS to IS-2062
8.2.10	Material of construction of flanges	:	MS to IS-2062
8.2.11	Corrosion allowance		3.0 mm (minimum)
8.2.12	Supply of Accessories & Services	:	
8.2.12.1	Flanges with nuts, bolts and gaskets	:	Yes
8.2.12.2	Pressure gauge with snubber	:	Yes
8.2.12.3	Pressure Transmitter	:	Yes
8.2.12.4	Temperature gauge	:	Yes
8.2.12.5	Relief valve	:	Yes, set pressure shall be at least 10% above working pressure
8.2.12.6	Trap station	:	Yes
8.2.12.7	Level gauge	:	NA
8.2.12.8	Vent valve/plug	:	Yes



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SR. NO.	ITEM		DETAIL
8.2.12.9	Level Transmitter	:	NA
8.2.12.10	Supporting stand with necessary foundation bolts, nuts, sleeves etc	:	Yes
8.2.12.11	Eye bolts, lifting tackle etc.	:	Yes
8.2.12.12	Automatic Drain Trap		Yes
8.2.12.13	Painting	:	
A	External	:	Two coats of epoxy Primer and two finish coats of epoxy paints.
B	Internal	:	Cleaned and one coat of black bituminous paint applied.
8.2.12.14	Inspection and Testing		
A	Material testing and identification	:	Yes
B	Bend test as per BS-5169	:	Yes
C	Spot radiography of circumferential and longitudinal butt welds	:	Yes
D	Field performance test	:	Yes
E	D.P. test where radiography cannot be done	:	Yes
F	Hydraulic Test	:	Yes
G	Other specific tests as specified in relevant Clause of this specification	:	Yes
8.3	INTERCOOLER, AFTERCOOLER, MOISTURE SEPARATOR, PIPING, VALVES ETC:		
8.3.1	After cooler :		
A	Installation	:	Indoor
B	Type	:	Shell and Tube
C	Relief Valve	:	Yes
D	Moisture Separator	:	Yes
E	Trap Station	:	Yes
F	Temperature Indicator	:	Yes



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SR. NO.	ITEM		DETAIL
G	Temperature Switch	:	Yes
H	Temperature Transmitter	:	Yes
I	Level Gauge	:	Yes
8.3.2	Intercooler :		
A	Installation	:	Indoor
B	Type	:	Shell and Tube
C	Relief Valve	:	Yes
D	Trap Station	:	Yes
E	Pressure Gauge	:	Yes
F	Temperature Indicator	:	Yes
G	Temperature Switch	:	Yes
H	Temperature Transmitter	:	Yes
I	Moisture Separator	:	Yes
8.3.3	Supply of Accessories and Services	:	
A	Supporting stands with bolts, nuts and gaskets	:	Yes
B	Eye bolts, lifting tackle etc with tools and tackle	:	Yes
C	Flanged connections for supply and return of cooling water	:	Yes
8.3.4	Material of Construction :		
A	Tube	:	Stainless steel within star profile
B	Shell	:	Mild Steel
C	Tube Sheet	:	IS 2002 Gr 2
D	Baffles	:	IS 2062
E	Flanges	:	IS 2062
8.3.5	Cooling Water Data	:	Same as mentioned earlier



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SR. NO.	ITEM	DETAIL
8.3.6	Piping, Valves and Fittings for Compressed Air System :	
A	Pipes for cooling water line	: IS-1239 (Heavy grade) upto 150 NB. IS-3589 for sizes above 150 NB with minimum pipe thickness of 6 mm.
B	Pipes for compressed air line & interconnecting air line	: ASTM A-53 type E Gr. B galvanized /IS 1239 heavy galvanized/IS 3589 Gr 410 Galvanized to IS-4736 or equivalent.
8.3.7	Fittings	
A	Fittings for cooling water line	: ASTM A-234 Gr. WPB for sizing including 65 NB and above. And ASTM A105 for sizes up to 50 NB
B	Fittings for compressed air piping & interconnecting air piping	: Stainless steel as per ASTM A-182 F304
C	Valves for air line	: Stainless Steel
D	Testing and inspection	: As per relevant clause of this section.
E	Valves for cooling water line	: As per respective volume in LP Piping



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**1X660 MW PANKI EXTN
TECHNICAL SPECIFICATION
FOR
MILL REJECT SYSTEM (PNEUMATIC TYPE)

SPECIFIC TECHNICAL REQUIREMENTS-
MECHANICAL**

SPECIFICATION No: PE-TS-426-160-A001

**PACKAGE: MILL REJECT SYSTEM
(PNEUMATIC TYPE)**

SECTION-I

SUB-SECTION-IA

REV. 00

DATE: JUNE 2019

#

**SUB-SECTION – IA
CUSTOMER SPECIFICATION
CLEANING, PROTECTIVE COATING & PAINTING REQUIREMENTS**

PART OF SPECIFICATION PE-TS-426-160-A001

CHAPTER 7: PAINTING

1.0 SCOPE

This section covers the painting requirements for the power plant equipment, structures, piping etc. and any other surface required to be painted. The painting system should ensure optimal protection of the installation with minimum need for maintenance, environmental friendly & easy to apply.

2.0 CODES AND STANDARDS

Painting of equipment shall be carried out as per the specifications indicated below and shall conform to the relevant IS contract for the material and workmanship.

The following Indian Standards may be referred to for carrying out the painting job:

IS: 5	:	Colours for ready mixed paints and enamels
IS: 101	:	All Parts and Sections for paint testing
IS: 1303	:	Glossary of terms relating to paints
IS: 2379	:	Colour code for identification of pipelines
IS: 1477	:	Code of practice for painting of ferrous metals in buildings (Parts I & II)
IS: 2524	:	Code of practice for painting of non-ferrous metals in buildings (Parts I & II)
IS: 6278	:	Code of practice for white washing and colour Washing
IS: 13183	:	Aluminium Paint, heat Resistant specification
IS: 158	:	Ready mixed paint, brushing, bituminous, black, Lead free, acid, alkali, water and heat resisting
IS: 2074	:	Ready mixed paint, air drying, red Oxide Zinc Chrome, priming
IS: 104	:	Ready mixed paint, brushing, Zinc Chrome, priming
IS: 2932	:	Enamel, synthetic, exterior (a) undercoating (b) finishing.
IS: 2629	:	Recommended Practice for Hot Dip Galvanising
BS EN ISO 14713	:	Code of practice for protection of iron & steel structure against corrosion
ISO 8501-1	:	Preparation of steel substrates before application of paint & related Products. Part-1: Rust grades & preparation grades of uncoated steel substrates & steel substrates after overall removal of previous coatings
ISO 8502-3	:	Assessment of dust on steel surface prepared for painting (Pressure sensitive tape method)
ISO 12944 (Part 1 to 7)	:	Corrosion protection of steel structures by Protective paint systems
SSPC	:	US Specifications of Steel Structures Painting Council, SSPC Volumes I and II
SSPC-SP-08	:	Surface preparation by Pickling
NORSOK M-501	:	Surface preparation & Protective coating
ISO 20340	:	Pre-Qualification test
ASTM	:	American Standard Test Method for paints and coatings
AWWA	:	American Water Works Association

SIS: 55900 : Swedish standard for blasting

In the event of conflict between the Codes and Standards referred to in the specification and the requirement of this specification, the latter shall govern. Statutory and Local regulations shall be strictly followed in selection and application of paint.

3.0 GENERAL

- 3.1 This specification covers the surface preparation, method of application and material to be used for all coating of equipment, steel structures and piping. Steel material subjected to surface preparation on shop/site shall have minimum requirements in accordance with Rust Grade B (SSPC/SSPM Volume-2).
- 3.2 Coating materials according to SSPC, EN ISO, ASTM, BIS or DIN standards, shall be used. The paint shall comply with applicable laws, regulations, ordinances etc., of the local authority, state or the nation pertains to the work. The materials shall be matched with each other so that they are compatible. Coatings deviating this specification shall be subject to approval. Standards of surface preparation and painting shall give a time to first maintenance of 10 years.
- 3.3 The paint to be applied shall be approved by Customer / Engineer.
- 3.4 All paints & paint material used shall be procured from approved manufacturers. Paint shall be supplied in manufacturers original containers with the description of content, specification No., colour, ref no, date of manufacture, shelf life expiry date & pot life.
- 3.5 The paint manufacturers shall provide coating system data sheet for each coating system to be used containing the following information:
 1. Surface preparations
 2. Film thickness (min and max)
 3. Min and max recoating intervals at relevant temperatures
 4. Mixing ratio, thinner details and coating repair systems
- 3.6 The sample for testing the paint being used may be taken by the customer at any time.
- 3.7 In general Shop fabricated equipment will be delivered to the site coated with a shop applied system or the manufacturer's standard finish in accordance with the requirements of this specification.
- 3.8 For equipment that has received shop prime coat, touch-up prime coat and additional coats shall be applied in accordance with the coating schedule. It is responsibility of the vendor to ensure compatibility between shop and field applied paint systems.
- 3.9 Necessary precautions shall be provided to all equipment, structures to protect other surfaces from abrasive blasting, coating over spray and spatter. Damage to other surfaces or equipment shall be repaired by the vendor.
- 3.10 The Contractor shall submit the following for review and approval by the Customer:



1. Manufacturer's recommended paint scheme for the project
2. Latest published product & instructions for application data,
3. Procedures for surface preparation and application.
4. Pre qualification for equipments and blasting materials, product, procedure and personnel qualifications for the paint and painting systems.
5. Painting repair procedures

Painting records shall contain:

- Equipment/components/location painted
- Date of painting
- Paint details such as specification No, colour, date of manufacture, shelf life, expiry date
- Application equipments
- Ambient conditions at the time of painting
- Surface temperature
- Drying time between coating, DFT and number of coatings
- Appropriate work plan for painting.

- 3.11 The supply of all necessary equipments, weather protection, and scaffolding for painting to ensure work is carried out in accordance with the specification and agreed programme.
- 3.12 Maintenance of the paint work until completion of the contract, this shall include repair of any damaged areas caused by third party.
- 3.13 Disposal of painting waste resulting from painting, shall comply with applicable laws, regulations, ordinances etc., of the local authority, state or the nation pertains to the work and coating materials.
- 3.14 It is a mandatory requirement that all operatives working to this procedure take full cognizance and implement necessary safety precautions.

4.0 PREPARATION OF SURFACES

- 4.1 All surfaces to be painted shall be thoroughly cleaned of all grease, oil, loose mill scale, dust, rust, weld spatters, sharp edges and any other foreign matter. Removal of grease and oil contamination shall be in accordance with SSPC-SP1 prior to cleaning process described below.
- 4.2 Mechanical cleaning by power tool and scrapping with steel wire brushes shall be adopted to clear the surfaces. However, in certain locations where power tool cleaning cannot be carried out, hand scrapping may be permitted with steel wire brushes and/or abrasive paper. Cleaning with solvents shall be resorted to only in such areas where other methods specified above have not achieved the desired results. Cleaning with solvents shall be adopted only after written approval of the Engineer.
- 4.3 The blast cleaned surface shall be checked for signs of salt contamination as per ISO 8502-6 & 9. The maximum allowable level of contamination shall be 20 mg/m². Surfaces that do not meet these criteria shall be reprocessed.

Mechanical Cleaning:

Manual/power tool cleaning shall be done as per grade St-2 or St-3, of ISO 8504-3. This method to be used for repair painting or on already painted



surface and in case of usage on new construction painting prior approval may be obtained from purchaser/engineer.

	Condition of surface	ISO 8504-3	SIS 055900	SSPC
Hand tool cleaning	Rusted	C St2	C St2	SP2
	Rusted and pitted	D St2	D St2	SP2
Power tool cleaning	Rusted	C St3	C St3	SP3
	Rusted and pitted	D St3	D St3	SP3

- i) Grade St-2: Thorough scraping and wire brushing, machine brushing, grinding etc. This grade of preparation shall remove loose mill scale, rust and foreign matter. Finally the surface is to be cleaned with a vacuum cleaner or with clean compressed air or with clean brush. After preparation, the surface should have a faint metallic sheen. The appearance shall correspond to the prints designated St-2.
- ii) Grade St-3: very thorough scraping and wire brushing, machine brushing, grinding etc. After preparing the surface, it should have a pronounced metallic sheen and correspond to the prints designated St-3.

Blast cleaning:

Compressors: Compressed air supply for blast cleaning shall be free of water and oil. Air compressors shall not be allowed to deliver air at 110deg C. The blasting activity shall be performed at ambient temperatures above 5°C and relative humidity less than 85%. Steel temperature shall be 3°C above dew point. Necessary safety precautions for equipment and operator shall be adhered to.

Abrasives: Abrasives used for blast cleaning carbon steel and alloy steel shall be as per ISO 8504-2 and SSPC painting manual. Suggested abrasives may be chilled iron grit or shot steel and malleable iron grit and shots non metallic abrasive (aluminium oxide, copper slag, garnet etc.).

Removal of mill scale and rust using abrasives such as grit or shot under high pressure. The grade of blasting performed in line with the approved painting scheme.

Surfaces to be coated shall be free of all grease, oil, loose rust, and loose mill scale. Rust, mill scale, weld spatter, flux, shall be removed by the methods indicated in the Coating Schedule. Oil and grease shall be removed by solvent cleaning method as outlined in SSPC - SP - 1 prior to blasting.

The quality and grain size of abrasives and the parameter of their use are to be chosen to obtain the surface profile depth and cleanliness. Abrasives shall comply with applicable laws, regulations, ordinances etc., of the local authority, state or the nation pertaining to the work.

Profile measurements for abrasive blast cleaned surface shall be made with a Profile comparator and permanent record shall be maintained with Testex Press-O-Film.

Surfaces prepared for coating shall be coated the same day and before any visible rusting occurs (the time elapsed between blast cleaning and



commencement of painting shall under no circumstances exceed 4 hours, but in any case must commence before signs of degradation occur).

After blasting cleaning, depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 25 mm may be used.

The grades of surface finish:

	ISO 8501-1	SIS 055900	SSPC	NACE
White metal	Sa3	Sa3	SP5	1
Near White metal	Sa 2½	Sa 2½	SP10	2
Commercial blast	Sa2	Sa2	SP6	3
Brush off blast	Sa1	Sa1	SP7	4

Paint Application

General:

Paints and other coating materials shall be applied in accordance with the paint manufacturer's instructions. The surface preparation and painting system shall be as described in ANNEXURE with the following exceptions:

- Nameplates, code stampings and push buttons
- Concrete brickwork, tile, and glass unless specified by the Purchaser / Engineer
- Non-ferrous materials
- Austenitic stainless steel
- Plastic and / or plastic coated materials
- Insulated surface of equipment and pipes except colour coating wherever required
- Any surface specified by the Purchaser / Engineer not to be painted.

Paint Application Requirements

The paint shall be applied in accordance with the paint manufacturer's product data sheet, which shall include the mix ratio, the method of application, and the use of thinners and over coating times.

Paint application shall be by brush, roller or spray gun. Local regulations regarding spray and roller coating shall be observed. A smooth uniform film shall be applied to the surfaces to be coated.

Painting shall be performed when the temperature of the surface is greater than 3°C above the dew point of the surrounding air and relative humidity of the air is less than 85% unless local conditions dictate otherwise and the Customer is in agreement. Guidance on the estimation of the probability of condensation can be found in ISO 8502-4. The measurement of these conditions is the responsibility of the Vendor.

In addition, paints shall not be applied under the following conditions:

- When the surface temperature is greater than 60 °C (unless a higher temperature is agreed by the paint manufacturer)
- When the air temperature is less than approximately 5°C, (depending on local conditions)



- When there is the likelihood of an unfavourable change in weather conditions within two hours after painting
- When there is a deposition of moisture in the form of rain, condensation, frost, etc., on the surface.
- When the available light is less than 500 lux.

Paints shall not be applied within 50 mm of edges which will later have to be welded. Such weld areas shall be taped/one coat of weldable primer for distance of 50 mm either side of the weld line.

When zinc rich primers are used, care shall be taken to mask to avoid any possibility of over spraying onto duplex, austenitic stainless steels; nickel alloys or 9% nickel steel components.

Two pack coatings like Air drying epoxy, Polyurethane coatings etc shall be mixed in the ratio recommended by manufacturer to ensure proper and complete curing of the coatings. The base and hardener are to be separately mixed first to obtain a homogenous mixture. The hardener is to be added to the base slowly, with continuous mixing / agitation and not the reverse. Power agitation is preferred over hand mixing.

Any addition of thinner to achieve the application viscosity should be made only after the components are thoroughly mixed. Excess thinner is not recommended, as increase in volume, leads to lower DFT, sagging, longer curing time, etc.

Coating containing heavy or metallic pigments that have a tendency to settle shall be kept in suspension by continuous use of a mechanical agitator whilst being applied, to ensure uniformity over the surface area (e.g., zinc MIO's pigmented materials).

Transport and erection of painted structures shall be carried out only after the drying time specified by the paint manufacturer has elapsed. Handling & packing of painted material shall be appropriate to avoid damage to painting, such as the use of non-metallic slings, etc for handling and by minimising handling after painting. All steel equipment shall be provided with priming or coating system to protect the steel surface during transport, storage, installation and construction.

Spray Application

Airless or pneumatic spray applications are preferred methods of application. Spraying shall be carried out keeping the spray gun at the minimum suitable distance from the work piece and consistently at 90° to the surface being painted.

Approval of Purchaser / Engineer shall be obtained during spray painting which may cause interference to other works. If spray painting is to be carried out, the following shall be taken into account:

The correct spray tips, air pressures, etc, as recommended by the equipment supplier, shall be used.

Conventional air spray equipment is used, the correct combination of air volume, air pressure and fluid flow to give good atomisation to be ensured to



get a defect free painted surface. The major disadvantage of conventional air spray is that high build coatings can generally not be applied by this method as most paints have to be thinned to a suitable viscosity for satisfactory atomisation, and so lose their high build properties. Vendor shall follow manufacture's instruction.

Air spray (pressure pot) is recommended in cases where large quantities of paint are to be applied as paint in the tank can be prevented from settling, reduces application time and also enables the gun to be turned to any angle to coat objects effectively without spilling paint.

Airless spray is recommended as high build coatings can be applied without thinning, very rapid application is possible, giving an economic advantage, compared to conventional spray, overspray and bounce-back are reduced, leading to reduced losses of material and less dust and fume hazards.

Each coat shall be applied uniformly and completely over the entire surface. All runs and sags shall be brushed out immediately or the paint shall be removed and the surface re-sprayed.

Very complex structures should be painted by brush instead of spray gun to avoid overspray, dry spray and unacceptable paint losses.

Brush application

Brush application may be used under the following circumstances:

- When areas cannot be properly coated by spraying for reasons such as material or environmental considerations
- For the initial coat of paint to corners, edges, crevices, holes, welds or irregular surface prior to spray application
- For "touch up" or repairs to localize damaged paint or areas of incorrectly applied paint
- Where the paint manufacturer considers the coating material suitable for brush application.

Brushes shall be of a style and quality that will permit the proper application of paint.

Brush applications should be done in two passes that are perpendicular to each other "wet on wet" so that a smooth coat, as near uniform in thickness as possible, is obtained thereby avoiding running and droplets. There should be no deep or detrimental brush marks. Paint shall be worked into all crevices and corners. Runs and sags shall be brushed out.

During the application of each coat, all areas such as corners, edges, welds, small brackets, bolts, nuts and interstices shall receive additional paint to ensure that these areas have at least the minimum specified dry film thickness and to ensure continuity of coating.

Roller application

Roller application shall only be used on relatively large surface areas and only if spraying is not an option. Roller application shall only be used if the first or priming coat of paint has been applied by brush. Roller application shall be in accordance with the paint Manufacturer's instructions.

Coating materials

The selected coating materials shall be suitable for the intended use and shall be selected after an evaluation of all relevant aspects such as

- Corrosion protective properties
- Requirements to health, safety and environment
- Properties related to application conditions, equipment and personnel
- Experience with the coating materials and coating system.

All coating materials and solvents shall be protected from ignition sources and shall remain within storage temperatures and storage conditions recommended by the coating manufacturer. All coating materials and solvents shall be stored in the original container bearing the manufacturer's label and instructions. Performance standard as listed below shall be established by paint manufacturer the records shall be submitted for review.

- Adhesion test (pull off test)
- Flexibility test
- Salt spray test (min 1000 Hrs)
- Water absorption test
- UV resistance test (external coating)
- Cathodic disbonding test (internal coating)
- Abrasion test (internal coating)
- Impact resistance test
- Sea water immersion test (structures in tidal, splash zone and conveying sea water)

Each product shall have a batch number showing year and month of manufacture and giving full traceability of production. Shelf life shall be included in the technical data sheet. All coating materials and solvents shall be stored in the original container bearing the manufacturer's label and instructions.

The composition of the paint shall be at the discretion of the manufacturer, provided that the finished product meets the requirements of, State or Local regulatory bodies for the products. All vehicle components for use in the manufacture of paints and enamels shall meet the ASTM/ ISO Specification except as otherwise stated coating systems shall be selected as per corrosivity category listed in the table below. Coating systems are tabulated in ANNEXURE and shall be pre-qualified in accordance with specification. Coating systems/ alternative coating systems may be re-subjected to pre-qualification, at the discretion of OWNER/ ENGINEER. The specified coating systems, the number of coats and the coating film thicknesses given in Annexure are minimum requirements Top coat colors should be in accordance with Annexure.

Gratings and step threads

- i) Surface preparation

Gratings and step threads shall be cleaned by acid pickling as per SSPC-SP-08.

- ii) Hot dip galvanising

The hot dip galvanising shall be done as per IS 2629 .The average mass of coating shall be 610 gms/m².



iii) Post galvanising treatment

Immediately after galvanising, post treatment such as chromating shall be applied to retard white rust attack.

iv) Touch up mechanical damages

The repair of damages coatings shall be done as per the recommended practice ASTM A 780.

CORROSIVITY OF ENVIRONMENTS

Corrosivity category		Mass loss per unit surface (per year of exposure)	
		Mass loss g/mm ²	Thickness loss μ m
C2	Low	>10 to 100	>1.30 to 25
C3	Medium	200-400 g/m ²	(25-50 μ m)
C4	High	400-650 g/m ²	(50-80 μ m)
C5	Very High Industrial & marine	650-1500g/m ²	(80-200 μ m)

Tests required for evaluation of acceptance of coating materials:

TABLE -1**PERFORMANCE TEST OF PAINT**

SL. No.	Test	ASTM TEST METHOD
1.0	Abrasion Resistance: (topcoat only)	ASTM D4060
2.0	Adhesion:	ASTM D4541
3.0	Dry Heat Resistance:	ASTM D2485
4.0	Flexibility: (topcoat only)	ASTM D522, 180° bend
5.0	Pencil Hardness: (topcoat only)	ASTM D3363
6.0	Salt Fog Resistance:	ASTM B117, 1000 hours
7.0	Weather Resistance:	ASTMG23 Type D
8.0	Test	ASTM Test Method
9.0	Density	D 1475
10.0	Dipping properties	D 823
11.0	Drying time	D 1640
12.0	Flexibility	D 1737/D 522
13.0	Hardness	D 3363
14.0	Adhesion (pull off test)	D 4541
15.0	Abrasion resistance	D 968/D 4060
16.0	DFT/Coat	As per SSPC Guidelines
17.0	Storage Stability	D 1849
18.0	Resistance to	
	i) Humidity for 2000 hrs.	D 2247
	ii) Salt Spray for 2000 hrs.	B 117
	iii) Accelerated Weathering	D 822



INSPECTION:

Inspection will be performed by an inspector authorised by Purchaser / Engineer. Paint materials including primers and thinners brought to site by contractor for application shall be procured directly from manufactures as per specification and shall be accompanied by manufacturer's test certificates.

The painting work shall be subjected to inspection by purchaser / engineer at all times. The vendor shall offer following stage of inspection:

- Surface preparation
- Primer application
- Subsequent coats
- Paint qualification test

Vendor shall provide the expert technical services of the paint manufactures as and when required by purchaser / engineer to ensure both the surface preparation and applications are carried out as per their recommendations. This service shall be provided without any obligation to purchaser.

The following coating inspection & test shall be carried out:

1. Ambient and steel temperature, relative humidity and dew point min twice in a shift.
2. Surface finish & profile check each component or once per 10 m2 after surface preparation.
3. Salt contamination test - Free from salt contamination.
4. Dry Film Thickness as per ISO 2808 No.6.
5. Holiday Test as per ASTM D 5162/ NACE RP 0188.
6. Adhesion Test as per ISO 2409 for cross-cut test, or a pull-off test as per ISO 4624/ ASTM D 4541.

6.0 SUGGESTED COLOUR CODES FOR PAINTING:

Sl. No.	Item/Service	Colour	IS-5	Colour (Band)	IS-5
1.0	Structures, platforms, ladders and handrails	Dark Admiralty Grey	632		
2.0	Boiler casing, ESP and ducting	Nut Brown	413		
3.0	Fans, pumps, motors,	Light Grey	631		
4.0	Tanks (without insulation and cladding)				
4.1	Outdoor	Aluminium			
4.2	Indoor	Light grey	631		
5.0	Vessels & all other proprietary equipment (without insulation & cladding)	Light grey	631		
6.0	Switchgear	Light grey	631		
7.0	Control & relay panels	Light grey	631 78 of IS1650		
8.0	Turbine	Golden	356		



Sl. No.	Item/Service	Colour	IS-5	Colour (Band)	IS-5
		Yellow			
9.0	Generator & exciter	Light grey	631		
10.0	Transformers	Aluminium			
11.0	Machinery guards	Signal red	537		
12.0	Crane				
12.1	Crane structure	Golden Yellow	356		
12.2	Trolley and hook	Crimson	540		
13.0	Piping (without insulation and cladding)				
13.1	Water System				
13.1.1	Boiler feed	Sea green	217		
13.1.2	Condensate	Sea green	217	Light brown	410
13.1.3	Bearing cooling water	Sea green	217	French blue	166

Notes:

1. This colour code basically refers to IS: 2379 for piping with necessary modifications.
2. Where band colour is specified, same shall be provided at 30 meter intervals on long uninterrupted lines and also adjacent to valves and junctions.

PAINTING SCHEME FOR C2 AMD C3 ENVIRONMENT

S. No	Description	Surface Preparation	Primer			Intermediate paint			Finish coat		Total DFT
			Paint	No. of coats	DFT	Paint	No. of coats	DFT	Paint	No. of coats	
1.	Boiler structure, un-insulated ducts, suspensions, hangers temperature <120°C	Sa 2 ½	In organic Zn silicate	2	80 µ	HB MIO epoxy	1	120 µ	Poly urethane	2	260µ
2.	Indoor structure	Sa 2 ½	HB Zn Phosphate	2	80 µ	HB MIO epoxy	1	120 µ	--	--	260µ
3.	Insulated parts exposed to temp >120°C	Sa 2 ½	In organic Zn silicate	2	60 µ						60µ
4.	Work shop	Sa 2 ½	HB Zn Phosphate	2	80 µ	HB MIO epoxy	1	120 µ	--	--	260µ
5.	Water Treatment Plant (external)	Sa 2 ½	Zn rich epoxy	2	80 µ	HB MIO epoxy	2	200 µ	Aliphatic poly urethane	2	360µ
6.	Coal Handling Plant	Sa 2 ½	In organic Zn silicate	2	80 µ	HB MIO epoxy	1	120 µ	poly urethane	2	260µ
7.	Fuel pipings	Sa 2	Ehthy Zn silicate	1	40 µ				HR aluminium paint	2	80µ
8.	Un insulated silencer, steel stacks >120°C	Sa 2 ½	Ehthy Zn Silicate	1	40 µ				HR silicone aluminium paint	2	80µ
9.	Above ground piping	Sa 2 ½	In organic Zn silicate	2	80 µ	HB MIO epoxy	1	120 µ	Poly urethane	2	260µ
10.	Burried piping (External)	Sa 2 ½	Coal tar primer, coal tar enamel, inner wrap of fibre glass, final outer wrap of enamel impregnated fibre								4.0m m
11.	Burried piping (Internal)	Sa 2 ½	Solid rigid poly urethane 500 µ								500µ
12.	Storage tanks (external)	Sa 2 ½	In organic Zn silicate	2	80 µ	HB MIO epoxy	1	120 µ	Poly urethane	2	260µ
13.	Storage tanks (internal)	Sa 2 ½	3 coats of amine adducts								400µ



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DCPL

			Hard rubber lining min 4 mm thickness								4. mm
14.	DM water piping (internal)	Sa 2 ½									
15.	DM water tank (internal)	Sa 2 ½	In organic Zn silicate	2	80 μ	HB MIO epoxy	1	150 μ	HB coal tar epoxy	1	150 μ
16.	Fuel oil tanks (internal)	Sa 2 ½	In organic Zn silicate	2	80 μ	HB MIO epoxy	1	150 μ	HB coal tar epoxy	1	380μ
17.	Insulated parts continuously exposed to condensing water	Sa 2 ½	In organic Zn silicate	2	75 μ						75μ
18.	For insulated piping <125°C	Sa 2 ½	Polyamide cured epoxy coating	2	250 μ						250μ
19.	Electrical parts, control panels, valves, pumps & motors (indoor)*	Sa 2 ½	Zn phosphate epoxy	2	80 μ				Chlorinated rubber	2	160μ
20.	Electrical parts, control panels, valves, pumps & motors (outdoor)*	Sa 2 ½	Zn phosphate epoxy	2	80 μ				Chlorinated rubber	2	180μ
21.	Switch yard, floor grills walk ways	Sa 2 ½	Hot dip galvanising 80μ								80μ

* Note: Manufacturer to specify details of painting system capable of withstanding environmental conditions for a period of 10 years before first maintenance



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PART OF SPECIFICATION PE-TS-426-160-A001

PAINTING SCHEME FOR C4 AMD C5 ENVIRONMENT

S. No	Description	Surface Preparation	Primer			Intermediate paint			Finish coat			Total DFT
			Paint	No. of coats	DFT	Paint	No. of coats	DFT	Paint	No. of coats	DFT	
1.	Boiler structure, un-insulated ducts, suspensions, hangers temperature <120°C	Sa 2 ½	HB Zn Phosphate	2	80 µ	HB MIO epoxy	2	200 µ	Epoxy PU HB	2	80 µ	360µ
2.	Indoor structure	Sa 2 ½	HB Zn Phosphate	2	80 µ	HB MIO epoxy	1	120 µ	Poly urethane	2	60 µ	260µ
3.	Insulated parts exposed to temp >120°C	Sa 2 ½	In organic Zn silicate	2	60 µ							60µ
4.	Work shop	Sa 2 ½	HB Zn Phosphate	2	80 µ	HB MIO epoxy	1	120 µ	Poly urethane	2	60 µ	260µ
5.	Water Treatment Plant (external)	Sa 2 ½	Zn rich epoxy	2	80 µ	HB MIO epoxy	2	200 µ	Epoxy PU HB	2	80 µ	360µ
6.	Coal Handling Plant	Sa 2 ½	HB Zn Phosphate	2	80 µ	HB MIO epoxy	2	200 µ	Poly urethane	2	60 µ	340µ
7.	Coal Fuel pipings	Sa 2	Ethy Zn silicate	1	40 µ				HR aluminium paint	2	40 µ	80µ
8.	Un insulated silencer, steel stacks >120°C	Sa 2 ½	Ethy Zn Silicate	1	40 µ				HR silicone aluminium paint	2	40 µ	80µ
9.	Above ground piping	Sa 2 ½	In organic Zn silicate	2	80 µ	HB MIO epoxy	1	120 µ	Poly urethane	2	60 µ	260µ
10.	Burried piping (external)	Sa 2 ½	Coal tar primer, coal tar enamel, inner wrap of fibre glass, final outer wrap of enamel									4.0 mm
11.	Burried piping (internal)	Sa 2 ½	Solid rigid poly urethane 500 µ									500µ
12.	Storage tanks (external)	Sa 2 ½	In organic Zn silicate	2	80 µ	HB MIO epoxy	2	200 µ	Poly urethane	2	60 µ	340µ
13.	Storage tanks (internal)	Sa 2 ½	3 coats of amine adducts									400µ
14.	DM water piping (internal)	Sa 2 ½	Hard rubber lining min 4 mm thickness									4.0



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												mm
15.	DM water tank (internal)	Sa 2 ½	In organic Zn silicate	2	80 μ	HB MIO epoxy	1	150 μ	HB coal tar epoxy	1	150 μ	380μ
16.	Fuel oil tanks (internal)	Sa 2 ½	In organic Zn silicate	2	80 μ	HB MIO epoxy	1	150 μ	HB coal tar epoxy	1	150 μ	380μ
17.	Insulated parts continuously exposed to condensing water	Sa 2 ½	In organic Zn silicate	2	75 μ							75μ
18.	For insulated piping <125°C	Sa 2 ½	Polyamide cured epoxy coating	2	250 μ							250μ
19.	Electrical parts, control panels, valves, pumps & motors (indoor)*	Sa 2 ½	Zn phosphate epoxy	2	80 μ				Chlorinated rubber	2	80 μ	160μ
20.	Electrical parts, control panels, valves, pumps & motors (outdoor)*	Sa 2 ½	Zn phosphate epoxy	2	80 μ				Chlorinated rubber	2	100 μ	180μ
21.	Switch yard, floor grills walk ways	Sa 2 ½	Hot dip galvanising coating Wt. 610 gms/M ² (coating thickness of 80μ)									80μ

*** Note:** Manufacturer to specify details of painting system capable of withstanding environmental conditions for a period of 10 years before first maintenance.



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**1X660 MW PANKI EXTN
TECHNICAL SPECIFICATION
FOR
MILL REJECT SYSTEM (PNEUMATIC TYPE)

SPECIFIC TECHNICAL REQUIREMENTS-
MECHANICAL**

SPECIFICATION No: PE-TS-426-160-A001

**PACKAGE: MILL REJECT SYSTEM
(PNEUMATIC TYPE)**

SECTION-I

SUB-SECTION-IA

REV. 00

DATE: JUNE 2019

**SUB-SECTION – IA

CUSTOMER SPECIFICATION

GENERAL TECHNICAL REQUIREMENTS**

PART OF SPECIFICATION PE-TS-426-160-A001

CHAPTER 5 : GENERAL TECHNICAL REQUIREMENTS**1.0 INTRODUCTION**

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

2.0 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 Owner to determine that the products proposed are equivalent or superior to those named.

3.0 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 Bidder 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 may 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 Owner. Sufficient amount of information for justifying such proposals shall be furnished to Owner along with the bid to enable the Owner to determine the acceptability of these proposals.

4.0 COMPLETENESS OF FACILITIES

- 4.1 Bidders may note that this is a contract inclusive of the scope as indicated elsewhere in the specification. Plant shall be engineered and designed in accordance with the specification requirement. All engineering and associated services are required to ensure that a completely engineered plant is provided.
- 4.2 All equipments furnished by the Bidder 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 & maintenance 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.
- 4.3 All similar standard components/ parts of similar standard equipment provided shall be interchangeable with one another.

5.0 Codes & Standards

- 5.1 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.) Bureau of Indian Standards (BIS)
- (b.) Indian Electricity Act (2003)
- (c.) Indian Electricity Rules
- (d.) Indian Explosives Act
- (e.) Indian Factories Act and State Factories Act
- (f.) Indian Boiler Regulations (IBR)
- (g.) Regulation of Central Electricity Authority
- (h.) Regulations of the Central Pollution Control Board, India
- (i.) Regulations of the Ministry of Environment & Forest (MoEF), Government of India
- (j.) Pollution Control Regulations by Department of Environment, Government of India
- (k.) State Pollution Control Board.
- (l.) Building and other construction workers (Regulation of Employment and Conditions of services) Central Rules, 1998
- (m.) Explosive Rules, 1983
- (n.) Petroleum Rules, 1976,
- (o.) Gas Cylinder Rules, 1981
- (p.) Static and Mobile Pressure Vessels (Unified) Rules, 1981
- (q.) Workmen's Compensation Rules, 1924
- (r.) Rules for Electrical installation by Tariff Advisory Committee (TAC) and appropriate Electrical Inspectorate.
- (s.) Owner's Safety Policy
- (t.) Any other statutory codes / standards / regulations, as may be applicable.

5.2 Unless covered otherwise by Indian codes & standards and in case nothing to the contrary is specifically mentioned elsewhere in the specifications, the latest editions (as applicable as on date of bid opening), of the codes and standards given below shall also apply:

- (a.) British Standards (BS)
- (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 Organisation for Standardization (ISO)
- (i.) Tubular Exchanger Manufacturer's Association (TEMA)
- (j.) American Welding Society (AWS)
- (k.) Cooling Tower Institute (CTI)
- (l.) National Electrical Manufacturers Association (NEMA)
- (m.) National Fire Protection Association (NFPA)
- (n.) International Electro-Technical Commission (IEC)
- (o.) Expansion Joint Manufacturers Association (EJMA)
- (p.) Heat Exchange Institute (HEI)
- (q.) IEEE standard
- (r.) JEC standard

5.3 Other International/ National standards such as DIN, VDI, BS, etc. shall also be accepted for only material codes and manufacturing standards, subject to the Owner's approval, for which the Bidder shall furnish, along with the offer, adequate information to justify that these standards are equivalent or superior to the standards mentioned above. In all such cases the Bidder shall furnish



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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.

- 5.4 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. In addition, these standards shall be referred for the design of machine foundations, wherever specifically mentioned in the specifications. However, for those of the above equipment not covered by these National / International standards, established and proven standards of manufacturers shall also be considered.
- 5.5 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.
- 5.6 Two (2) English language copies of all-national and international codes and/or standards used in the design of the plant, equipment, civil and structural works shall be provided by the Bidder to the Owner within two calendar months from the date of the Notification of Award.
- 5.7 In case of any change in codes, standards & regulations between the date of bid opening and the date when vendors proceed with fabrication, the Owner shall have the option to incorporate the changed requirements or to retain the original standard. It shall be the responsibility of the Bidder to bring to the notice of the Owner such changes and advise Owner of the resulting effect.

6.0 EQUIPMENT FUNCTIONAL GUARANTEE

- 6.1 The Equipment and Auxiliaries shall be capable of continuous operation in frequency range of 47.5 to 51.5 Hz.
- 6.2 The functional guarantees of the equipment under the scope of the Contract shall be as per "Chapter 8 - Functional Guarantee & LD", Volume-II. These guarantees shall supplement the general functional guarantee provisions covered under General Conditions of Contract.
- 6.3 Liquidated damages for shortfall in meeting functional guarantee(s) during the performance and guarantee tests shall be assessed and recovered from the Bidder as specified elsewhere in this specification.

7.0 DESIGN OF FACILITIES / MAINTENANCE & AVAILABILITY CONSIDERATIONS

7.1 Design of Facilities

- 7.1.1 All the design procedures, systems and components proposed shall have already been adequately developed and shall have demonstrated good reliability under similar conditions elsewhere.
- 7.1.2 The Bidder shall be responsible for the selection and design of appropriate equipments to provide the best co-ordinate 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.

7.2 Maintenance and Availability Considerations

- 7.2.1 Equipment/facilities 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.
- 7.2.2 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 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.
- 7.2.3 Lifting devices i.e. hoists and chain pulley jacks, etc. shall be provided by the Bidder for handling of any equipment or any of its part having weight in excess of 500 Kgs during erection and maintenance activities.
- 7.2.4 Lifting devices like lifting tackles, slings, etc. to be connected to hook of the hoist / crane shall be provided by the Bidder for lifting the equipment and accessories covered under the specification.

8.0 DOCUMENTS, DATA AND DRAWINGS TO BE FURNISHED BY BIDDER

- 8.1 Plant and equipment shall be fully integrated, engineered and designed to perform in accordance with the technical specification. All engineering and technical services required ensuring a completely engineered plant shall be provided in respect of mechanical, electrical, control & instrumentation, civil & structural works as per the scope.

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

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

- 8.2 The number of copies/prints/CD-ROMs/manuals to be furnished for various types of documents is given in Annexure-I attached with Chapter 5, Volume-II.
- 8.3 The documentation that shall be provided by the Bidder is indicated in various sections of specification. The documentation shall include but not be limited to the following:

8.3.1 Basic Engineering Documentation

Prior to commencement of the detailed engineering work, the Bidder shall furnish a Plant Definition Manual within 4-6 weeks from the date of the Notification of Award. This manual shall contain the following as a minimum:-

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



- 2) Technology scans for each system / sub-system & equipment.
- 3) Selection of appropriate technology / schemes for various systems/ subsystems including techno-economic studies between various options.
- 4) Optimization studies including thermal cycle optimization.
- 5) Sizing criteria of all the systems, sub-systems including various piping systems/ equipments/ structures/ equipment foundations along with all calculations justifying and identifying the sizing and the design margins.
- 6) Schemes and Process & Instrumentation diagrams for the various systems/ sub-system with functional write-ups.
- 7) Operation Philosophy and the control philosophy of the Main Plant and other plants.
- 8) General Layout plan of the power station incorporating all facilities in Bidder's as well as those in the Owner's scope. This drawing shall also be furnished in native (Word, Excell, ACAD etc) in the form of CD discs to the Owner for engineering of areas not included in Bidder's scope.
- 9) Basic layouts and cross sections of the main plant building (various floor elevations), boiler, fuel oil area and other areas included in the scope of the Bidder.
- 10) 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 Owner.

After approval of Plant Definition Manual / Design Basis Report, Bidder shall furnish detailed technical specification of all system / packages of the Plant.

8.3.2 Detailed Engineering Documentation

- 1) Layouts, general arrangements, elevations and cross-sections drawings for all the equipment and facilities of the plant.
- 2) Flow diagrams, Process & Instrumentation Diagrams along with write-up and system description.
- 3) Start-up curves for turbine, boiler and both turbine and boiler combined together as a unit for various start-ups, viz. cold, warm and hot start-up.
- 4) Piping isometric, composite layout and fabrication drawings.
- 5) Piping engineering diagrams, pipe and fittings schedules, valve schedules, hanger and support schedules, insulation schedules.
- 6) Technical data sheets for all bought out and manufactured items. Bidder shall use the specifications as a base for placement of orders on their sub-vendors.



- 7) Detailed design calculations for components, system/sub-system, piping etc., wherever applicable including sizing calculations for all auxiliaries as per criteria specified elsewhere in specification.
- 8) Boiler pressure part schedule and sizing calculations. Boiler performance data and boiler design dossier.
- 9) Transient, hydraulic and thermal stress analysis of piping and system wherever applicable & input and output data along with stress analysis isometrics showing nodes.
- 10) Thermal cycle information (heat balance diagrams, boiler performance calculations, condenser and heat exchanger thermal calculations etc.).
- 11) Characteristic Curves/ Performance Correction Curves. Hydraulic & Mechanical design calculations for condensers & heaters.
- 12) Model Studies/ CFD analysis for ESP, CW sump etc and furnishing report with recommendations.
- 13) Characteristic Curves/ Performance Correction Curves and thermal design calculations for Cooling Tower.
- 14) Composite Water Balance for total Plant.
- 15) Hydraulic calculation/profile for Water Treatment Plant.
- 16) Comprehensive list of all terminal points which interface with Owner's facilities giving details of location, terminal pressure, temperature, fluid handled & end connection details, forces, moments etc.
- 17) Power supply single line diagram, block logics, control schematics, electrical schematics, etc.
- 18) Protection systems diagrams and relay settings. Load Flow study.
- 19) Interconnection diagrams.
- 20) Cable routing plan.
- 21) 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.
- 22) Alarm and annunciation list and alarms & trip set points.
- 23) Sequence and protection interlock schemes.
- 24) Type test reports and power system stability study report.
- 25) Control system configuration diagrams and card circuit diagrams and maintenance details.



- 26) Detailed software manuals & source software listing.
- 27) Detailed flow chart for digital control system.
- 28) Mimic diagram layout.
- 29) Civil Task drawings (for the Engineering by Owner), Design and Drawings for the Civil & Structural works in the scope of the Bidder.
- 30) Model study reports wherever applicable.
- 31) Functional & guarantee test procedures and test reports.
- 32) Documentation in respect of Quality Assurance System as listed out elsewhere in this specification.
- 33) Documentation in respect of commissioning as listed out elsewhere in this specification.

The Bidder while submitting the above documents / drawings for approval / reference as the case may be, shall mark on each copy of submission the reference letter along with the date vide which the submissions are made.

8.3.2 Instruction Manuals

The Bidder shall submit to the Owner, 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 finalization and approval of the Owner 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 Owner. 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 particular equipment/system. The erection manual should contain the following as a minimum.

- 1) Erection strategy.
- 2) Sequence of erection.
- 3) Erection instructions.
- 4) Critical checks and permissible deviation/tolerances.
- 5) List of tool, tackles, heavy equipments like cranes, dozers, etc.
- 6) Bill of Materials
- 7) Procedure for erection.



- 8) General safety procedures to follow during erection/installation.
- 9) Procedure for initial checking after erection.
- 10) Procedure for testing and acceptance norms.
- 11) Procedure / Check list for pre-commissioning activities.
- 12) Procedure / Check list for commissioning of the system.
- 13) 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

- i.) Description of operating principle of equipment / system with schematic drawing / layouts.
- ii.) Functional description of associated accessories / controls. Control interlock protection writes up.
- iii.) Integrated operation of the equipment alongwith the intended system. (The is to be given by the supplier of the Main equipment by taking into account the operating instruction given by the associated suppliers).
- iv.) Exploded view of the main equipment, associated accessories and auxiliaries with description. Schematic drawing of the equipment alongwith its accessories and auxiliaries.
- v.) Design data against which the plant performance will be compared.
- vi.) Master list of equipments, Technical specification of the equipment/ system and approved data sheets.
- vii.) Identification system adopted for the various components, (it will be of a simple process linked tagging system).



- viii.) 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

- i.) Protection logics provided for the equipment alongwith brief philosophy behind the logic, Drawings etc.
- ii.) Limiting values of all protection settings.
- iii.) Various settings of annunciation/interlocks provided.
- iv.) Start-up and shut down procedure for equipment alongwith the associated systems in step mode.
- v.) Do's and Don'ts related to operation of the equipment
- vi.) Safety precautions to be taken during normal operation. Emergency instruction on total power failure condition/lubrication failure/any other conditions.
- vii.) Parameters to be monitored with normal value and limiting values.
- viii.) Equipment isolating procedures.
- ix.) Trouble shooting with causes and remedial measures.
- x.) Routine testing procedure to ascertain healthiness of the safety devices alongwith schedule of testing.
- xi.) Routine Operational Checks, Recommended Logs and Records
- xii.) Change over schedule if more than one auxiliary for the same purpose is given.
- xiii.) System/plant commissioning procedure.
- xiv.) Preservation procedure on long shut down.

3) **Chapter 3.0 - Plant Maintenance**

To contain the following sections specific to the equipment supplied

- i.) Exploded view of each of the equipments. Drawings alongwith bill of materials including name, code no. & population.
- ii.) 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
- iii.) List of Special T/ P required for Overhauling /Trouble shooting including special testing equipment required for calibration etc



- iv.) 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.
 - v.) Preventive Maintenance schedules linked with running hours/calendar period alongwith checks to be carried out
 - vi.) Overhauling schedules linked with running hours/calendar period alongwith checks to be done
 - vii.) Long term maintenance schedules
 - viii.) Consumables list alongwith the estimated quantity required during normal running and during maintenance like Preventive Maintenance and Overhauling
 - ix.) 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
 - x.) Tolerance for fitment of various components
 - xi.) Details of sub vendors with their part no. in case of bought out items
 - xii.) List of spare parts with their Part No, total population, life expediency & their interchange ability with already supplied spares to OWNER.
 - xiii.) List of mandatory and recommended spare list along with manufacturing drawings, material specification & quality plan for fast moving consumable spares.
 - xiv.) Lead time required for ordering of spares from the equipment supplier, instructions for storage and preservation of spares
 - xv.) 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.
- 8.3.2.2 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.
- 8.3.2.3 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.

8.3.3 Plant Handbook and Project Completion Report



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8.3.3.1 Plant Handbook

The Bidder shall submit to the Owner 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

- 1) Design and performance data.
- 2) Process & Instrumentation diagrams.
- 3) Single line diagrams.
- 4) Sequence & Protection Interlock Schemes.
- 5) Alarm and trip values.
- 6) Performance Curves.
- 7) General layout plan and layout of main plant building and auxiliary buildings.
- 8) Important Do's & Dont's

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

8.3.3.2 Project Completion Report

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

8.3.4 Drawings

- a) i) All the plant layouts shall be made in computerised 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 (GTR)-Vol-II.

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 (GTR), Vol-II.
- iv) The completed plant documentation including integrated 3-D model with equipment drawings, data sheets, P&ID, BOQ, schematics, logic diagrams, test reports and quality plan, etc. attached to the respective equipments / systems in the 3D model shall be furnished to Employer,



along with the design review software (network ready) which shall include interference check, walk-through animation, simulation, visual effect, photo realism etc. loaded on a server with four (4) work stations (latest configuration for server & workstation) with one A4 size colored laser printer and one A0 size colored plotter. The software shall include facility for obtaining hard copies of all the drawings/documents on standard plotter / printer.

The requisite hardware and software shall be supplied and commissioned by the Contractor at Employer's Head Office at Lucknow & Site Office at Panki as per mutually agreed schedule.

All softwares provided shall necessarily include the 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 (3) years after warranty/guarantee period.

- b) All documents/text information shall be in latest version of MS Office or MS Excel 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 subvendor) 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 so as 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.
- f) The Contractor shall also furnish a "Master Drawing List" which shall be a comprehensive list of all drawings/ documents/ calculations envisaged to be furnished by him during the detailed engineering to the Employer. Such list should clearly indicate the purpose of submission of these drawings i.e. "FOR APPROVAL" or "FOR INFORMATION ONLY".
- g) Similarly, all the drawings/ documents submitted by the Contractor during detailed engineering stage shall be marked "FOR APPROVAL" or "FOR INFORMATION" prior to submission. Further, space shall be identified on each drawing for Approval stamp and electronic signature



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- h) 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.
- i) 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.
- j) 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.
- k) 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.
- l) 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 Owner prior to erection. Small diameter pipes shall however be routed as per site conditions in consultation with site authority/representative of Owner based on requirements of such piping indicated in approved / finalized 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.
- m) Assessing & anticipating the requirement and supply of all piping and equipment shall be done by the Bidder 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.
- n) As Built Drawings**
After final acceptance of individual equipment/system by the Owner, the Bidder will update all original drawings and documents for the equipment/ system to "as built" conditions in requisite number.
- o) Drawings must be checked by the Bidder in terms of its completeness, data adequacy and relevance with respect to engineering schedule prior to submission to the Owner. In case drawings are found to be submitted without proper endorsement for checking by the Bidder, the same shall



not be reviewed and returned to the Bidder for re-submission. The Bidder 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 Bidder 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 Owner's scope and submit all necessary drawings/documents for the same.

- p) The Bidder shall submit adequate prints of drawing/data/document for Owner's review and approval. The Owner shall review the drawings and return one (1) copy to the Bidder 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 Bidder to submit/rectify and resubmit in time shall not be accepted as a reason for delay in the contract schedule.
- q) All engineering data submitted by the Bidder after final process including review and approval by the Project Manager/Owner 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.

8.4 Engineering Information Submission Schedule

Prior to the award of Contract, a Detailed Engineering Information Submission Schedule shall be tied up with the Owner. For this, the bidder shall furnish a detailed list of engineering information alongwith the proposed submission schedule. This list would be a comprehensive one including all engineering data / drawings / information for all bought out items and manufactured items. The information shall be categorised into the following parts.

- a) Information that shall be submitted for the approval of the Owner before proceeding further, and
- b) Information that would be submitted for Owner's information only.

The Master Drawing List (MDL) shall be updated periodically and submitted to the employer, highlighting the changes made in MDL.

The schedule should allow adequate time for proper review and incorporation of changes/ modifications, if any, to meet the contract without affecting the equipment delivery schedule and overall project schedule. The early submission of drawings and data is as important as the manufacture and delivery of equipment and hardware and this shall be duly considered while determining the overall performance and progress.

8.5 Engineering Progress and Exception Report

8.5.1 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 including those for revision after commenting last revision .
- 8.5.2 The draft format for this report shall be furnished to the Owner within four (4) weeks of the award of the contract, which shall then be discussed and finalized with the Owner.

8.6 Engineering Co-ordination Procedure

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

Project Manager (UPRVUNL EC):

Name :
 Designation :
 Address
 a) Postal :
 b) Telegraphic /e-Mail :
 c) FAX : TELEPHONE (Land & Mobile) :

Contractor's/ Vendor's Engineering Coordinator (VENDOR EC):

Name :
 Designation :
 Address :
 a) Postal :
 b) Telegraphic /e-Mail :
 c) FAX : TELEPHONE(Land & Mobile) :

- 8.6.2 All engineering correspondence shall be in the name of above coordinators on behalf of the respective organizations.

- 8.6.3 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 OWNER'S information/ interface and or review and approval are referred by the general term "drawings".
- b) The 'Master drawings list' indicating titles, Drawing Number, Date of submission and approval etc. shall be finalised mutually between Contractor and Owner before the award of contract. This list shall be updated if required at suitable interval during detailed engineering.
- 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 subvendor along with his purchase order for subvendor's compliance.
- d) Owner shall intimate the contractor, OWNER drawing number procedure. Vendor, thereafter, shall indicate OWNER drawing number in MDL and in subsequent Submission of drawing, in the space provided for this purpose in



title plate, in addition to his own drawing number, if any.

- 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 Owner'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 Owner. 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 adequate prints of drawing / data / document for Owner's review and approval. The drawings submitted by the Contractor/vendor shall be reviewed by OWNER and their comments shall be forwarded within four (4) 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/action:

CATEGORY/Action - 1 : Distributed
CATEGORY/Action - 2 : Approved

CATEGORY/Action - 3 : Approved, subject to incorporation of comments/ modification as noted. Forward final drawing Resubmit revised drawing incorporating the comments

CATEGORY/Action - 4 Approved, subject to incorporation of comments/ modification as noted. Resubmit revised drawing incorporating the comments

CATEGORY/Action - 5: Not approved. Resubmit revised drawings for approval after incorporating comments/ modification as noted in accompanying memo.

CATEGORY/Action - 6 : For information and records.

- h) Contractor shall resubmit the drawings marked/stamped under Category/Action 3,4 & 5 within two(2) weeks of receipt of comments on the drawings, incorporating all comments. Every revision of the drawing shall



bear a revision index wherein such revisions shall be highlighted in the form of description or marked up in the drawing identifying the same with relevant revision Number enclosed in a triangle (e.g. 1, 2, 3 etc). Contractor shall not make any changes in the portions of the drawing other than those commented. If changes are required to be made in the portions already approved, the Contractor shall resubmit the drawing identifying the changes for Owner's review and approval. **Drawings resubmitted shall show clearly the portions where the same are revised marking the relevant revision numbers and Owner shall review only such revised portion of documents.**

- i) In case, the Contractor/ Vendor does not agree with any specific comment, he shall furnish the explanation for the same to OWNER 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 shall be the responsibility of the Contractor/ Vendor to get all the drawings approved as the case may be and complete the 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.
- m) 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.

9.0 Technical Co-Ordination Meetings

- 9.1 The Bidder shall be called upon to organize and attend monthly Design/ Technical Co-ordination Meetings with the Owner / Owner's representatives / OWNER Consultant during the period of contract. The Bidder shall attend such meetings at his own cost at mutually agreed venue as and when required and fully co-operate with such persons and agencies involved during the discussions.
- 9.2 The Contractor should note that Time is the essence of the contract. In order to expedite the early completion of engineering activities, the Bidder shall submit all drawings as per the agreed Engineering Information Submission Schedule. The drawings submitted by the Bidder will be reviewed by the Owner as far as practicable within three (3) weeks from the date of receipt of the drawing. The comments of the Owner shall then be discussed across the table during the above co-ordination Meetings wherein best efforts shall be made by both sides to ensure the approval of the drawing.



- 9.2.1 The Contractor shall ensure availability of the concerned experts / consultants/ personnel who are empowered to take necessary decisions during these meetings. The Bidder 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.
- 9.2.2 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.
- 9.3 Any delays arising out of failure by the Bidder to incorporate Owner's comments and resubmit the same during the TCM shall be considered as a default and in no case shall entitle the Bidder to alter the Contract completion date.

10.0 Design Improvements

The Owner 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 Bidder proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly.

11.0 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 Owner. Each base plate which 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.

12.0 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.

13.0 Lubricants, Servo Fluids and Chemicals

- 13.1 The Bidder's scope includes all the first fill and one year's topping, requirements of consumables such as oils, lubricants including grease, servo fluids, gases and essential chemicals etc. Consumption of all these consumables during the initial operation and final filling after the initial operation shall also be included in the scope of the Bidder. Bidder shall also supply a quantity not less than 10% of the full charge of each variety of lubricants, servo fluids, gases, chemicals etc. used which is expected to be utilised during the first year of operation. This additional quantity shall be supplied in separate Containers.
- 13.2 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.



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 Owner along with lubrication requirements.

14.0 Lubrication & Chemicals

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.

14.1 Chemicals for Water System

Bidder's scope include Chemical required for complete water system up to final handing over EPC package and further two (2) months plant operational requirement.

15.0 Material of Construction

All materials used for the construction of the equipment shall be new and shall be in accordance with the requirements of this specification. Materials utilized for various components shall be those which have established themselves for use in such applications.

16.0 Rating Plates, Name Plates & Labels

- 16.1 Each main and auxiliary item of plant including instruments 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 Owner.
- 16.2 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 Owner or as detailed in appropriate section of the technical specifications.
- 16.3 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. The name plates shall be suitably fixed on both front and rear sides.
- 16.4 Items of plant such as valves, which are subject to handling, shall be provided with engraved chromium plated nameplate or label with engraving filled with epoxy. The name plates for valves shall be marked in accordance with MSS standard SP-25 and ANSI B 16.34 as a minimum.
- 16.5 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. Suitable scale shall also be provided to indicate load on support/hanger.



- 16.6 Valves, steam traps and strainers shall be identified by Owner'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.
- 16.7 Safety and relief valves shall be provided with the following:
- Manufacturer's identification.
 - Nominal inlet and outlet sizes in mm.
 - Set pressure in Kg/cm² (abs).
 - Blowdown and accumulation as percentage of set pressure.
 - Certified capacity in Kg of saturated steam per hour or in case of liquid certified capacity in litres of water per minute.
- 16.8 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.
- 16.9 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

17.0 Tools and Tackles

The Bidder shall supply with the equipment one complete set of all special tools and tackles and other instruments required for the erection, assembly, disassembly and proper maintenance of the plant and equipment and systems (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 Bidder shall also ensure that these tools and tackles are not used by him during erection, commissioning and initial operation. For this period the Bidder should bring his own tools and tackles. All the tools and tackles shall be of reputed make acceptable to the Owner.

18.0 Welding

- 18.1 If the manufacturer has special requirements relating to the welding procedures for welds at the terminals of the equipments to be per formed by others the requirements shall be submitted to the Owner in advance of commencement of erection work.

19.0 Colour Code for all Equipments/ Pippings/ Pipe Services

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

20.0 Protection and Preservative Shop Coating



20.1 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. The parts which are likely to get rusted, due to exposure to weather, should also be properly treated and protected in a suitable manner. 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 Chapter 9, Volume II.

20.2 Preservative Shop Coating

- 20.2.1 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 with at least two coats of primer.
- 20.2.2 Transformers and other electrical equipments if included shall be shop finished with one or more coats of primer and two coats of high grade epoxy. The finished colours shall be as per manufacturer's standards, to be selected and specified by the Owner at a later date.
- 20.3 Shop primer for all steel surfaces which will be exposed to operating temperature below 95 degrees Celsius shall be selected by the Bidder after obtaining specific approval of the Owner 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 Owner.
- 20.4 All other steel surfaces which are not to be painted shall be coated with suitable rust preventive compound subject to the approval of the Owner.
- 20.5 All piping shall be cleaned after shop assembly by shot blasting or other means approved by the Owner. Lube oil piping or carbon steel shall be pickled.
- 20.6 Painting for Civil structures shall be done as per relevant part of technical specification.

21.0 QUALITY ASSURANCE PROGRAMME

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 program to control such activities at all points, as necessary. Such programs 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 program shall be generally in line



with ISO-9001/IS-14001. A quality assurance program of the contractor shall generally cover the following:

- a) His organization structure for the management and implementation of the proposed quality assurance program
- b) Quality System Manual
- c) Design Control System
- d) Documentation and Data Control System
- e) Qualification data for bidder's key personnel.
- f) The procedure for purchase of materials, parts, components and selection of sub-Bidder's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.
- g) System for shop manufacturing and site erection controls including process, fabrication and assembly.
- h) Control of non-conforming items and system for corrective actions and resolution of deviations.
- i) Inspection and test procedure both for manufacture and field activities.
- j) Control of calibration and testing of measuring testing equipment.
- k) System for Quality Audits.
- l) System for identification and appraisal of inspection status.
- m) System for authorising release of manufactured product to the Owner.
- 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 as per formats enclosed as Annexure-I and Annexure-II respectively.

22.0 General Requirements - Quality Assurance

- 22.1 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 Bidder 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 Bidder's responsibility to draw up and implement such programme duly approved by the Owner. The detailed Quality Plans for manufacturing and field activities shall be drawn up by the Bidder and will be submitted to Owner for approval. Schedule



- of finalisation of such quality plans will be finalised before award. Monthly progress reports on MQP/FQP submission/approval shall be furnished.
- 22.2 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 Bidder's/ Sub-Bidder'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 e.g. CD or E-mail in addition to hard copy, for review and approval. After approval the same shall be submitted in compiled form on CD-ROM.
- 22.3 Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Bidder's "Site Quality Control Organisation", during various stages of site activities starting from receipt of materials/equipment at site.
- 22.4 The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality Plans and reference documents/standards etc. will be subject to Owner's approval without which manufacturer shall not proceed. These approved documents shall form a part of the contract. In these approved Quality Plans, Owner shall identify customer hold points (CHP), i.e. test/checks which shall be carried out in presence of the Owner's Project Manager or his authorised representative and beyond which the work will not proceed without consent of Owner in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Owner along with technical justification for approval and dispositioning.
- 22.5 No material shall be despatched from the manufacturer's works before the same is accepted, subsequent to predespatch final inspection including verification of records of all previous tests/inspections by Owner's Project Manager/Authorised representative and duly authorised for despatch by issuance of Material Despatch Clearance Certificate (MDCC).
- 22.6 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.
- 22.7 The Bidder shall submit to the Owner Field Welding Schedule for field welding activities in the format enclosed at Annexure-V. The field welding schedule shall be submitted to the Owner 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.
- 22.8 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 Owner.



- 22.9 All welding/brazing procedures shall be submitted to the Owner or its authorised representative for approval prior to carrying out the welding/brazing.
- 22.10 All brazers, welders and welding operators employed on any part of the contract either in Bidder's/sub-Bidder'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 Owner.
- 22.11 Welding procedure qualification & Welder qualification test results shall be furnished to the Owner for approval. However, where required by the Owner, tests shall be conducted in presence of Owner/authorised representative.
- 22.12 For all pressure parts and high pressure piping welding, the latest applicable requirements of the IBR (Indian Boiler Regulations) shall also be essentially complied with. 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 Unless otherwise proven and specifically agreed with the Owner, welding of dissimilar materials and high alloy materials shall be carried out at shop only.
- 22.14 No welding shall be carried out on cast iron components for repair.
- 22.15 All the heat treatment results shall be recorded on time temperature charts and verified with recommended regimes.
- 22.16 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.
- 22.17 All plates of thickness above 40mm & all bar stock/Forging above 40mm dia shall be ultrasonically tested. For pressure parts, plate of thickness equal to or above 25mm shall be ultrasonically tested.
- 22.18 The Bidder shall list out all major items/ equipment/ components to be manufactured in house as well as procured from sub-contractors bought out items (BOI). All the sub-Bidder proposed by the Bidder for procurement of major bought out items including castings, forging, semi-finished and finished components/equipment etc., list of which shall be drawn up by the Bidder and finalised with the Owner, shall be subject to Owner's approval. The Bidder's proposal shall include vendor's facilities established at the respective works, the process capability, process stabilization, QC systems followed, experience list, etc. along with his own technical evaluation for identified sub-contractors enclosed and shall be submitted to the Owner for approval within the period agreed at the time of pre-awards discussion and identified in review category prior to any procurement. Monthly progress reports on sub-Bidder detail submission / approval shall be furnished. Such vendor approval shall not relieve the Bidder from any obligation, duty or responsibility under the contract.
- 22.19 For components/equipment procured by the contractors for the purpose of the contract, after obtaining the written approval of the Owner, the Bidder's



purchase specifications and inquiries shall call for quality plans to be submitted by the suppliers. The quality plans called for from the sub-Bidder 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 Owner and such approved Quality Plans shall form a part of the purchase order/contract between the Bidder and sub-Bidder. Within three 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 Owner on the monthly basis by the Bidder along with a report of the Purchase Order placed so far for the contract.

22.20 Owner reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Bidder's or their sub-Bidder's quality management and control activities. The Bidder shall provide all necessary assistance to enable the Owner carry out such audit and surveillance.

22.21 The Bidder shall carry out an inspection and testing programme during manufacture in his work and that of his sub-Bidder'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. Bidder 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.

22.22 Quality audit/surveillance/approval of the results of the tests and inspection will not, however, prejudice the right of the Owner 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 Bidder in ensuring complete conformance of the materials/equipment supplied to relevant specification, standard, data sheets, drawings, etc.

22.23 For all spares and replacement items, the quality requirements as agreed for the main equipment supply shall be applicable.

22.24 Repair/rectification procedures to be adopted to make the job acceptable shall be subject to the approval of the Owner/ authorised representative.

22.25 Environmental Stress Screening

All solid state electronic system / equipment / sub assembly shall be free from infant mortile components. For establishing the compliance to this requirement, the contractor / sub – contractor should meet the following

- 1) The Contractor / Sub – contractor shall furnish the established procedure being followed for eliminating infant mortile components. The procedure followed by the Contractor / Sub – contractor should be substantiated along with the statistical figures to validate the procedure being followed. The necessary details as required under this clause shall be furnished at the stage of QP finalization.



OR

In case the Contractor / Sub – contractor do not have any established procedure to eliminate infant mortile components then two number or 10% whichever is less, most densely populated Panels shall be tested for Elevated Temperature Cycle Test as per the following procedure.

Elevated Temperature Test Cycle

During the elevated temperature test which shall be for 48 hours of the total 168 hours of testing, the ambient temperature shall be maintained at 50 deg.C. The equipment shall be interconnected with devices which will cause it to repeatedly perform all operations it is expected to perform in actual service with load on various components being equal to those which will be experienced in actual service.

During the elevated temperature test the cubicle doors shall be closed (or shall be in the position same as they are supposed to be in the field) and inside temperature in the zone of highest heat dissipating components/modules shall be monitored. The temperature rise inside the cubicle should not exceed 10 deg.C above the ambient temp. at 50 deg.C.

In case of any failure during the test cycle, the further course of action should be mutually discussed for demonstrating the intent of the above requirement.

2) Burn in Test Cycle

The 48 hours elevated temperature test shall be followed by 120 hours of burn in test as above except that the temperature shall be reduced to the ambient temperature prevalent at that time.

During the above tests, the process I/O and other load on the system shall be simulated by simulated inputs and in the case of control systems, the process which is to be controlled shall also be simulated. Testing of individual components or modules shall not be acceptable.

In case the Bidder/ sub-Bidder is having any alternate established procedure of eliminating infant mortile components, the detail procedures followed by the Bidder/ sub- Bidder along with the statistical figures to validate the alternate procedure to be forwarded.

- 22.26 The Bidder/Sub-Bidder shall carry out routine test on 100% item at Bidder/sub-Bidder's works. The quantum of check/test for routine & acceptance test by Owner 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.

23.0 QA Documentation Package

- 23.1 The Bidder shall be required to submit the QA Documentation in two hard copies and two CD ROMs, as identified in respective quality plan with tick (✓) mark.



- 23.1.1 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 CD-Rom may be issued not later than three weeks.

- 23.2 Typical contents of QA Documentation are 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 Owner and Bidder for the agreed Customer Hold Points.
- h) Certificate of Conformance (COC) wherever applicable.
- i) MDCC

- 23.3 Similarly, the Bidder shall be required to submit two sets (two hard copies and two CD ROMs), containing QA Documentation pertaining to field activities as per Approved Field Quality Plans and other agreed manuals/ procedures, prior to commissioning of individual system.

- 23.4 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 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 3 weeks after the despatch of equipment.

23.5 Transmission of QA Documentation

On release of QA Documentation by Inspector, one set of quality document shall be forwarded to Quality Assurance Department (@ Head Office) and other set to respective Project Site of Owner.

For the particular case of phased deliveries, the complete quality document to the Owner shall be issued not later than 3 weeks after the date of the last delivery of equipment.

24.0 Project Manager's Supervision

24.1 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 General Conditions of Contract, the Bidder shall proceed to comply with the Project Manager's decision.

24.2 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 Bidder'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.

25.0 Inspection, Testing and Inspection Certificates

- 25.1 The word 'Inspector' shall mean the Project Manager and/or his authorized representative and/or an outside inspection agency acting on behalf of the Owner to inspect and examine the materials and workmanship of the works during its manufacture or erection.
- 25.2 The Project Manager or his duly authorized representative and/or an outside inspection agency acting on behalf of the Owner 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 Bidder shall obtain for the Project Manager and for his duly authorized representative permission to inspect as if the works were manufactured or assembled on the Bidder's own premises or works.
- 25.3 The Bidder shall give the Project Manager/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Bidder'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 Bidder 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.
- 25.4 The Project Manager or Inspector shall within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Bidder, 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 Bidder 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.
- 25.5 When the factory tests have been completed at the Bidder's or sub-Bidder'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 Bidder's test certificate by the Project Manager /Inspector. Project Manager /Inspector to issue such a certificate shall not prevent the Bidder from proceeding with the works. The completion of these tests or the issue of the certificates shall not bind the Owner to accept the equipment should it, on further tests after erection be found not to comply with the contract.
- 25.6 In all cases where the contract provides for tests whether at the premises or works of the Bidder or any sub-Bidder, the Bidder, 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 authorized representatives to carry out effectively such tests on the equipment in accordance with the

Bidder and shall give facilities to the Project Manager/Inspector or to his authorized representative to accomplish testing.

25.7 The inspection by Project Manager / Inspector and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Bidder in respect of the agreed Quality Assurance Programme forming a part of the contract.

25.8 To facilitate advance planning of inspection in addition to giving inspection notice as specified at clause no 9.05.03 of this chapter, the Bidder 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.

25.9 All inspection, measuring and test equipment used by Bidder shall be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Bidder shall maintain all the relevant records of periodic calibration and instrument identification, and shall produce the same for inspection by the Owner. Wherever asked specifically, the Bidder shall re-calibrate the measuring/test equipment in the presence of Project Manager/Inspector.

25.10 Associated document for quality assurance programme:

25.10.1 List of items requiring quality plan and sub supplier approval. (Annexure-III).

25.10.2 Status of items requiring Quality Plan and sub supplier approval (Annexure-IV)

25.10.3 Field Welding Schedule (Annexure-V).

25.10.4 Manufacturing Quality Plan (Annexure-I).

25.10.5 Field Quality Plan (Annexure-II).

25.11 TESTING OF MAJOR DESIGN FEATURES OF I&C SYSTEM:

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 four 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 fulfil 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) Unified HMI for DDCMIS

The results of the above tests, after its acceptance by the Owner, shall be properly documented and submitted to Owner.

25.12 DEMONSTRATION OF APPLICATION ENGINEERING

2.12.1 Based on UPRVUNL inputs, the 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).

25.12.2 The above typical cases shall be finalized with the Owner 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 based on UPRVUNL inputs. After implementation of these logics & loops, the Contractor shall test each logic /loop and record the observations in a format to be provided by the Owner and demonstrate to Owner at Owner 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 Owner premises & the results shall be documented as part of test report.

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



26.0 PRE-COMMISSIONING, COMMISSIONING, TRIAL OPERATION, PERFORMANCE TEST

- 26.1 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 Owner and the Bidder 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 Bidder's quality assurance programme as well as those included elsewhere in the Technical Specifications.
- b) The Bidder'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) It will be the responsibility of the Bidder to assess and furnish a list of all commissioning spars required for successful commissioning of all the equipment covered under the contract. Such a list shall be furnished by the Bidder within 12 months from the date of LOA, separately for each equipment and shall be reviewed by the Owner and discussed for mutual agreement. The commissioning spares will be so identified as not to allow the trial operation to suffer for want of such commissioning spares. The identification of commissioning spares will not in any way relieve the Bidder of any of his responsibilities of satisfactory performance under the provisions of other conditions of contract. All the commissioning spares shall be deemed to be included in scope of the Bidder as a part of the respective equipment package at no extra cost to the Owner.
- d) 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 Owner six months prior to the respective implementations. The Owner will approve final verification of cleanliness.
- e) The time consumed in the inspection and checking of the units shall be considered as a part of the erection and installation period.
- f) 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 Owner's commissioning (start-up) Engineer(s), should be checked out and cleaned. The checking and inspection of individual systems should then follow a prescribed commissioning documentation [SLs (Standard Check List) / TS (Testing Schedule) / CS (Commissioning Schedule)] approved by the Owner.
- g) The Bidder 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.

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

- a) Biodata including experience of the Commissioning Engineers.
- b) Role and responsibilities of the Commissioning Organisation members.
- c) Expected duration of posting of the above Commissioning Engineers at site.

26.2 Initial Operation / Trail Operation Test

- 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.

The Initial Operation Test shall be considered successful, if during the above period of initial operation, the 660MW unit shall generates a minimum of 451 million kWhrs*, as measured a generator terminals.

- c) The Initial Operation shall be considered successful, provided that each item/ part of the facility has 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.
- d) The Bidder shall intimate the Owner about the commencement of initial operation and shall furnish adequate notice to the Owner in this respect.
- e) Any loss of generation due to constraints attributable to the Owner shall be construed as Deemed Generation.
- f) 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 Bidder. 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 Bidder to the full satisfaction of the Owner 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 withholding the aforesaid permission.

(* - shall be appropriately adjusted for any generation loss attributable to Employer.)

26.3 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. The contractor's Commissioning, start-up and initial operation shall make the unit ready to conduct such test. Such test will be commenced, within a period of **three (3) months** after the successful completion of Initial Operations. Any extension of time beyond the above **three (3) months** shall be mutually agreed upon.
- 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, to the approval of the Owner shall be used. 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 Owner'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 Bidder, free of cost.
- e) The Guarantee tests and specific tests to be conducted on equipments have been brought out in detail elsewhere in the specification.

27.0 TAKING OVER

Upon successful completion of Initial Operations and all the tests (including all PG test) 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.

28.0 TRAINING OF OWNER'S PERSONNEL

28.1 The scope of service under training of Owner shall include a training module in 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 Owner:



- 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.
- d) Training for special packages for various PC based systems.
- 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 analysers, CCTV and 24 VDC systems.
- h) Training for numerical relays & networking systems supplied under MV & LT switchgear system.
- i) Details of training modules for Mechanical, Electrical and C&I systems are given at Annexure – VII,

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

- 28.2 The scope of services under training shall also necessarily include training of Owner's Engineering personnel covering a training module as indicated in Annexure – VII. 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 softwares 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.
- 28.3 Contractor shall also arrange for training of Employer's personnel in respect of fire detection and protection systems and other Balance of Plant equipments.



- 28.4 Four (4) man month and two (2) man month training for OWNER Engineering Personnel on the offered CFD modelling code for SG & ESP including alternative geometry modeling technique shall be provided.
- 28.5 Bidder shall furnish in his offer, details of training module(s) covering above requirements which shall be subject to Owner's approval. Consolidated training period included above (Annexure – VII for O&M and Engineering) is indicative only. Owner reserves the right to reappropriate the training period between O&M and engineering depending upon the details of training module proposed by the Bidder.
- 28.6 Exact details, extent of training and the training schedule shall be finalised based on the Bidder's proposal within two (2) months from placement of award.
- 28.7 In all the above cases, wherever the training of Owner's personnel is arranged at the works of the manufacturer's (within Employer's Country) it shall be noted that the lodging and boarding of the Owner's personnel shall be at the cost of Bidder. The Bidder shall make all necessary arrangements towards the same.
- 28.8 In case the training of Owner's personnel is arranged at the works of the manufacturer's (outside Employer's Country) it shall be noted that the all the expenses including travel, air fare, application processing fees, lodging and boarding of the Owner's personnel shall be at the cost of Bidder. The Bidder shall make all necessary arrangements towards the same.
- 28.9 Take off prices (product wise) should be indicated by the Bidder in the Bid Proposal Sheets. Owner reserves the right to include or exclude these item(s) during place of Award.
- 28.10** In addition to above, the contractor shall also arrange for training of 30 Owner's Personnel at a running 660 MW unit on operation of power station, for a period of six (6) months. The training shall be conducted before commissioning of the unit. The lodging and boarding of the Owner's personnel shall be at the cost of Bidder. The Bidder shall make all necessary arrangements towards the same

Note: For training purposes, one (1) man month implies 30 working days (excluding all intervening holidays) per person.

29.0 SAFETY ASPECTS DURING CONSTRUCTION AND ERECTION

In addition to the requirements given in Erection Conditions of Contract (ECC) the following shall also cover:

- a) Working platforms should be fenced and shall have means of access.
- b) Ladders in accordance with Owner's safety rules for construction and erection shall be used. Rungs shall not be welded on columns. All the stairs shall be provided with handrails immediately after its erection.

30.0 Noise level



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The equivalent 'A' weighted sound pressure level measured at a height of 1.0 m above floor level in elevation and at a distance of one (1) meter horizontally from the nearest surface of any equipment / machine, furnished and installed under these specifications, expressed in decibels to a reference of 0.0002 microbar, shall not exceed 85 dBA except for

- a) Safety valves and associated vent pipes for which it shall not exceed 105 dBA.
- b) Regulating drain valves in which case it shall be limited to 90 dBA.
- c) TG unit in which case it shall not exceed 90 dBA.
- d) For HP-LP bypass valves and other intermittently operating control valves, the noise level shall be within the limit of 85 dBA.
- e) Mill noise which will be limited to 85-90 dBA.

31.0 PACKAGING AND TRANSPORTATION

All the equipments & spares shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. Each spare shall be clearly marked or labelled on the outside of the packing with its description. When more than one spare part is packaged in a single case, a general description of the contents shall be shown on the outside of such a case and other packages must be suitably marked and numbered for the purpose of identification. All cases, containers or packages, are liable to be opened for such examination as may be considered reasonable by the Engineer. In case of equipment supplied with grease/lubricants from imported origin, the supplied shall clearly indicate the indigenous equivalent of the grease/lubricant and source of supply so as to enable the Owner to procure these items from indigenous sources. While packing all the materials, the limitation from the point of view of the sizes of railway wagons available in India should be taken account of. The Bidder shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. The Bidder shall ascertain the availability of Railway wagon sizes from the Indian Railways or any other agency concerned in India well before effecting dispatch of equipment. Before dispatch it shall be ensured that complete processing and manufacturing of the components is carried out at shop, only restricted by transport limitation, in order to ensure that site works like grinding, welding, cutting & pre-assembly to bare minimum. The Owner's Inspector shall have right to insist for completion of works in shops before dispatch of materials for transportation.

32.0 ELECTRICAL EQUIPMENTS/ENCLOSURES

All electrical equipments and devices, including insulation, heating and ventilation devices shall be designed for ambient temperature and a maximum relative humidity as specified elsewhere in the specification.

33.0 Instrumentation and Control

All instrumentation and control systems/ equipment/ devices/ components, furnished under this contract shall be in accordance with the requirements stated herein, unless otherwise specified in the detailed specifications.



- 33.1 All instrument scales and charts shall be calibrated and printed in metric units and shall have linear graduation. The ranges shall be selected to have the normal reading at 75% of full scale.

All scales and charts shall be calibrated and printed in Metric Units as follows:

a)	Temperature	-	Degree centigrade (deg C)
b)	Pressure	-	Kilograms per square centimeter (Kg/cm ²). Pressure instrument shall have the unit suffixed with 'a' to indicate absolute pressure. If nothing is there, that will mean that the indicated pressure is gauge pressure.
c)	Draught	-	Millimeters of water column (mm wc).
d)	Vacuum	-	Millimeters of mercury column (mm Hg) or water column (mmWcl).
e)	Flow (Gas)	-	Tonnes/ hour
f)	Flow (Steam)	-	Tonnes/ hour
g)	Flow (Liquid)	-	Tonnes / hour
h)	Flow base	-	760 mm Hg. 15 deg.C
i)	Density	-	Grams per cubic centimeter.

- 33.2 All instruments and control devices provided on panels shall be of miniaturized design, suitable for modular flush mounting on panels with front draw out facility and flexible plug-in connection at rear.

- 33.3 All electronic modules shall have gold plated connector fingers and further all input and output modules shall be short circuit proof. These shall also be tropicalized & components shall be of industrial grade or better.

34.0 ELECTRICAL NOISE CONTROL

The equipment furnished by the Bidder shall incorporate necessary techniques to eliminate measurement and control problems caused by electrical noise. Areas in Bidder's equipment, which are vulnerable to electrical noise shall be hardened to eliminate possible problems. Any additional equipment, services required for effectively eliminating the noise problems shall be included in the proposal. The equipment shall be protected against ESD as per IEC-801- 2. Radio Frequency interference (RFI) and Electro Magnetic Interference (EMI) protection against hardware damage and control system mal-operations/errors shall be provided for all systems.

35.0 SURGE PROTECTIONS FOR SOLID STATE EQUIPMENT

All solid state systems /equipment shall be able to withstand the electrical noise and surge as encountered in actual service conditions and inherent in a power plant and shall meet the requirements of surge protection as defined in ANSI C37.90.1-1989 on its suitable equivalent class of IEC 254-4. Details of the features incorporated and relevant tests carried out. The test certificates etc. shall be submitted by the Bidder.

36.0 Instrument Air System

The instrument air supply system as supplied by the Bidder for various pneumatic control & instrumentation devices like pneumatic actuators, power



cylinders, E/P converters, piping / tubing etc. shall be as per the details furnished elsewhere.

Each pneumatic instrument shall have an individual air shut - off valve. The pressure-regulating valve shall be equipped with an internal filter, a 50 mm pressure gauge and a built-in filter housing blow down valve.

37.0 TAPPING POINTS FOR MEASUREMENTS

Tapping points shall include probes, wherever applicable, for analytical measurements and sampling.

For direct temperature measurement of all working media, one stub with internal threading of approved pattern shall be provided along with suitable plug and washer. The Bidder will be intimated about thread standard to be adopted.

The following shall be provided on equipment by the Bidder. The standard which is to be adopted, will be intimated to the Bidder.

- a) Temperature test pockets with stub and thermowell.
- b) Pressure test pockets

38.0 SYSTEM DOCUMENTATION (DDCMIS)

The Bidder shall provide drawings, system overview & description, hardware/software details, technical literature, functional & hardware schemes, bill of material, parts list, interconnection diagrams, data sheets, erection/ installation/ commissioning procedures, instruction/ operating manuals, etc. for each of the C&I system / sub-systems/ equipment supplied under this package. The documentation shall include complete details of the C&I systems/ sub-systems/ equipment to enable review by Owner during detailed engineering stage and to provide information to plant personnel for operation & Maintenance (including quick diagnostics & trouble shooting) of these C&I systems/ sub-systems/ equipment at site. The minimum documentation requirements for C&I systems shall be as stipulated under C&I "Technical Data Sheets" Part of specifications. In addition to this, system documentation for DDCMIS shall include as a minimum to that specified elsewhere in the Technical Specification.

The exact format, submission schedule and contents of various documents shall be as finalised during detailed engineering stage.

- 38.1 Bill of material (instrument list) for all C&I equipment/ devices shall be furnished by the bidder in standard formats as approved by the Owner.

39.0 MAINTENANCE MANUALS OF ELECTRONIC MODULES

The Contractor shall have to furnish two(2) sets of all maintenance manual of each and every electronic card/module as employed on the various systems and equipment including peripherals etc., offered by him. The Contractor will also have to furnish the data regarding the expected failure rate of various modules and other system components. Further, the contractor shall furnish a set of operating manuals which should include block diagrams, make,



model/type, details wiring and external connection drawings etc as required to do the testing and maintenance of the electronic modules.

40.0 ENVIRONMENTAL MONITORING & CONTROL MEASURES

- 40.1 The Power Plant will be developed based on the guidelines of the State Environmental Authorities and that of MoEF. Suitable provisions will be incorporated in the design of buildings, structures, and selection of equipment, so that there are no adverse effects due to emissions, noise, and contamination of soil, water and air.
- 40.2 One single flue stack of 275 meter will be provided for 660 MW unit for wider dispersion of pollutant as per environmental guidelines.

41.0 LIST OF CODES AND STANDARDS

←---	Indian Standards Title	-->	← International and international recognized Standards →
IS: 277	Galvanised steel sheets (plain or corrugated)		
IS: 655	Specification for metal air duct		
IS: 800	Code of practice for use of structural steel in general building construction 1-1952		BS 449:1969 BS 5950 ASA A57,
IS: 807	Code of practice for design, manufacture, erection and testing (Structural portion) of cranes and hoists 6588 (Issued by Standards Association of Australia) DIN 120:1936 (Sheet 1) DIN 120:1936 (Sheet 2) 327 part-I, 1951 BS 466 part-II, 1960 BS 644:1960BS 1757:1951 BS 2573:part-I:1960		Draft Revision, A.S. NO. CS.2 SAA Crane and Hoist code Doc:No. BU/4 Rev
IS:875	Code of practice for design loads (other than Canadaearthquake) for buildings and structures Leading standards (issued by Canadian Standard) DIN-1055-1955 (Issued by ASA)		National Building code of (1953)-Part-IV Design section 4.1



IS:1239 Part-I	Mild steel tubes	(ISO/R 65-1957) (ISO/R-64-1958) (ISO/R-65-1958) (BS 1387 : 1957)
IS:1239 Part-II	Mild steel tubulars and other wrought steel pipe fittings	BS 1387 : 1967 BS 1387 :1967 BS 1740 :1965
IS:2825	Code for unfired vessels	
IS:1520	Horizontal centrifugal pumps for clear cold and fresh water	
IS:1600	Code for practice for performance of constant speed IC Engines for general purpose	
IS:1601	Specification for performance of constant speed IC Engines for general Purpose	
IS:1893	Criteria for earthquake resistant design of structures	
IS1978-1971	Line Pipe April 1969.	API Standards 5L
IS:2254-1970	Dimensions of vertical shaft motor for pumps	IEC Pub 72-1 part I NEMA Pub MG 1 1954
IS:2266	Steel wire ropes for general engineering purposes	BS :302 : 1968
IS:2312	Propellant type Ventilation fans	
IS:2365	Steel wire suspension ropes for lifts and hoists	BS : 1957
IS:3346	Method for the determination of thermal conductivity of thermal insulation materials (two slab guarded hot plate method)	DIN 52612 (Deutscher Normenausschuss) ASTM C 163-1964 (American Society of Testing and materials) ASTM C 167-1974 ASTM C 177-1963
IS:3354	Outline dimensions for electric lifts.	
IS:3401	Silica gel	
IS:3588	Specification for electrical axial	



	flow fans	
IS:3589	Electrically welded steel pipes for water, gas and sewage (200mm to 2000 mm Nominal Diameter)	
IS:3677	Unbonded rock and slag wool for thermal insulation	
IS:3815	Point hook with shank for general engineering purposes	BS 482 - 1968 Doc.:67/3 1284 (Revision of BS 2903) (Issued BS)
IS:3895	Specification for monocrystallines semiconductor rectifier cells and stacks	
IS:3963	Roof extractor unit	
IS:3975	Mild steel wires, strips and tapes for armouring cables	
IS:4503	Shell and tube type heat Exchanger	
IS:4540	Specification for monocrystallines rectifier assembly equipment	
IS:4671	Expanded polystyrene for thermal insulation purpose	
IS:4736	Hot dip zinc coating on steel tubes	
IS:4894	Centrifugal fans	
IS:5456	Code of practice for testing of positive displacement type air compressors and exhauster (For Test Tolerance Only)	
IS:5749	Forged ramshorn hooks	Entwurf DIN 15402 Blett 1 Entwurf DIN 15402 BS 3017-1958
IS:6392	Steel pipe flanges	BS 4504 : 1969
IS:6524 Part-I	Code of practice for design of tower cranes Static and rail mounted	BS 2799 : 1956
IS:7098	Cross linked Polyethylene insulated PVC sheathed	Standard No. 1 to IPCEA (USA) Pub.



	cables No. 5-66-524
IS:7373	Specification for wrought aluminium and aluminium sheet and strips
IS:7938	Air receivers for compressed air installation
ISO:1217	Displacement compressor-Acceptance test
ASHRAE-33	Methods of testing for rating of forced circulation air cooling and air heating coils.
ASHRAE-52-76	Air cleaning device used in general ventilation for removing particle matter.
ASHRAE-22-72	Method of testing for rating of water cooled refrigerant condensers.
ASHRAE 23-67	Methods of testing for rating of positive displacement refrigerant compressors.
ARI-450-6	Standard for water cooled refrigerant condensers.
ARI-550	Standard for centrifugal water chilling packages.
ARI-410	Standard for forced circulation air cooling and air heating coils
ARI-430/435 BS:848 (Part-1,2)	Central station AHU/Application of Central Station AHU Fans
BS:400	Low carbon steel cylinders for the storage & transport of permanent gases.
BS:401	Low carbon steel cylinders for the storage & transport of liquefied gases.
CTI Code ACT-105	Acceptance test code for Water Cooling Tower.
ANSI-31.5	Refrigerant piping
ASME-PTC- 23-1958	Atmospheric Water Cooling Equipment
AMCA A-21C	Test Code for air moving devices
API:618	Reciprocating Compressor for general refinery services.
HYDRAULIC INSTITUTE STANDARDS.	
HYDRANT SYSTEM MANUALS OF TAC.	
TAC MANUALS OF SPRAY SYSTEM	



NFPA USA/ NSC UK/ UL USA/ FM USA STANDARDS.

INDIAN EXPLOSIVES ACT.

INDIAN FACTORIES ACT.

STANDARD OF TUBULAR EXCHANGER MANUFACTURER'S ASSOCIATION.

CODE AND STANDARD FOR CIVIL WORKS

Some of the applicable Standards, Codes and references are as follows:

Excavation & Filling

IS: 2720 (Part-II, IV TO VIII, XIV, XXI, XXIII, XXIV, XXVII TO XXIX, XL) Methods of test for soils-determination for water content etc.

IS: 4701 Code of practice for earth work on canals.

IS: 9758 Guide lines for Dewatering during construction.

IS: 10379 Code of practice for field control of moisture and compaction of soils for embankment and sub-grade.

Properties, Storage and Handling of Common Building Materials

IS: 269 Specification for ordinary Portland cement, 33 grade.

IS: 383 Specification for coarse and fine aggregates from natural sources for concrete.

IS: 432 Specification for mild steel and (Parts 1&2) medium tensile steel bars and hard-drawn steel wires for concrete reinforcement.

IS: 455 Specification for Portland slag cement.

IS: 702 Specification for Industrial bitumen.

IS: 712 Specification for building limes.

IS: 808 Rolled steel Beam channel and angle sections.

IS: 1077 Specification for common burnt clay building bricks.

IS: 1161 Specification of steel tubes for structural purposes.

IS: 1363 Hexagon head Bolts, Screws and nuts of production grade C.

IS: 1364 Hexagon head Bolts, Screws and Nuts of Production grade A & B.

IS: 1367 Technical supply conditions for Threaded fasteners.

IS: 1489 Specification for Portland-pozzolana cement:

(Part-I) Fly ash based.



(Part-II)	Calcined clay based.
IS: 1542	Specification for sand for plaster.
IS: 1566	Specification for hard-drawn steel wire fabric for concrete reinforcement.
IS: 1786	Specification for high strength deformed bars for concrete reinforcement.
IS: 2062	Specification for steel for general structural purposes.
IS: 2116	Specification for sand for masonry mortars.
IS: 2386 (Parts-I to VIII)	Testing of aggregates for concrete.
IS: 3150	Hexagonal wire netting for general purpose.
IS: 3495 (Parts-I to IV)	Methods of tests of burnt clay building bricks.
IS: 3812	Specification for fly ash, for use as pozzolana and admixture.
IS: 4031	Methods of physical tests for hydraulic cement.
IS: 4032	Methods of chemical analysis of hydraulic cement.
IS: 4082	Recommendations on stacking and storage of construction materials at site.
IS: 8112	Specification for 43 grade ordinary portland cement.
IS:8500	Medium and high strength structural steel.
IS: 12269	53 grade ordinary portland cement.
IS: 12894	Specification for Fly ash lime bricks.

Cast-In-Situ Concrete and Allied Works

IS: 280	Specification for mild steel wire for general engineering purposes.
IS: 456	Code of practice for plain and reinforced concrete.
IS: 457	Code of practice for general construction of plain & reinforced concrete for dams & other massive structures.
IS: 516	Method of test for strength of concrete.
IS: 650	Specification for standard sand for testing of cement.
IS:1199	Methods of sampling and analysis of concrete.
IS: 1791	General requirements for batch type concrete mixers.

