

**UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM
LIMITED**

1X660 MW PANKI STPP

TECHNICAL SPECIFICATION

FOR

AIR CONDITIONING SYSTEM

SPECIFICATION NO.: - PE-TS-426-553-A001 (REV0)



**BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
POWER PROJECT ENGINEERING INSTITUTE BUILDING
SECTOR-16A, PLOT NO.-25, NOIDA, INDIA**



TITLE:

**TECHNICAL SPECIFICATION FOR
AIR CONDITIONING SYSTEM**

SPECIFICATION No: PE-TS-426-553-A001

SECTION

REV. 00

SHEET : 1 OF 2

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**1x660MW PANKI STPP
AIR CONDITIONING SYSTEM**

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SECTION - I



**1x660MW PANKI STPP
AIR CONDITIONING SYSTEM
INTENT OF SPECIFICATION**

SPECIFICATION No: PE-TS-426-553-A001

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SECTION-I

SUB-SECTION-A

INTENT OF SPECIFICATION

	1x660MW PANKI STPP AIR CONDITIONING SYSTEM INTENT OF SPECIFICATION	SPECIFICATION No: PE-TS-426-553-A001	
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1.0 INTENT OF SPECIFICATION

1.1 The specification covers Supply part, Services part and Mandatory spares comprising of design (i.e. Preparation and submission of drawing /documents including “As Built” drawings and O&M manuals), engineering, manufacture, fabrication, assembly, inspection / testing at vendor's & sub-vendor's works, painting, maintenance tools & tackles (as applicable), fill of lubricants & consumables, mandatory spares along with spares for erection, start up and commissioning as required, forwarding, proper packing, shipment and delivery at site, unloading, handling, transportation & storage at site, in-site transportation, assembly, erection & commissioning, final painting at site, minor civil work, trial run at site and carrying out Performance guarantee / Functional / Demonstration tests at site (As applicable), training of customer/client O&M staff and handover in flawless condition of the package to the end customer complete with all accessories for the total scope defined as per BHEL NIT & tender technical specification as specified above, amendment & agreements till placement of order for **1X660 MW PANKI STPP at KANPUR, UTTAR PRADESH.**

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

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 highest 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. Similarly, the extent of supply also includes all items required for completion of the system and not withstanding that they may have been omitted in drawings / specifications or schedules.

1.5 The general term and conditions, instructions to tenderers 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.

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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 SEC-II of the specification **within 10 days of receipt of tender documents**. In absence of any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of Purchaser / Customer shall prevail and shall be complied by the bidder without any commercial implication 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 along with cost of withdrawal in the enclosed schedule (in Sec – II); 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 & requirements of different codes/standards and between respective clauses of sub-section C & sub-section D, more stringent clause 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

For definition of word like Contractor, bidder, supplier, vendor, Customer/ Purchaser Employer, consultant, please refer relevant clause of General Conditions of Contract (GCC).



**1x660MW PANKI STPP
AIR CONDITIONING SYSTEM
PROJECT INFORMATION WITH WIND AND
SEISMIC DESIGN CRITERIA**

SPECIFICATION No: PE-TS-426-553-A001

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SUB-SECTION: B

PROJECT INFORMATION WITH WIND CRITERIA

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 and NTPC	
1.4	Project Site Location	:	Place	Panki
			District	Kanpur
			State	Uttar Pradesh
			Country	India
1.5	Latitude & Longitude of project site	:	North	N26°28'20"
			East	E 80°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 → EI(-) 0.500M Plant FFL → RL(+) 126.5M → EI(+/-) 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

			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 O ₂	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	⁰ 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	⁰ C	12
	b) Summer		21
5.0	Flash Point (min)		
	a) Abel	⁰ 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)	⁰ C	66
4.0	Pour Point (max)	⁰ 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.

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.

जलवायवी सारणी CLIMATOLOGICAL TABLE

1951 से 1976 तक के प्रेक्षणीय आँकड़ों पर आधारित
BASED ON OBSERVATIONS FROM 1951 TO 1976

स्थान : कानपुर (ए)
STATION : Kanpur (A)

अक्षांश : 26°26' N
LAT 26°26' N

देशान्तर : 80°22' E
LONG 80°22' E

ऊँचाई : 120 मीटर
HEIGHT ABOVE M. S. L. 120 METRES

महीना	वायु तापमान										वर्षा									
	माध्यम					चरम					अर्द्धांश					वर्षा के संबंध में				
	गुप्त नमूना	दैनिक नमूना	दैनिक नमूना	दैनिक नमूना	दैनिक नमूना	दैनिक नमूना	दैनिक नमूना	दैनिक नमूना	दैनिक नमूना	दैनिक नमूना	दैनिक नमूना	दैनिक नमूना	दैनिक नमूना	दैनिक नमूना	दैनिक नमूना	वर्षा के संबंध में	वर्षा के संबंध में	वर्षा के संबंध में	वर्षा के संबंध में	वर्षा के संबंध में
	गुप्त नमूना	दैनिक नमूना	दैनिक नमूना	दैनिक नमूना	दैनिक नमूना	दैनिक नमूना	दैनिक नमूना	दैनिक नमूना	दैनिक नमूना	दैनिक नमूना	दैनिक नमूना	दैनिक नमूना	दैनिक नमूना	दैनिक नमूना	दैनिक नमूना	वर्षा के संबंध में	वर्षा के संबंध में	वर्षा के संबंध में	वर्षा के संबंध में	वर्षा के संबंध में
MONTH	AIR TEMPERATURE										CLOUD AMOUNT									
	MEAN					EXTREMES					HUMIDITY					NO. OF RAINY DAYS				
	DRY BULB	WET BULB	DAILY MAX	DAILY MIN	HIGHEST IN THE MONTH	HIGHEST IN THE MONTH	LOWEST IN THE MONTH	DATE AND YEAR	DATE AND YEAR	DATE AND YEAR	RELATIVE HUMIDITY	VAPOUR PRESSURE	ALL CLOUDS	LOW CLOUDS	Obs. of sky	MONTHLY TOTAL	MONTHLY TOTAL	MONTHLY TOTAL	MONTHLY TOTAL	MONTHLY TOTAL
	°C	°C	°C	°C	°C	°C	°C	°C	°C	°C	%	mm	%	%	%	mm	mm	mm	mm	mm
JAN	10.2	11.3	22.7	8.5	27.1	4.4	31.1	21	1959	14	79	10.5	1.8	0.6	21.1	74.7	0.0	48.5	04	1853
FEB	10.0	11.7	26.4	11.3	31.9	6.7	35.6	28	1950	02	86	11.1	1.4	0.4	12.5	87.5	0.0	58.2	20	1942
MAR	9.7	15.8	32.5	16.6	38.2	11.1	42.8	27	1945	07	52	13.0	1.6	0.3	6.2	77.2	0.0	61.7	30	1944
APR	9.3	18.8	38.3	22.0	42.5	16.7	45.6	30	1938	03	37	14.1	1.3	0.3	4.5	84.2	0.0	25.9	09	1928
MAY	9.8	21.4	41.4	26.5	45.0	21.7	47.2	30	1941	03	22	17.3	1.1	0.4	9.8	47.2	0.0	40.0	12	1969
JUN	9.5	24.8	40.1	28.7	44.8	23.8	47.3	09	1966	03	54	24.9	3.5	1.2	85.4	378.7	6.0	133.3	10	1916
JUL	9.1	26.2	34.3	26.7	39.8	23.8	45.0	10	1903	28	80	31.8	5.9	3.2	229.8	704.1	36.6	181.0	25	1965
AUG	9.8	27.9	32.2	25.9	35.6	23.7	40.6	01	1903	25	68	31.2	6.1	3.1	289.5	664.2	40.0	235.2	31	1915
SEP	9.0	27.8	33.0	24.9	35.6	22.2	40.0	02	1932	16	81	29.9	4.0	2.3	124.4	527.6	5.2	242.8	16	1966
OCT	9.6	25.0	32.7	20.2	35.6	15.4	40.6	03	1896	30	69	21.5	1.4	0.8	60.7	335.3	0.0	136.1	05	1970
NOV	10.0	23.5	29.0	13.2	32.7	8.8	36.1	04	1896	19	65	13.6	0.8	0.3	1.0	92.2	0.0	58.2	19	1911
DEC	10.0	23.5	24.2	8.9	28.1	4.8	31.3	15	1959	27	76	10.8	1.3	0.3	7.7	82.6	0.0	40.6	25	1950
YEARLY TOTAL	994.3	23.5	32.2	19.5	45.6	3.7	47.3	-0.9			65	19.3	2.5	1.2	832.6	42.6	420.6	242.8		9.6
MEAN	991.2	23.8	32.2	19.5	45.6	3.7	47.3	-0.9			47	18.9	2.6	1.1	832.6	42.6	420.6	242.8		9.6
OF YEARS	23	23	23	23	23	23	23	23	23	23	23	23	23	23	23	25	25	85	85	22

स्टेशन : कानपुर (ए)
STATION : Kanpur (A)

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ANNEXURE-I: CLARIFIED WATER ANALYSIS

S. No.	Description	Unit	Parameter
1	Physical characteristics		
	pH at 25°C	-	7.59
	Turbidity	NTU	<15
	Conductivity	μs /cm	590
	Total Dissolved solids	ppm	285
	Total Suspended Solids	ppm	<15
2	Cations		
	Calcium Hardness	ppm as CaCO ₃	113.86
	Magnesium Hardness	ppm as CaCO ₃	40
	Sodium + Potassium	ppm as CaCO ₃	37.2
	Iron	ppm as CaCO ₃	0.3
	Total Cations	ppm as CaCO ₃	191.36
3	Anions		
	Bicarbonate	ppm as CaCO ₃	97
	Carbonate	ppm as CaCO ₃	0.34
	Hydroxyl	ppm as CaCO ₃	0.02
	Chlorides	ppm as CaCO ₃	27.1
	Sulphate	ppm as CaCO ₃	66.4
	Nitrate	ppm as CaCO ₃	0.5
	Total Anions	ppm as CaCO ₃	191.36
4	Carbon Di-oxide as CO ₂	ppm	5.54
5	Dissolved Silica	ppm as SiO ₂	10.0
6	Colloidal Silica	ppm as SiO ₂	0.5



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001





**1x660MW PANKI STPP
AIR CONDITIONING SYSTEM
TECHNICAL SPECIFICATION**

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TECHNICAL SPECIFICATIONS



**1x660MW PANKI STPP
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SPECIFIC TECHNICAL REQUIREMENT**

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SPECIFIC TECHNICAL REQUIREMENT



**1x660MW PANKI STPP
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1.0 FUNCTION

The purpose of the system is to provide Air-Conditioning for different areas of Panki STPP (1 x 660 MW) under the scope of BHEL.

2.0 SYSTEM DESCRIPTION

2.1 AC AREAS WITHIN POWER HOUSE BUILDING (AC PLANT-1)

In main power house building is provided to cater the air conditioning requirements of the following areas: -

- Central Control Room
- Control Equipment Rooms
- UPS (Uninterrupted Power Supply) room.
- Steam and water analysis system rooms (SWAS)

The AC plant comprises of 1X100% capacity Vapour Absorption Machine and 2X50% screw Chilling machines (as standby). VAM shall be provided with PRDS with plunger pump and piping, Motorized Steam flow regulating valve with strainer, Condensate tank with steam trap and other accessories, Condensate transfer pumps with accessories, associated steam piping with thermal insulation, all fittings and control valve. . The condenser cooling water shall be circulated through these units by means of 3X50% horizontal centrifugal pump sets and 3X50% FRP cooling towers. The chilled water produced by the chilling units shall be circulated to the air handling units (AHU) (2X100%) located adjacent to air-conditioned areas as above (except SWAS room, where separate Fan Coil Units (2X100%) have been envisaged) in Power House by means of 3X50% horizontal centrifugal pump sets. The conditioned air from AHUs is distributed to the air-conditioned areas by galvanised sheet steel ducting and extruded aluminium grilles / diffusers. For main plant areas, the return air shall be led back to the AHU Room through return air duct.

Water softening plant(2x60%), common for AC plant I (i.e. Power House) & AC Plant III (i.e. Service Building) shall be provided to cater to soft water requirement of VAM/ Screw Chillers of for both power house area and service building. Two nos. (1W+1S) Make-up water Pumps with associated piping & valves shall be provided at outlet to softening plant for supply of water till make-up water tank of Service Building. Two no. Make-up cum soft water tank for Power House's cooling towers shall be provided. Additionally, one number storage tank(if required) of required capacity for dilution of brine solution after softening plant shall also be provided. Diluted brine solution shall be led to nearest neutralizing pit through suitable pump(1W+1S),(if required). Necessary piping& supports along with accessories for the same shall be in the scope of AC System supplier.

One no. Non Chemical water treatment device at the common outlet of CW pumps shall be provided.

Provided Inlet steam parameters shall be 16 ata pressure and 290 Deg. Celsius temperatures. Spray water to PRDS shall be taken from VAM condensate. Balance amount of condensate shall be discharged to Flash tank A (refer zone 10 H of equipment layout drawing at ground floor). Outlet parameters are based on vendor's design.

Location of DE superheating Station shall be inside AC plant room.



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2.2 AC PLANT-2 - WATER COOLED DIRECT EXPANSION SYSTEM (DX SYSTEM)

To cater the air conditioning requirements of ESP-FGD control room: -

AC plant comprises of 2x100% (1W + 1S) water cooled direct expansion system (DX system) and condensing unit. The refrigerant produced by the chilling units shall be circulated to the air handling units (AHU) (1W + 1S) located adjacent to air-conditioned areas. The conditioned air from AHUs shall be distributed to the air-conditioned areas by galvanized sheet steel ducting and extruded aluminium grilles / diffusers.

The return air shall be ducted and led back to AHU room

The condenser cooling water shall be circulated through these units by means of 2X100% horizontal centrifugal pump sets and 2X100% FRP cooling towers (VFD fan).

Water softening plant(2x100%) shall be provided to cater to soft water requirement of Condensing Unit of ESP-FGD Building. Two no. Make-up cum soft water tank for cooling towers shall be provided. Additionally, one number storage tank (If required of required capacity for dilution of brine solution after softening plant shall also be provided). Diluted brine solution shall be led to nearest neutralizing pit through suitable pump(1W+1S) (If Required). Necessary piping & supports along with accessories for the same shall be in the scope of AC System supplier.

2.3 AC PLANT-3 -

To cater the air conditioning requirements of Service building: -

The AC plant comprises of 2X100% screw/ centrifugal Chilling machines. The condenser cooling water shall be circulated through these units by means of 2X100% horizontal centrifugal pump sets (VVF driven) and 2X100% FRP cooling towers (with VVF driven fan). The chilled water produced by the chilling units shall be circulated to the air handling units (AHU) (1X100%, VVF driven) located adjacent to air-conditioned areas by means of 2X100% primary chilled water pumps & 2X100% VVF driven secondary chilled water pumps (horizontal centrifugal type). The conditioned air from AHUs is distributed to the air-conditioned areas by galvanized sheet steel ducting and extruded aluminium grilles / diffusers. The return air shall be collected above the false ceiling and led back to the AHU rooms which acts as mixing plenum for return and fresh air.

Two number make up water tank of required capacity shall be provided for service building air conditioning system, which will be fed from the discharge of softening plant through pumps provided for AC Plant I (i.e. Power House area).

2.4 AC PLANT-4 -

To cater the air conditioning requirements of Administrative Building: -

The AC plant comprises of 2X100% screw/ centrifugal Chilling machines. The condenser cooling water shall be circulated through these units by means of 2X100% horizontal centrifugal pump sets (VVF driven) and 2X100% FRP cooling towers (with VVF driven fan). The chilled water produced by the chilling units shall be circulated to the air handling units (AHU) (1X100%, VVF driven) located adjacent to air-conditioned areas by means of 2X100% chilled water pumps (horizontal centrifugal type). The conditioned air from AHUs is distributed to the air-conditioned areas by galvanised sheet steel ducting and extruded aluminium grilles / diffusers. The return air shall be collected above the false ceiling and led back to the AHU rooms which acts as mixing plenum for return and fresh air.



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. Water softening plant (2x60%) shall be provided to cater to soft water requirement of Screw Chillers of Administration Building. Two no. Make-up cum soft water tank for cooling towers shall be provided. Additionally, one number storage tank of required capacity for dilution of brine solution after softening plant shall also be provided, if required. Diluted brine solution shall be led to nearest neutralizing pit through suitable pump (1W+1S), if required. Necessary piping with supports along with accessories for the same shall be in the scope of AC System supplier.

2.5 AC PLANT-5 -

To cater the air conditioning requirements of Training Centre building: -

AC plant comprises of 2x100% (1W + 1S) water cooled direct expansion system (DX system) and condensing unit. The refrigerant produced by the chilling units shall be circulated to the air handling units (AHU) (1W + 1S) located adjacent to air-conditioned areas. The conditioned air from AHUs shall be distributed to the air-conditioned areas by galvanized sheet steel ducting and extruded aluminium grilles / diffusers.

The condenser cooling water shall be circulated through these units by means of 2X100% horizontal centrifugal pump (VFD) sets and 2X100% FRP cooling towers (VFD fan).

.
Water softening plant (2x100%) shall be provided to cater to soft water requirement of DX Water cooled condensing unit of Training Centre. Two no. Make-up cum soft water tank for cooling towers shall be provided. Additionally, one number storage tank of required capacity for dilution of brine solution after softening plant, if required shall also be provided. Diluted brine solution shall be led to nearest neutralizing pit/tank through gravity. Necessary piping along with accessories for the same shall be in the scope of AC System supplier.

Note: Air conditioning system for Service building, Administration Building & Training Centre building shall be designed with ECBC code to make it '**Green Building**'. Please refer to clause 25.3.19 and other relevant clauses of customer specification (Section I C2-A) (Volume III Ch 25) for other detail.

2.7 AC PLANT-6

To cater the air conditioning requirements of other areas: -

Ductable Split/ Precision/ Package/ Cassette/ Hi-wall Split type air conditioners shall be provided to cater to the air conditioning requirements of control rooms/ other areas for auxiliary building. 100% standby shall be provided for offsite control rooms.

Additional requirements:

For areas like ESP control rooms, water system control room, where A/C load is of the order 25-60 TR, direct expansion (D-X) type condensing unit shall be provided depending on the availability of space/ layout etc. For areas where A/C load is of the order of 15-25 TR, ductable split/ packaged A/C shall be provided. Smaller areas which are away from the D-X type condensing unit/ central chilling units which may require air conditioning up to 15 TR rating shall be served with Hi-Wall split/ Cassette air conditioner units as per requirement. For static excitation Control Room (if applicable) precision air conditioners of required capacity shall be provided.

- .
a) Local isolator / MCB shall be provided with split units.
b) Hand operated remote and other accessories as specified, Local Distribution Boards containing Switch / MCB shall be provided for Split Air Conditioners and FCUs. Each split unit shall also be s



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- c) Single phase electrical feeders of following ratings shall be provided for split units. Bidder to ensure the suitability as per these feeder requirements.

Capacity of Split AC	Single phase feeder
1.5 TR	32 AMP
2TR	

3.0 DESIGN CRITERIA

3.1 SYSTEM DESIGN CRITERIA - AIR CONDITIONING SYSTEM

The outside design conditions considered are as follows: -

	Summer	Monsoon	Winter
DBT (°C)	42.8	36.1	7.2
WBT (°C)	25	28.3	5.6

The inside design conditions to be maintained are as follows: -

- $24^{\circ}\text{C} \pm 1^{\circ}\text{C}$ & RH $50\% \pm 5\%$ for all air conditioned areas
- A design margin of 5%, 5% & 10% on sensible, latent heat & overall heat respectively shall be considered while designing the AC Plant capacity for each area.
- For winter heating load calculation, 50% of eqpt. / panel load as available in the room shall be considered.
- For other design parameters refer to clause 25.3. of volume III Ch 25, customer specification (Section I C2-A).

4.0 SYSTEM CAPACITY AND CONFIGURATION:

a) For AC Plant-1:

1 x 150 TR (Minimum) Actual capacity VAM and 2x75 TR Water cooled Semi-Hermetic Screw Chiller (as Standby) shall be provided.

b) For AC Plant-2:

2 x 45 TR (minimum) Actual capacity water cooled direct expansion system (DX system (1 working + 1 Standby) shall be provided for each unit.

c) For AC Plant-3:

2 x 200 TR (minimum) Actual Capacity water cooled chiller units (1 working + 1 Standby) shall be provided for Service building.

d) For AC Plant-4: (Admin Building)

2 x 200 TR (minimum) Actual Capacity water cooled chiller units (1 working + 1 Standby) shall be provided for Admin Building.

e) For AC Plant-5: (Training Centre building)

2 x 45 TR (minimum) Actual Capacity water cooled direct expansion units (1 working + 1 Standby) shall be provided for Training Centre building.

f) For AC Plant-6: (For other Areas)



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Suitable Split type air conditioners (air cooled) shall be provided to cater to the air conditioning requirements of PLC areas having workstation for auxiliary plant. Or according to design criteria 25.3.17 of customer specification.

5.0 LAYOUT CONSIDERATIONS:

a) AC PLANT-1

- i. The central VAM and Screw Chilling Machine, Condenser Water & Chilled Water Pumps for AC Plant shall be housed in AC Plant Room at 0.0 M level in E-F' Bay 1-4 col of Power House Building.
- ii. The AHUs for this AC Plant would be located as under:
 - 2 AHUs (2 x 100 %) for areas at 17 m i.e. CCR, CER unit 1&2, computer rooms, shift in-charge, etc., located in AHU Room at 24 M level of Power House Building in BC Bay col 1-4.
 - 2 AHUs (2 x 100%) for areas at 8.5 m i.e. UPS room etc., located in AHU Room at 8.5 M level of Power House Building in E'F' Bay col 12-14.
 - FCU for SWAS (dry panel room)
- iii. The Cooling Towers, Make-up cum soft water Storage Tank, Expansion Tank, Water Softening plant, Brine Dilution Tank(if required), Make-up cum Soft water booster pumps shall be located at 33 M level in CE'F' Bay.

3 T Capacity Electrical Hoist with Monorail arrangement shall be provided for the AC Plant-1 room only for maintenance purpose.

b) AC PLANT-2

Water cooled direct expansion type units and AHU (2x 100%), 2x100% cooling towers(VFD Fan), 2x100% Condenser water pumps and 2x100% Softening plant shall be placed at terrace of ESP –FGD Building.

c) AC PLANT-3

Screw Chillers, primary and secondary Chilled Water Pumps at **ground floor(AC plant room)** of service building. Condenser Water pumps , Cooling Towers, Make-up cum soft water Storage Tank, Expansion Tank and all other accessories for AC Plant-3 shall be housed at **roof** of service building.

AHUs (1x100%) for this building shall be placed on respective floors. Clear height of 4m shall be available in AHU room.



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d) AC PLANT-4

Screw chillers, Chilled Water Pumps at **ground floor(AC plant room)** of admin building .Cooling Towers, Condenser Water pumps, Water Softening Plant, Make-up cum soft water Storage Tank, Expansion Tank and all other accessories for AC Plant-4 shall be housed at **roof** of admin building.

AHUs (1x100%) for these chilling units shall be placed on respective floors.

Clear height of 4m shall be available in AHU room.

e) AC PLANT-5

2X100% Dx-water cooled system, Condenser Water & Chilled Water Pumps along with Cooling Towers, Water Softening Plant, Make-up cum soft water Storage Tank, Expansion Tank and pumps for AC Plant-5 shall be housed in AC Plant Room at **roof** of Training Center building.

AHUs (1x100%) for these chilling units shall be placed on roof.

6.0 SPECIAL CONSIDERATION

- a) Water flow rate for chilled water pump selection: 0.7 cmh/TR.
- b) Water flow rate for condenser water pump selection: 1.0 cmh/TR.
- c) Design margins in various equipment shall be as per relevant clause 25.3.16 of Volume III Ch 25 of customer specification (Section I C-2A).
- d) All equipment shall be of high quality and high efficiency meeting the stipulated power consumption as defined elsewhere in the specifications.
- e) MOC of expansion tank shall be FRP/MS.
- f) The design fouling factor of refrigerant condenser to be 0.0002 (in MKS unit), chiller and cooling coil shall be 0.0001 (in MKS unit).
- g) Condenser cooling water for Air Conditioners shall be soft water supplied from make-up cum soft water storage tank through water softening plant and Non-Chemical Water Treatment Device, as applicable.
- h) Clarified water analysis for design of Water softening plants is attached in Section IB of this specification.

7.0 AC EQUIPMENT DETAILS

7.1 VAM (Chiller Unit)

- a) Refer to clause 25.7.1 and other relevant clauses of customer specifications (section I C2-A).
- b) Accessories (valves, pressure gauges, water flow switches, controls and instruments etc. shall be provided with VAM machine as per attached P&ID. However, AC System P&ID shall be approved by customer during detail engineering. Any change in instrumentation during detail engineering, within the guidelines stipulated in this specification elsewhere, shall not have any commercial implication at later date.



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7.2 Vapour Compression Type Machines

- a) Refer to clause 25.7.2 & 25.7.3 and other relevant clauses of customer specifications. (section I C2-A).
- b) Accessories (valves, pressure gauges, water flow switches, controls and instruments etc. shall be provided with Vapour Compression type machine as per customer approved PID. Any change in instrumentation during detail engineering, within the guidelines stipulated in this specification elsewhere, shall not have any commercial implication at later date.

7.3 AIR HANDLING UNIT (DOUBLE SKIN TYPE)

- a) Refer to clause 25.7.4 and other relevant clauses of Vol III of customer specification. (section I C2-A).
- b) Pre filter (Min. 50 mm thick having efficiency of 90% down to 10 microns in accordance with BS:6540/ASHRAE – 52-76/EN-779), fine filter (150 or 300mm thick having efficiency of more than 99.5% down to 5 microns in accordance with BS: 6540/ASHRAE – 52-76 EN-3928) shall be provided for all areas. Static pressure of AHU Fan shall be minimum 90 mm WC
- c) Motors shall be installed inside the AHU.
- d) All AHU shall be VVFD type
- e) Accessories (valves, pressure gauges, water flow switches, controls and instruments etc.) shall be provided with pump as per customer approved PID
- f) Drain piping from the AHUs up to nearest drain point.
- g) Other details shall be as per BHEL standard specification, sub section D.

7.4 CENTRIFUGAL FAN FOR AHU

- a) AHU centrifugal Fan shall be as per clause 25.7.5 of Volume III of customer specification.

7.5 MIXING BOX

- a) Mixing Box shall be complete with fresh and return air dampers, mixing box shall be provided wherever the return air is ducted back to the AHU

7.6 STRIP HEATER & PAN HUMIDIFIER

- a) One set of electrical strip heater package of suitable capacity shall be provided in supply air duct. Heater package shall be connected with thermostat / humidistat which will be provided in return air path inside AHU Room.
- b) Temp gauge and RH cum temp sensor shall be provided and the same shall be hooked with DCS.
- c) One No. Pan type humidification system comprising heater, humidistat, water tank, low level switch over flow, draining, make up connection, float valves etc. for each AHU Room
- d) Refer to relevant clause 25.7.7 and other relevant clauses of section Vol III, customer specification (Section I C2-A)



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7.7 HI-WALL SPLIT/CASSETTE AIR CONDITIONERS

- a) Refer to relevant clause 25.7.8 and other relevant clauses of section Vol III, customer specification (Section I C2-A)

7.8 CHILLED AND CONDENSER WATER PUMP SETS

- a) Refer to clause 25.7.9 and other relevant clauses of section Vol III, customer specification (Section I C2-A).
- b) Accessories (valves, pressure gauges, water flow switches, controls and instruments etc. shall be provided with pump as per customer approved PID. Any change in instrumentation during detail engineering, within the guidelines stipulated in this specification elsewhere, shall not have any commercial implication at later date

7.9 COOLING TOWER

- a) Design ambient wet bulb temp: 28.3 deg C.
- b) Approach: 4 deg. C.
- c) Range :5 Deg C
- d) Induced draft (single cell) FRP/GRP type shall consist of all accessories i.e. fan, motor, FRP basin, FRP louvre, PVC eliminators, nozzles, make up connection, drains overflow & piping, valves & fittings, strainer of brass wire mesh, ladder and supporting structure and all accessories as specified shall be provided.
- e) Refer to clause 25.7.11 and other relevant clauses of section Vol III customer specification (Section I C2-A).

7.10 Water Softening Plant

The clarified water analysis is attached in Section IB of this specification .The make-up water to Ac Cooling Tower will be a soft water (Total Hardness ~ 40 ppm as CaCo3) which shall be achieved through the blending of clarified & soft water (Softening plant Outlet) the CT is expected to operate at 2-3 Cycle of concentration & accordingly provision for suitable blowdown to be provided .The softening plant shall be resin based & it is proposed to have it on a prefabricated & preassembled skid (comprising of Softener, ACF & DMF) to minimize Site activities .Suitable disposal of brine solution shall be envisaged as shown in sketch attached (Refer Ac –Plant P&ID).

The softening plant shall be complete with all instrumentation & required facilities as per the system requirement including initial fill of resin. The softening plant service cycle (i.e time between two successive regeneration) shall not be less than 20 Hrs. Sampling/Analyzing provision shall also be there.

To control scaling/corrosive properties of circulating water, as per system requirement a suitable chemical treatment program (e.g dosing of corrosion inhibitor ,scale inhibitor ,biocide etc with dosing facility shall be provided .The required chemicals for initial commissioning and further till handing over shall be in the scope of bidder.

7.11 ONLINE NON CHEMICAL WATER TREATMENT EQUIPMENT

- a) Refer to clause 25.7.12 and other relevant clauses of section Vol III customer specification (Section I C2-A).



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7.12 SHEET METAL WORK

- a) Refer to clause 25.7.13 and other relevant clauses of Vol III, customer specification (Section I C2-A).
- b) Volume control dampers in supply / return ducts shall be provided for air balancing.
- c) The supply and return air ducts shall be provided with motorized fire damper at locations where duct pass through walls & floors for ease of isolation, maintenance and as well as for emergency operation. The operation of these automatic dampers shall be interlocked the fire alarm system. Fire rating for the fire dampers shall be minimum 90 minutes.
- d) For other details regarding fire damper, refer to clause 25.7.11 (Instruments, Protective Devices & Interlock), 25.3.9 and other relevant clauses of Vol III customer specification (Section I C2-A).

7.13 INSULATION

- a) Refer to clause 25.7.14 and other relevant clauses of Vol III, customer specification (Section I C2-A)

7.14 PIPING VALVES ETC

- a) Refer to clause 25.7.15 (Piping & fittings) & 25.7.10 (valves) and other relevant clauses of Vol III, customer specification (Section I C2-A)
- b) For calculating friction loss in piping system: WILLIAM & HAZEN formula shall be used with C value as 100.
- c) All the drain piping between the drain connection of each equipment upto the Purchaser's common drain point in the equipment room shall be provided by the Contractor. Necessary seal loops as required shall be incorporated in the drain piping.
- d) Valves shall have full size port and Suitable for horizontal and as well as vertical installation.

7.15 ELECTRICAL ITEMS

- a) Refer to section C-3, electrical portion of specifications.

7.16 For other items refer to relevant clauses of section C2-A, customer specification (Section I C2-A)

8.0 CONTROL PHILOSOPHY

For control philosophy, refer to section C-4 of specification/ customer speciifcation

9.0 SPECIFIC REQUIREMENT

Efficiency of centrifugal fan and pump shall not be less than 70%.

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10.0

GENERAL

1)

Basis of design all calculations including heat load calculations for summer seasons, equipment selection criterion, layout drawings/ schemes/G.A. dwg and documents like data sheet/ technical particulars etc are subject to Customer approval during detail engineering stage.

2)

Vendor to furnish characteristic curves for all major equipment offered indicating duty point during detailed engineering.

3)

All drawings and documents shall be computer based.

4)

All commissioning spares & consumables for trouble free operation until handing over of the system shall be provided

5)

Quality Requirements in the Technical Specification are indicating minimum requirements for inspection and testing. Vendor shall note that quality plan is subject to Customer & BHEL-approval during detail engineering stage. Standard QP format is enclosed in the technical specification for reference.

6)

Indicative list of makes is enclosed as per Annexure-I. However, these makes shall be subject to Customer & BHEL approval during detail engineering Stage.

7)

Fixing frame works for diffusers and grilles in the scope of Vendor.

8)

Anchor fastener shall be used by vendor for fixing duct pipes etc. wherever applicable.

9)

Necessary supports and structures / frames etc. as required for supporting the duct / piping / equipment etc. as lump-sum basis is in the scope of Vendor and no unit rates shall be applicable for these items. However, Primary Support Structure shall be provided by BHEL.

10)

Drain piping within room up to the drain point to be provided by the Vendor.

11)

Vendor shall furnish schedule of power and control cables. Vendor shall also furnish cable termination details interconnection drawings etc. during detail engineering stage.

12)

The tools and machine required for erection of equipment shall be arranged by Vendor.

13)

Tools & tackles as required for regular maintenance shall be supplied by Vendor.

14)

Instruments required for performance testing of various equipment / system of the package shall be arranged by Vendor at site.

15)

Instrument for testing shall be calibrated by Air-conditioning plant supplier before taking up testing.

16)

Temperature gauges shall be provided with thermo wells and fixing arrangement.

17)

Pressure gauges shall have provision for air venting. Three way valves shall be used which shall have air venting provision.

18)

Matching sockets / stubs (weld type) for flow switches and other instruments shall be supplied.

19)

Bidders shall guarantee to maintain specified inside design conditions during summer, monsoon and winter and also even if the internal equipment load varies from 100% to 25%.

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20)	Besides the system performance as above, bidder shall guarantee major technical parameters of various equipment as per design basis / details furnished.
21)	The guarantee tests shall be performed as per clause 5.21 section I-Sub Section C2B of customer specification(Section I C2-A).
22)	For motorized fire damper / 3 Way valve actuators / motorised valves, power supply shall be derived by vendor from respective control panels. BHEL shall not provide any feeder for them. Suitable transformer shall be provided by bidder (if required) to derive the power input. Further distribution through junction box / distribution board shall be in vendor scope and shall have provision for isolation of individual fire damper/ valves.
23)	Tender drawings enclosed form the part of specification and the bidder shall check the space requirements for installing the equipment as per the specification and layout requirements given in the specifications.
24)	Bidder should suitably group the signals coming from various instruments etc. & the same shall terminate in local JB, from Local JB common cable to DCS / panel / MCC shall be selected. Any Electrical / C&I items and accessories like junction box, glands etc. shall be included by vendor in his scope.
25)	In the event of any conflict between the requirements of two clauses of this specification documents or requirements of different codes and standards specified, the more stringent requirement as per the interpretation of the owner shall apply.
26)	Bidder to note that BHEL reserve the right for drg/doc submission through web based Document Management System. Bidder would be provided access to the DMS for drg/doc approval and adequate training for the same. Bidder to ensure proper net connectivity at their end.
27)	The drawings/ documents submitted by vendor shall be complete in all respects with revised drawing submitted incorporating all comments. Any incomplete drawing submitted shall be treated as non-submission with delays attributable to vendor's account. For any clarification/discussion required to complete the drawings, the bidder shall himself depute his personal to BHEL / Customer's place as per the requirement for across the table discussions/ finalizations/ submissions of drawings.
28)	Sealing of duct opening, grouting of foundation / foundation bolts etc. including special type of grouting like GPX2 etc. are in the scope of Air-conditioning system vendor.
29)	Flat, platform type RCC / PCC foundation shall be provided for installing Chiller/ PUMP, AHU and FAN etc. Vendor shall fix the equipment using anchor fasteners, as applicable, to secure the equipment obtain parameters related to vibration and noise.
30)	Bidder to note that the P&ID shows only the bare minimum requirement of valves and instruments. Any instrumentation & valves as required for the completion of the system in line with technical specification shall be provided by bidder during detailed engineering without any commercial implication.
31)	RCC foundation of cooling tower shall be provided by BHEL. However, steel beam / joist etc as required shall be supplied by air-conditioning plant supplier.
32)	Air-conditioning plant supplier to furnish drawings/ documents as per the dwg. / documents distribution as per project requirement.



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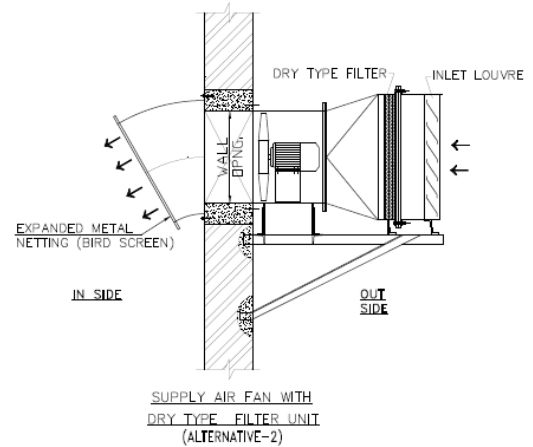
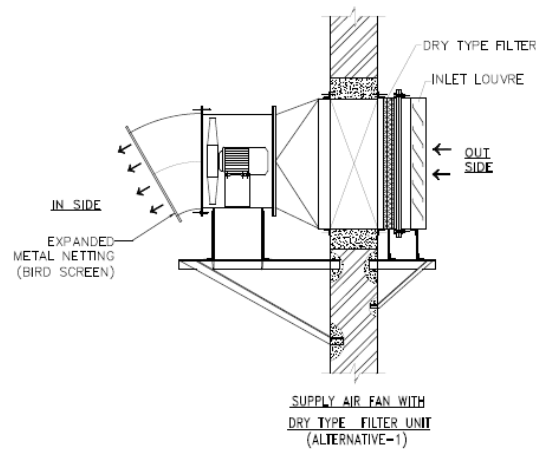
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- 33) Each motor terminal box shall be provided with cable gland and lugs for the size and type of power and control cable of respective motor.
- 34) All electrical equipment shall be suitable for the power supply fault levels and other climatic conditions indicated in project information / synopsis / specifications enclosed.
- 35) The bidder shall furnish complete tech. Particulars in data sheet and schedules as specified elsewhere in the specification during detail engineering.
- 36) Training of officials, for AC system shall be provided as per customer specification Section I C2-B chapter 5 Annexure VII.
- 37) Supports required for supporting the fan and/or filter section for FA fans shall be under bidder's scope



- 38) All VVF drives shall be provided with enclosure. For details of enclosure, please refer clause no.2.00.06 of Part B/Ch2 pf Vol 5 of customer spec refer section C4 (C&I portion) of this tender specification.

	1x660MW PANKI STPP AIR CONDITIONING SYSTEM SPECIFIC TECHNICAL REQUIREMENT	SPECIFICATION No: PE-TS-426-553-A001	
		SECTION : I	
		SUB-SECTION : C 1	
		REV. 00	
		Page 14 of 14	

11.0

EXCLUSIONS

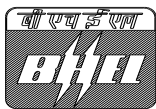
Items of works listed below are excluded from scope of the air-conditioning plant supplier.

- a) Construction of AC plant room, air handling unit room, foundations for AC equipment.
- b) False ceiling, drop ceiling.
- c) Slab cut out for running ducts, pipes, cables, grilles/dampers. Underground masonry trenches and masonry risers. However minor civil work like making opening to suit / finishing of opening, sealing of duct opening, grouting of foundation bolts including special type of grouting like GPX2 etc. are in the scope of AC system vendor.
- d) Provision of drain traps / points,
- e) For Electrical scope, refer Electrical scope matrix sheet.



**TECHNICAL SPECIFICATION
ELECTRIC HOISTS & CHAIN PULLEY BLOCKS
1X660 MW UPRVUNL PANKI TPS EXTN.**

Material Handling Equipments



TECHNICAL SPECIFICATION
ELECTRIC HOISTS & CHAIN PULLEY BLOCKS
1X660 MW UPRVUNL PANKI TPS EXTN.

1.0 ELECTRIC HOIST AND MANUAL HOIST (CHAIN PULLEY BLOCK)

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

Manual hoists (hand operated) shall be designed to duty class 2 as per IS 3832 and electric wire rope hoist shall be designed as per IS: 3938 (latest).

The stipulations of all statutory codes like Indian Electricity Act, Indian Electricity Rules, Factory Acts, Local Municipality act etc. shall however prevail over the specification requirements, in case any conflict arises between this specification and the statutory codes.

Maintenance tools and tackles shall be as per data sheet attached.

DESIGN CRITERIA

- 1.0.0** Electrically operated wire rope hoists of suitable capacity, lift, and travel length shall be provided for handling of items weighing 1000 kgs and/or having lifting height more than 10m. The hoist capacity shall be selected considering 25% margin over the weight of heaviest component /equipment to be handled. The hoist parameters (i.e. lift & travel) are subject to change/s, to suit the final layout of the area in which it is intended to be installed.

Electric hoist shall be provided for capacity >1T. Electric hoists shall be provided for lifts >10m irrespective of the capacity.

Chain pulley block (Manual hoist) - 300kg to <1T, wherever feasible, considering layout constraints.

Capacity of electric and manual (Chain pulley block) hoists shall be decided keeping 25% margin over equipment to be handled.

For hand operated hoists, the hoists shall be suitable for operation from floor level. Hand chain shall be provided for long travel of trolley and the Hoisting mechanism. The operator shall be able to control the movement of the electrical/ manual hoist with the help of floor operated pendant

MINIMUM LIFTING REQUIREMENT

S.N.	AREA DESCRIPTION	QTY (nos)	CAPACITY(T)	TYPE
1	LIST TO BE MENTIONED AS APPLICABLE			
2				
3				

Note:

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

2.0 SCOPE OF SUPPLIES

Equipment and services to be furnished by the bidder for the ELECTRIC HOIST/ MANUAL HOIST with accessories as per the details given in the technical specification and data sheet A. Any equipment / accessories not specified in the specification but required to make the ELECTRIC HOIST/ MANUAL HOIST complete and efficient operation shall also be under the



**TECHNICAL SPECIFICATION
ELECTRIC HOISTS & CHAIN PULLEY BLOCKS
1X660 MW UPRVNL PANKI TPS EXTN.**

bidder's scope of work.

Compliance with this specification shall not relieve the bidder of the responsibility of furnishing material and workmanship to meet the specified working/duty conditions.

- 2.1.0 Electric hoist shall include but not be limited to the following: -
- a) Equipment offered shall be suitable for indoor duty conforming to Class II of IS: 3938.
 - b) Equipment shall be designed to operate in non- hazardous area.
 - c) Electric hoists shall be pendent operated.
 - d) Both hoisting and trolley movement shall be motor driven.
 - e) Hoisting motion shall be thru' VVVF drives to achieve creep speed of 10% of main speed.
 - f) Wheels shall be single flanged type.
 - g) Hook shall be swiveling type and fitted with a safety latch.
 - h) Control panel shall be hoist mounted.
 - i) Power feeding to the electric hoists shall be thru' PVC shrouded DSL.
 - j) Brakes shall be fail to safety.
 - k) Load/overload testing of the hoists shall be carried out as per IS: 3938.
 - l) All material, castings and forgings will be of tested quality & certificates shall be made available for review as per approved QAP
- 2.2.0 Erection and Commissioning spares (ELECTRIC HOIST)
The Bidder shall also supply erection & commissioning spares along with his main equipment as per his experience, for replacement of damaged or unserviceable parts during the execution of the project at site, to avoid delay in the project schedule. This shall form part of the main equipment supply. The Purchaser shall retain the unutilized commissioning spares. The initial fill of lubricants, oil etc. shall also be supplied by the bidder.
- 2.3.0 Services to be provided by the bidder
Packing, forwarding and transportation to site, storage and handling at site.
- 2.4.0 Erection and Commissioning
- 2.5.0 Functional test (Overload testing, load testing at rated speed, travel and hoisting motion checks as per relevant Indian standards)
- 2.6.0 Obtaining clearance and acceptance certificate from the concerned competent authority after site test as applicable. Necessary fees/expenditure as required shall be borne by the supplier.

3.0 Inspection and Testing

As per enclosed reference quality plan and as per IS 3938 (latest revision). Prime inspection agency shall be Consultant/ End Customer. Equipment supplied shall be strictly in accordance with nomenclature & technical specification. Any additional testing requirement/CHP (Customer Hold Point) at any stage of inspection deemed necessary by Consultant/ End Customer during detailed engineering shall be carried out without any commercial or technical implication.

4.0 Works Excluded

Supply of ISMB monorail.

5.0 PAINTING SPECIFICATION

As per painting details specified elsewhere in specification.

6.0 PACKING

In general packing shall be wooden box packing.

7.0 TESTING AT VENDOR'S WORKS

Hoist along with its drives, controls and other accessories shall be demonstrated for the rated capacity against the rated speed of motions and for the service conditions specified as specified in QAP and as per IS 3938 for electric hoist and IS 3832 for manual hoist.

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



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

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

8.0 MAKE OF SUB - VENDOR ITEMS

Makes of bought out items will be as per list specified in the specification. No other make will be acceptable, until and unless specifically got it approved by the purchaser/ end client. (Refer annexure-I)

9.0 TESTING AT SITE

A) ELECTRIC HOIST:

As required for statutory clearance for operating at site i.e., overload test, load test and other tests as per IS 3938.

Test for Operation -After the supply has been connected, tests shall be carried out to prove the following:

- a) The satisfactory operation of each controller, switch, contactor, relay and other control devices and in particular the correct operation of all limit switches under the most unfavorable conditions;
- b) The correctness of all circuits and interlocks and sequence of operation; and
- c) The satisfactory operation of all protective devices.

Overload Test -After test but before the hoist is put into service, it shall be tested with overload relays appropriately set, to lift and sustain a test load of 125 percent of the working load. During the overload test, the hoist shall sustain the load under full control. The specified speeds need not be attained but the hoist shall show itself capable of dealing with the overload without difficulty.

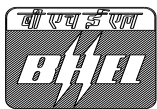
B) MANUAL HOIST:

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

10.0 TECHNICAL DATA SHEET:

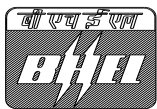
A) Technical data sheet-A for ELECTRIC HOIST:

Sl.no	DESCRIPTION	TECHNICAL PARTICULARS
1.0	Type	Steel wire electric hoist with electrically operated trolley
2.0	Scope (Qty., Capacity, Lift, Travel Length)	As mentioned in specification
3.0	Type of service	Indoor
4.0	Overload test	125% of SWL
5.0	Design Ambient temperature	50° C
6.0	General Design	As per IS: 3938 / 1983 or latest, Class-II duty
7.0	Operating speed	
7.1	Hoisting speed/ Creep speed (thru' VVVF drive)	3 MPM with creep speed 10% of main speed.
7.2	Trolley speed	10 MPM



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ELECTRIC HOISTS & CHAIN PULLEY BLOCKS
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8.0	Type of transmission	Through Electric motor and gear box.
9.0	Wire Rope	
9.1	Construction / core	6 x 36 or 6 x 37 construction, steel/ Fibre core
9.2	Code	IS:2266
9.3	Tensile designation	1770/1960 N/mm ²
9.4	Number of falls	Min. 4
9.5	Factor of safety	Not less than 5
10.0	Load Hook and block	Normalized hook only
10.1	Type of load hook	Plain shank trapezoidal section with safety latch.
10.2	Load hook Code	IS: 15560
10.3	Load hook Material	Alloy steel/carbon steel as per IS:15560
10.4	Hook suspension	Thrust bearing
10.5	Material of block suspension	Fabricated from steel plate, Material: IS: 2062
10.6	Hook can swivel freely under full load	Yes
10.7	Safety latch on hook provided	Yes
10.8	Locking device on swivelling hook	Provided
10.9	Bearing type	Antifriction Ball / Roller
10.10	Bearing life	10,000 working hours.
11.0	Gearing	
11.1	Type	Spur / Helical, hardened and tempered with machine cut teeth
11.2	Gear material	Forged steel as per IS 3938
11.3	Lubrication	Oil splash/ grease lubricated
11.4	Bearing type	Antifriction Ball / Roller
11.5	Bearing life	10,000 working hours.
12.0	Trolley drive	
12.1	Wheel	Single flange taper thread
12.2	Wheel conform to (Std. / code)	IS: 3938
12.3	Wheel material	Heat treated carbon steel/ low alloy steel, graded cast iron.
12.4	Bearing type	Antifriction Ball / Roller



TECHNICAL SPECIFICATION
ELECTRIC HOISTS & CHAIN PULLEY BLOCKS
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12.5	Bearing life	10,000 working hours.
12.6	Trolley type	Rolled structural steel with side plates extended beyond wheel flanges to protect wheels.
12.7	Hardness	Max hardness 200 BHN
13.0	SHEAVE	
13.1	Material	Cast steel or mild steel.
13.2	Bearing type	Antifriction Ball / Roller.
13.3	Bearing life	10,000 working hours.
14.0	BRAKE (HOIST)	
14.1	Type	DC EM brakes disc type (fail to safety).
14.2	Capacity	As per IS 3938.
14.3	Number	One number for each motor.
15.0	BRAKE (TROLLEY)	
15.1	Type	DC EM brakes disc type (fail to safety).
15.2	Capacity	As per IS 3938.
15.3	Number	One number for each motor
16.0	ROPE DRUM	
16.1	Material	Cast iron, cast steel or mild steel.
16.2	Flange / Flangeless	Flanged
16.3	Type of groove	As per manufacturers standard to suit the layout requirement.(Shall be decided during detail engineering)
17.0	TYPE OF DSL	
17.1	CT travel	PVC shrouded GI conductor bus bar -DSL shall be sized with a margin of 10% over load requirement.
18.0	MOTORS	
18.1	Type	Sq. Cage induction, TEFC, S4 duty, 60% CDF.
18.2	Number of start	300starts / hr, Motors shall be suitable for direct on-line (DOL) starting
18.3	Voltage , Phase and Frequency	Suitable for rated frequency of 50 Hz with a voltage variation of +/-10% and frequency variation of +3 to -5% occurring separately or combined voltage and frequency variation of 10%. 3 phase, 4 wire
18.4	Class of insulation	Class "F" and temperature rise limited to class B.
18.5	Type of enclosure	TEFC
18.6	Degree of protection provided	IP-55



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	for enclosure	
18.7	Margin	Motor nameplate rating at 50 deg C shall have Motor rating will be calculated keeping margin of at least 25% over the maximum power requirement. The hoist motors shall be rated to lift 125% of the design load at rated speed
19.0	LIMIT SWITCHES	Hoisting
19.1	Type	One (1) no. Snap action, self-actuating type
20.0	Control panel	One (1) no. two way limit switch
20.1	Qty	1 No.
21.0	Pendent Push buttons	* Fabricated from CRCA sheet steel not less than 1.6 mm thick * Degree of protection shall be IP 52 * Power on indicating lamps shall be provided * Panel illumination lamps operated by door switch. * 2 nos earthing terminals on panel. * Gland plate thickness shall be minimum 3mm. * Gland plate shall be double brass compression type.
22.0	Fixed type Power cables	Up /down / forward / Reverse push buttons. Indicative marking for easy operation shall be provided.
23.0	Fixed type Control cable	Copper/Aluminum material, minimum size : Min. 2.5 mm ² for Cu/ min 6 mm ² for Aluminum. Extruded PVC insulated, armoured and FRLS PVC sheathed heavy duty 1100 V
24.0	Trailing cable (Power/ Control)	Copper material, min. 1.5 mm ² Control cables shall have stranded copper conductor, Extruded PVC insulated, armoured and FRLS PVC sheathed heavy duty 1100 V
25.0	Control Voltage	EPR insulated, copper conductor trailing cables, as per IS:9968.
26.0	End stopper for CT	110 V
27.0	Buffer for CT	2 nos., MOC shall be as per IS 2062
28.0	Bearing (Type/life)	2 nos. Spring/rubber type shall be provided on trolley
		Antifriction Ball / Roller, 10,000 working hours life

B) MANUAL HOIST (CHAIN PULLEY BLOCK):

DATA SHEET-A

1.0	Type	Chain pulley block with/without trolley
2.0	General Design	IS: 3832
3.0	Duty Class as per IS:3832	Class –II
4.0	Hoisting Mechanism	
a)	Type	Hand operated gear transmission
b)	Type of gear	Spur / Helical
c)	Load Chain	
i)	Type	Link type
ii)	Material	As per relevant standard
iii)	Conforms to (Std./Code)	IS: 6216 / IS 3077/IS 3019



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d)	Hand Chain	
i)	Type	Link type
ii)	Material	Mild steel Grade 30
iii)	Conform to Std.	IS:2429 (Part II)
e)	Load Hook & Hook Block	
i)	Type of load hook	Plain shank- Trapezoidal section/ 'C' type
ii)	Load hooks conforms to	IS: 15560
iii)	Type of hook suspension	Swivelling type with safety latch
iv)	Type of make of bearing	Thrust ball bearing of hook suspension
v)	Type & Material of hook	As per IS 15560
f)	Gears/ Pinions	
i)	Type	Spur
ii)	Material	Alloy steel / carbon steel/ High graded cast iron
	Type of Bearing	Antifriction ball bearing / Roller
g)	Sprockets :	
	Type of bearings used	Antifriction ball bearing / Roller
i)	Method of lubrication	
	Bearings	Grease
	Gearing & Pinions	Grease
	Sprocket	Grease
h)	Brakes	
	Type	Screw and friction disc type
5.0	Trolley and Bridge drive	
a)	Trolley	
i)	Type	Geared (Manually operated)
ii)	Material of frame	Mild steel (IS:2062 Grade A or B)
b)	Drive Chain	
i)	Type	Link type
ii)	Material	Steel Gr.30
iii)	Design of drive chain	IS : 2429 part 1 :1870
c)	Wheel	
i)	Number of pairs of wheel	Two in each trolley/bridge
ii)	Flange	Single flanged
iii)	Type of bearings need	Antifriction
iv)	Wheel material	As per IS 3832
d)	Gears	
i)	Type	Spur / helical
ii)	Material	Cast iron/EN8
iii)	Type of bearings used	Antifriction
e)	Method of lubrication for	
i)	Bearings	Grease
ii)	General	Grease
iii)	Sprockets	Grease
6.0	Painting	As per manufacturer's standard

11.0 Maintenance Tools and Tackles

One (1) complete unused new set of special purpose tools, tackles and accessories along with detailed instructions and maintenance manual shall be supplied. Tools shall be of suitable sizes for maintenance of electric hoist of each type and capacity. Each tool and wrench shall be stamped so as to be identified easy for its use. The tools shall be supplied in steel toolbox and with a copy of



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instruction manual. The items supplied shall be of the best quality, specially protected against rusting. The following shall be provided as minimum requirement:

S. No.	Description	Qty.
1	Complete set of ring spanners	1 Set
2	Complete set of screwdrivers (Min. 6 nos of suitable sizes)	1 Set
3	Adjustable Spanner	1 No.
4	Insulated pliers	1 No.
5	Wrench spanner	1 No.
6	Grease Gun	1 No.
7	Oil Gun	1 No.
8	Hand Lamp	1 No.
9	Line tester	1 No.

Note: -The tools shall be supplied in one tool box .Bidder shall ensure that the tools & tackles mentioned in above list are sufficient to handle all sizes/capacities of hoists & in case any other /additional tool is required for handling/maintenance any size/capacity of hoist the same shall be included in this list.

12.0 DRAWING/DOCUMENT SUBMISSION

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

A) ELECTRIC HOIST

SI. No.	BHEL DRG.NO	DRAWING TITLE
1	PE-V0-426-553-A100	Manufacturing Quality Plan with Sub vendor list
2	PE-V0-426-553-A101	GA Drawing for Electric Hoist, DSL arrangement and painting details
3	PE-V0-426-553-A102	Schematic Circuit Diagram
4	PE-V0-426-553-A103	Mechanism Sizing Calculation
5	PE-V0-426-553-A105	O & M Manual

B) MANUAL HOIST (CHAIN PULLEY BLOCK):

SI. No.	BHEL DRG.NO	DRAWING TITLE
1	PE-V0-426-553-A200	Manufacturing Quality Plan
2	PE-V0-426-553-A201	GA Drawing for Chain Pulley Block with detail BOM with painting details
3	PE-V0-426-553-A202	O & M Manual

Notes:

1. The above drawing list is tentative and shall be finalized with the successful bidder after placement of order.
2. Drawings shall be prepared in Auto-Cad latest edition. Required no. of hard and soft copies (editable) of the drawings shall be furnished as per requirement specified elsewhere in the specification.



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3. All the drawings and documents including general arrangement drawing, data sheet, calculation etc. to be furnished to the customer during detailed engineering stage shall include / indicate the following details for clarity w.r.t. Inspection, construction, erection and maintenance etc.:-
- All drawings and documents shall indicate the list of all reference drawings including general arrangement.
 - 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.
 - Painting schedule shall also be made as a part of general arrangement drawing of each equipment / items indicating at least 3 trade names.
 - All the drawings required to be furnished to customer during detailed engineering stage shall include technical parameters, details of paints and lubrication, hardness and BOQ / BOM in tabular form indicating all major components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.
 - Drawings/ documents to be submitted for purchasers review/ approval shall be under Revision A, B, C... etc. while drawings /documents to be submitted thereafter for customer's approval after purchaser's approval shall be under R-0, 1, 2, 3etc.

13.0 MANDATORY SPARES:

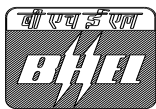
MANDATORY SPARES FOR ELECTRIC HOIST AND MANUAL HOIST (AS APPLICABLE)

A. Mechanical spares for Electric Hoist

S. No.	Description	Qty.	Remarks
1	Electric Hoists (FOR EACH TYPE & CAPACITY)		
a	All Bearings	1 set of each type / rating	
b	Brake assembly and its liners	1 set of each type / rating	
c	Wire rope	1 complete length	
d	Limit switch	2 nos of each type & rating	

B. Mechanical spares for Manual hoist

S. No.	Description	Qty.	Remarks
1	Manual Hoists(Chain Pulley Block)		

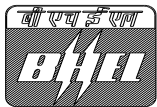


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	(FOR EACH TYPE & CAPACITY)		
a	All Bearings	1 set of each type / rating	
b	Brake assembly and its liners (as applicable)	1 set of each type / rating	

A. Electrical spares for entire lot of Electric Hoists in station/ plant

S. No.	Description	Qty.	Remarks
1	415 V Motors (FOR EACH TYPE & CAPACITY of motor)		
1.1	Terminal plates	10 Nos. each for small motors upto 30 kW & 4 Nos. each for more than 30 kW	
1.2	Heaters	2 sets	
1.3	Greasing arrangements	4 sets each type of motor	
1.4	Motor of each type and rating	10% of the installed quantity or minimum 1 number whichever be higher	a. Quantity mentioned in percentage (%) is the % of total installed quantity in complete lot of Electric hoists in plant. b. If percentage comes as fraction next higher integer should be considered for the purpose of quantity required.
1.5	Bearings (DE and NDE) for each type and rating of motors.	4 sets	
1.6	Stator winding coils for all type of LT motors	One (1) set	
1.7	Dust seals and gaskets for each type of motors	Three (3) sets	
2	Control desk and Control Panels (as applicable):-		
2.1	Devices mounted on Control desk	Ten (10) percent or 2 nos (whichever is more) of each type	a. Quantity mentioned in percentage (%) is the % of total installed quantity in complete lot of Electric hoists in plant. b. If percentage comes as fraction next higher integer should be considered for the purpose of quantity required.
2.2	LEDs for indicating lights shall be furnished.	100.00%	
2.3	control circuit fuses	One hundred percent spare replacement of each current rating required	
2.4	MCB/MCCB	Ten percent spare replacement of each current rating required	
2.5	Blank Mosaic Grid Tiles.	Ten (10) percent or 20 nos (whichever is more)	
2.6	Push buttons, ILPBs.(complete with contact elements)	Ten (10) percent or 2 nos (whichever is more) of each type and color.	



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2.7	Cooling Fans	20% or 2 nos. (whichever is more) of each type, model and rating.	
2.8	Electric meter.	Ten (10) percent or 2 nos (whichever is more) of each type	
2.9	Power supply modules.	Ten (10) percent or 2 nos (whichever is more) of each type	
3.0	POWER AND CONTROL CABLES		
3.1	1.1 KV Grade power cables for each type and size.	10% of installed quantity	a. Quantity mentioned in percentage (%) is the % of total installed quantity in complete lot of Electric hoists in plant. b. If percentage comes as fraction next higher integer should be considered for the purpose of quantity required.
3.2	1.1 KV Grade control cables for each type and size.	10% of installed quantity	

Note:-

1. "One (1) Set" is defined as 100% requirement for one hoist for the entire hoists of similar size & capacity.



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ANNEXURE I: MAKES AND SUB VENDOR LIST

Package Name	Vendor Name
ELECTRIC HOIST	Alpha Services
	CONSOLIDATED HOISTS PVT LTD
	CENTURY CRANE ENGINEERS PVT. LTD.
	TECHNO INDUSTRIES
	EDDY CRANES PVT. LTD.
	Grip Engineers Pvt. Ltd.,
	TRACTEL TIRFOR INDIA PVT. LTD.
	Mangla Hoists Pvt Ltd
	BRADY & MORRIS ENGINEERING CO. LTD.
	REVA INDUSTRIES LTD.
	UNIVERSAL HOIST-O-FABRIK
	UNIVERSAL HOIST-O-FABRIK
CHAIN PULLEY BLOCK	CENTURY CRANE ENGINEERS PVT. LTD.
	BAKELITE ELECTRICAL MFG. CO. PVT. LTD.
	TRACTEL TIRFOR INDIA PVT. LTD.
	BRADY & MORRIS ENGINEERING CO. LTD.
	TUOBRO FURGUSON (INDIA) PVT LTD
	TECHNO INDUSTRIES
	TECHNO INDUSTRIES

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

MAKES OF SUB VENDORS ITEMS AS APPLICABLE TO ELECTRIC HOIST:

Sl no.	ITEM	MAKES
1.0	STEEL	SAIL/IISCO/TATA STEEL / JINDAL
2.0	HOOKS	MOOZUMDAR / SIMRITI FORGING / HARMAN MOHTA / STEEL FORGING & ENGG. CO., KOLKATA /
3.0	GEAR COUPLINGS	ALLIANCE / HICLIFF / OEM
4.0	WIRE ROPE	USHA MARTIN Black / BOMBAY WIRE ROPES / FORT WILLIAMS / UNITED WIRE ROPE/BHARAT WIRE ROPES.
5.0	BEARINGS	SKF/ FAG
6.0	MOTORS	SIEMENS/ ABB /NGEF/ CROMPTON /KIRLOSKAR /GECA / BHARAT BIJLI / MARATHON / LHP.
7.0	BRAKES	STROM CRAFT/ ELECTROMAG /SPEED-O- CONTROL / EMCO LENZE
8.0	CONTACTOR	SIEMENS / L&T /TELE MECHANIQUE / BCH
9.0	OVER LOAD RELAYS	SIEMENS / L&T / TELE MACHANIQUE / ABB
10.0	HRC FUSES	SIEMENS / L&T/ ENGLISH ELECTRIC/GE Power
11.0	ISOLATING SWITCH	SIEMENS/ L&T / CONTROL & SWITCH GEAR
12.0	SWITCH FUSE UNITS	SIEMENS/ L&T/ CONTROL/ & SWITCH GEAR/ GEC A
13.0	TIME DELAY RELAYS	SIEMENS/ L&T/ ABB/ BCH/ GEC A
14.0	TRANSFORMERS	INDCOIL/AE / LOGICSTAT/ PRAGATI / KAPPA / SOUTHERN ELECTRIC
15.0	BULB & FLOURESCENT TUBES/FITTINGS	PHILIPS/ BAJAJ/ CROMPTON
16.0	CABLE LUGS (HEAVY DUTY)	DOWELLS



**TECHNICAL SPECIFICATION
ELECTRIC HOISTS & CHAIN PULLEY BLOCKS
1X660 MW UPRVUNL PANKI TPS EXTN.**

17.0	CABLES	
a)	POWER CABLES	NICCO / UNIVERSAL / INCAB / FORT GLOSTER TORRENT / CCI / ICL / RADIANT / FINOLEX/ POLYCAB/KEI/HAVELL
b)	CONTROL CABLES	NICCO / UNIVERSAL / INCAB / FORT GLOSTER / DELTON / FINOLEX / TORRENT / CCI / ICL / RADIANT POLYCAB / KEI/ HAVELL.
c)	TRAILING CABLE	UNIVERSAL/ FGL/CCL/HVP/KEI/RADIANT.
18.0	CABLE GLAND	COMMET / SIEMEN / SUNIL&CO.
19.0	PUSH BUTTONS	SIEMENS / L&T / BCH /TEKNIC/VAISHNO
20.0	LIMIT SWITCHES	SPEED-O-CONTROL / ELECTROMAG / JAI BALA JI / KAYCEE / BCH
21	SELECTOR SWITCHES	KAYCEE/ SULZER
22	PENDENT PUSH BUTTON STATION	OEM
23	INDICATING LAMPS	TEKNIC / BCH / SIEMENS / STANDARD/ VAISHNO
24	MCB	MDS / INDO COPP / STANDARD
25	PANELS	OEM/BCH
26	DSL	SUSHEEL/STROMAG
27	TERMINAL BLOCKS	ELMEX/CONNECTWELL/WAGO (FOR CONTROL ONLY)
28	VVVF	YASAKAWA(L&T)/ABB/SIEMENS/SCHNIDER
29	CASTING	KOLHAPUR STEEL / GNAT FOUNDRY / KIRTI ALLOYS
30	Tools & tackles	Reputed make

MAKES OF SUB VENDORS ITEMS AS APPLICABLE TO MANUAL HOIST:

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

NOTE:

1. THE SUB VENDOR LIST ABOVE IS INDICATIVE ONLY AND IS SUBJECT TO BHEL AND CUSTOMER APPROVAL DURING DETAILED ENGINEERING STAGE WITHOUT ANY COMMERCIAL & DELIVERY IMPLICATION TO BHEL.



**TECHNICAL SPECIFICATION
ELECTRIC HOISTS & CHAIN PULLEY BLOCKS
1X660 MW UPRVUNL PANKI TPS EXTN.**

PAINTING SPECIFICATION

1. Painting specification for steel structures:-

Surface preparation: De greasing and Mechanical cleaning with wire brush or blasting according to SIS 055900, Grade 2 ½ .

Primer : HB Zn Phosphate - 2 coat, Minimum DFT 80 µ per coat.

Finish Coat : HB MIO epoxy - 1 coat, Minimum DFT 120 µ per coat

Total DFT : 260 µm

2. Painting specification for Indoor components such as motors, electrical parts etc:-

Surface preparation: blasting according to SIS 055900, Grade 2 ½ . Depending on production flow, a weldable, inorganic ethyl zinc silicate shop primer of minimum dry film thickness 25 µm may be used.

Primer : Zinc phosphate epoxy - 2 coat, Total DFT 80 µm.

Finish Coat : Chlorinated rubber paint- 2 coats, Total DFT 80 µm for indoor and 100 µm for outdoor.

Total DFT : 160 µm for indoor and 180 µm for outdoor.

3. Color Shade:

SL. No	Item Description	Color Shade
1	Crane Structure	Golden Yellow shade 356 as per IS-5
2	Trolley and hook	Crimson shade 540 as per IS-5
3	Motors	Light grey, shade 631 as per IS-5
4	Control Panels	Paint shade shall be RAL 9002 for front & rear and RAL 5012 for side covers.
5	Bottom Block assembly.	Golden Yellow shade 356 as per IS-5
6	End Carriage sweep.	Golden Yellow shade 356 as per IS-5

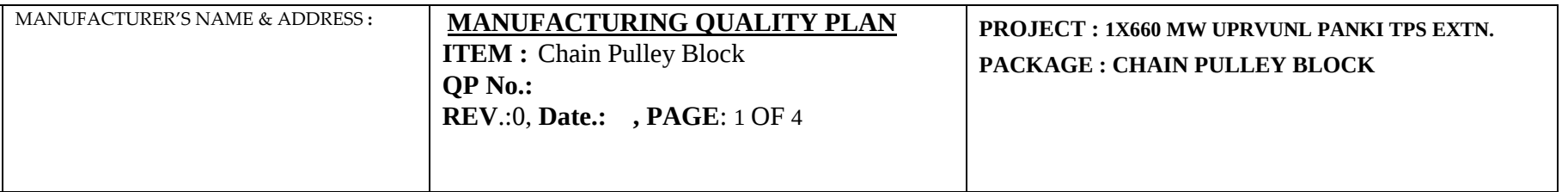
STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGE: ELECTRIC HOIST FOR AC VENTILATION

PROJECT 1X660 MW UPRVUNL PANKI TPS EXTN

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

<u>S. NO</u>	<u>DETAILS</u>	<u>SCOPE SUPPLY</u>	<u>SCOPE E&C</u>	<u>REMARKS</u>
1	Isolating Switch	Vendor	Vendor	BHEL will provide one number 415 V(3ph, 3W) supply feeder only up to isolating switches for cranes. Any other voltage level (AC/DC) required will be derived by the vendor. Motor starter shall be part of crane control panel.
2	Power cables, control cables, screened control cables and any special cables (if required) between equipment supplied by vendor.	Vendor	Vendor	Cable from supply feeder to isolating switch shall be in BHEL scope.
3	Cabling material (cable trays, accessories, cable tray supporting system, conduits etc).	Vendor	Vendor	
4	Equipment Earthing	Vendor	Vendor	All equipment metallic enclosures / frames, metal structure etc. shall be grounded at two points each to the nearest grounding points / risers provided by BHEL.
5	Motors	Vendor	Vendor	
6	Cable glands and lugs for equipment supplied by vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power & control cables.
7	a) Input cable schedules (C & I) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
8	Equipment layout drawings	Vendor	-	
9	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.



Sr. No.		CHARACTERISTICS	CLAS S	TYPE OF CHECK	QUANTU M OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS			
	COMPONENT / OPERATION				M	C/N				7.	8.	9.		M	C	N
														10.		
1.	2.	3.	4.	5.	6.								11.			

1	<u>RAW MATERIAL & B/OUT ITEMS:</u>												
1.1	HOOKS	CHEMICAL & MECH MARK & IDENTIFICATION INTERNAL DEFECTS PROOF LOAD TEST NDT AFTER PROOF LOAD TEST	MA MA MA MA MA	LAB ANALYSIS VISUAL UT REVIEW DPT	ONE SAMPLE PER HEAT 100% 100%	MATERIAL SPECIFICATION AS PER APPROVED DRAWINGS. HOOK TC FROM COMPETENT AUTHORITY ASTM A-388 (REFER NOTE I) IS 15560 ASTM E-165		MTC. TC IR TC TC	✓ ✓ ✓ ✓ ✓	P P P P P	V V V V V	V V V V V	ON SHANK PORTION
1.2	LOAD CHAIN	- DIMENSIONS - BREAKING STR & % ELONGATION - PROOF LOAD -HEAT TREATMENT -GRADE	MA MA MA MA MA	MEASUREMENT -TENSILE TEST -TENSILE TEST REVIEW REVIEW	100% 1/LOT 100% 100% 1/BATCH	APPD. DRGS -DO- -DO- -DO- -DO-	APPD. DRGS. -DO- -DO- -DO- -DO-	IR MTC MTC HT CHRT MTC	✓ ✓ ✓ ✓ ✓ ✓	P P P P P	V V V V V	V V V V V	

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

	MANUFACTURER'S NAME & ADDRESS :	MANUFACTURING QUALITY PLAN		PROJECT : 1X660 MW UPRVUNL PANKI TPS EXTN. PACKAGE : CHAIN PULLEY BLOCK
		ITEM : Chain Pulley Block		
		QP No.:		
		REV.:0, Date.: , PAGE: 2 OF 4		

Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLAS S	TYPE OF CHECK	QUANTU M OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS								
					M	C/N				M	C	N									
	1.				2.	3.				4.	5.	6.		7.	8.	9.	10.			11.	
1.3	RAW MATL. (BAR /FORGING) FOR GEAR BLANKS/SHAFTS/ PINIONS/AXLE/ RATCHET PAWL / RATCHET WHEEL & PLATES FOR FABRICATION ETC	CHEMICAL COMPOSITION MECHANICAL INTERNAL DEFECTS NDT AFTER MACHINING	MA MA MA MA	Review Review UT DPT	ONE SAMPLE PER HEAT 100% 100%	Material specification as per approved drawings. ASTM A-388 REFER NOTE 1 ASTM E-165 NO RELEVANT INDICATION		MFR’ S TC IR TC	✓ ✓ ✓ ✓	P P P P	V V V V	V V V V	TC or inspection report for components shall be given. For rounds ≥50mm and plates ≥25 mm.								
1.4.	LOAD CHAIN WHEELS	- CHEMICAL & MECHANICAL PROPERTIES	MA	CHEMICAL MECHANICAL PROPERTIES	ONE SAMPLE PER LOT	APPD. DRG.	APPD. DRG.	MTC	✓	P	V	V									
1.5	BEARINGS	MAKE, TYPE, CATALOUGE NO.	MA	VISUAL	RANDOM	APP DRG / MFR”S CATALOGUE	APP DRG / MFR”S CATALOGUE	IR	✓	P	V	V									
1.6	HAND CHAIN WHEEL	CHEMICAL MECHANICAL PROPERTIES	MA	CHEMICAL MECHANICAL PROPERTIES	ONE SAMPLE PER LOT	AS PER DRAWING	AS PER DRAWING	MTC	✓	P	V	V									
1.7	HAND CHAIN	GRADE/ DIMENSION	MA	GRADE DIMENSION	100%	AS PER DRAWING	AS PER DRAWING	MTC	✓	P	V	V									

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

	MANUFACTURER'S NAME & ADDRESS :	MANUFACTURING QUALITY PLAN ITEM : Chain Pulley Block QP No.: REV.:0, Date.: , PAGE: 3 OF 4	PROJECT : 1X660 MW UPRVUNL PANKI TPS EXTN. PACKAGE : CHAIN PULLEY BLOCK
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Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLAS S	TYPE OF CHECK	QUANTU M OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY	REMARKS
					M C/N				M C N	
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.

1.8	TROLLEY GEARS, PINION, WHEELS, AXLE	CHEMICAL & MECHANICAL	MA	LAB ANALYSIS,	100%	APPVD DRGS	APPVD DRGS	IR/TC	✓	P	V	V	
2	IN PROCESS												
2.1	RATCHET PAWL / RATCHET WHEEL	-HARDNESS -SURFACE CRACK	MA MA	HARDNESS DPT	100% 100 %	IS:3832/ APPD DRG. ASTM E165	IS:3832/ APPD. DRG. NO DEFECT	IR IR	✓ ✓	P P	V V	V V	
2.2	COMPONENTS AFTER HARDFACING & MACHINING	HEAT TREATMENT SURFACE HARDNESS SURFACE CRACK	MA MA MA	HT CHART HARDNESS DPT FOR SURFACE CRACK MEASURE	100% 10% 100%	IS 1875/IS 4367/IS 3832 --DO-- ASTM E 165	 NO DEFECT	IR IR IR	✓ ✓ ✓	P P P	V V V	V V V	
		DIMENSION	MA		10%		IS 3832	IR	✓	P	V	V	
3.0	FINAL INSPECTION												
3.1	COMPLETE ASSEMBLY	OVERALL DIMENSION	CR	MEASUREMENT	100 %	IS:3832 /APPD DRG	IS:3832 /APPD DRG	IR	✓	P	W	V	
		ENDURANCE TYPE TEST	MA	TYPE TEST	1 PER SIZE	IS 3832	IS 3832	TC	✓	P	V	V	
		OPERATIONAL PROOF LOAD & LIGHT LOAD TEST, EFFORT.	CR	LOAD TEST	100%	-DO-	-DO-	IR	✓	P	W	V	
										P	W	V	

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

	MANUFACTURER'S NAME & ADDRESS :	MANUFACTURING QUALITY PLAN ITEM : Chain Pulley Block QP No.: REV.:0, Date.: , PAGE: 4 OF 4	PROJECT : 1X660 MW UPRVUNL PANKI TPS EXTN. PACKAGE : CHAIN PULLEY BLOCK

Sr. No.		CHARACTERISTICS	CLAS S	TYPE OF CHECK	QUANTU M OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
	COMPONENT / OPERATION				M	C				N			
1.	2.	3.	4.	5.	M	C/N	7.	8.	9.	10.			11.

		HEIGHT OF LIFT SWIVELING OF HOOK	MA MA	VISUAL VISUAL	100 % 100%	-DO- APPROVED DRG -DO-	-DO- APPROVED DRG -DO-	IR IR	✓ ✓ ✓	P P	W W	V V	
		EFFORT	MA	PULL ON CHAIN	100%			IR					
3.2	PAINTING	-CLEANING - SHADE & DFT OF PAINT	MA MI	VISUAL VISUAL	AT RANDOM AT RANDOM	APPROVED DRAWING/ SPECIFICATI ON	APPROVED DRAWING/ SPECIFICATI ON	IR IR		P - p	--- W	-- ---	
3.3	NAME PLATE	VERIFICATION	MA	VISUAL	100%			IR		P	V	---	
3.4	PACKING	-VERIFICATION	MI	VISUAL	100%	SPECS.	SPECS.	IR		P	---	---	
3.5	REVIEW OF QA DOCUMENTATION	VERIFICATION	MA	VISUAL	100%	APPD. QP	APPD. QP		✓	V	V	V	

CR – CRITICAL, MA – MAJOR , MI – MINOR

NOTE 1: WHEN BACK WALL ECHO (BWE) IS SET AT 100% OF FULL SCREEN HEIGHT (FSH) IN DEFECT FREE AREA THEN

(A) DEFECT ECHO SHALL NOT EXCEED 20% OF FSH &

(B) BWE SHOULD BE MINIMUM 80% OF FSH IN ANY AREA.

NOTE 2: RECORDS IDENTIFIED WITH TICK SHALL BE ESSENTIALLY INLCUDED IN QA DOCUMENTATION.

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

		MANUFACTURERS NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT		1X660 MW UPRVUNL PANKI TPS EXTN.			
		AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE		ELECTRIC WIRE ROPE HOIST			
						REV	0	CONTRACT No					
						DATE	Mar, 2017	CONTRACTOR		BHEL-PEM			
						PAGE	1 of 4						
Sl.No	COMPONENT & OPERATIONS	CHARACTERISTICS	CATEGORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY		REMARKS	
1	2	3	4	5	6	7	8	9	D*	M	C	N	11
1.0	RAW-MATERIALS												
1.1	a) STRUCTURAL MATERIAL b) RAW MATERIAL FOR HOIST AND GEAR BOX HOUSING, TROLLEY PLATE, ROPE DRUM IF FABRICATED ETC	CHEM & MECH PROPS	MA	Lab analysis	1 SAMPLE PER LOT%	IS 2062 /APPD. DRG./ DATA SHEET		MTC/IR	√	P/V	V	V	Test shall be carried out in absence of mill TC or non-correlation of TC with material.BHEL to identify Samples for testing. Test to be carried out at NABL accredited Lab. Reports to be submitted for verification during inspection.
		NDT	MA	UT	100%	ASTM A388-2004	NOTE 1	IR	√	P	V	V	For dia / plate thickness above 25 mm
1.1 A	SEAMLESS PIPE FOR ROPE DRUM	CHEMICAL , MECHANICAL	MA	Lab analysis	1 SAMPLE /pipe	Approved drg/ASTM A 106 Grade A or B		MTC/IR	√	P/V	V	V	Test shall be carried out in absence of mill TC or non-correlation of TC with material.BHEL to identify Samples for testing. Test to be carried out at NABL accredited Lab. Reports to be submitted for verification during inspection
		Flattening & Acid Etching test	MA	PHYSICAL & METALLOGRAPHY	1 SAMPLE /pipe	No cracks, pitting, rusting , damage etc		IR	√	P	V	V	
		SURFACE DEFECTS	MA	Visual	100%								
1.2	FORGINGS FOR GEARS BLANKS ,PINIONS, SHAFT/AXLES, WHEELS , STEEL CASTINGS	MECH , CHEM. PROPS	MA	Lab analysis	100%	APPD. DRG./ DATA SHEET	APPD. DRG./ DATA SHEET / IS:3938	LAB. REPORT / MANUFACTURER'S TEST CERTIFICATE	√	P	V	V	
		NDT	CR	UT	100%	ASTM A 388	NOTE 1	INSPN. REPORT	√	P	V	V	IF DIA or THK > 50mm
		Hardeness , surface defects after hardfacing and machine grinding	MA	DPT/MPI	100%	ASTM E -165 /E-709, No linear indication		MTC	√	P	V	V	
1.3	WIRE ROPE	Dimensional, type, construction ,	MI	measurement	100%	APPD. DRG./ DATA SHEET	APPD. DRG./ DATA SHEET	MFRS' TEST CERT.	√	P	V	V	
		EXAMINATION OF REPORT OF BREAKING LOAD CAPACITY	CR	Review of TC	100%	IS: 2266		MFRS' TEST CERT.	√	P	V	V	
1.4	HOOKS	MECH. , CHEM. PROPS.	MA	Lab analysis	100%	APPROVED DRG/DATA SHEET IS:15560		MFRS' TEST CERT.	√	P	V	V	
		U.T IF SHANK DIA > 50mm	CR	NDT	100%	ASTM A 388	NOTE 1	INSPN. REPORT	√	P	V/W	V	SHANK PORTION ONLY
		Dimension & PROOF LOAD TESTING	CR	Measurment , PROOF LOAD TEST	100%	APPROVED DRG/DATA SHEET / IS:3938 / IS:15560		QCR	√	P	V/W	V	IF REQUIRED BY END CUSTOMER.
		DPT AFTER PROOF LOAD	CR	NDT	100%	ASTM E-165	NO CRACKS	INSPN. REPORT	√	P	V/W	V	
1.5	SHEAVES	MECH	MA	Tensile & hardness	1/lot	Approved drgs		MTC/IR	√	P	V	V	

		MANUFACTURERS NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT		1X660 MW UPRVUNL PANKI TPS EXTN.			
		AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE		ELECTRIC WIRE ROPE HOIST			
						REV	0	CONTRACT No					
						DATE	Mar, 2017	CONTRACTOR		BHEL-PEM			
						PAGE	1 of 4						
Sl.No	COMPONENT & OPERATIONS	CHARACTERISTICS	CATEGORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY		REMARKS	
1	2	3	4	5	6	7	8	9	D*	M	C	N	11
1.6	CASTING FOR BEARING PLATED, ROPE GUIDES, PULLEYS ETC	CHEMICAL & MECHANICAL	MAJOR	LAB ANALYSIS	1/LOT	APPROVED DRG/MFG STANDARD	APPROVED DRG/MFG STANDARD	LAB REPORT	√	P	V	V	
2.0	IN-PROCESS												
2.1	Welding process capability and welder skill	WPS,PQR & WPQ	MA	Welding procedure approval and Welder performance qualification in accordance with ASME Section IX	100%	ASME Section IX		WPS,PQR & WPQ		P	V	V	In case approved WPS/PQR/WPQ from BHEL/NTPC/EIL/LLOYDS/TPL available, then documents/records to be submitted for verification during inspection, else, Vendor shall get the approval of Welding Procedure / Welder from the
2.2	Welding of trolley, rope drum etc	Fillet weld	MA	DPT	10%	ASTM E165 or Eq/ No cracks or linear indication		INSPN. REPORT	√	P	V	V	
		Butt welds	MA	RT, DPT	100%	ASME SEC VIII, DIV 1, UW 51/52		RT FILM & REPORT	√	P	V	V	100% RT for butt weld in tension and 10 % in compression. 100% RT on butt weld of rope drum
		DPT AFTER STRESS RELIEVING OF ROPE DRUM	MA	NDT	100%	ASTM E-165 NO CRACKS		INSPN. REPORT	√	P	V	V	
2.3	NDT OF LOAD BEARING BUTT WELDS (IF ANY)	WELD QUALITY OF BUTT WELDS IN TENSION	CR	PT & RT	100%	ASME SEC. VIII DIV. I	ASME SEC. VIII DIV. 4 . CLUW-51 FOR RT APPENDIX -8 FOR PT	INSPN. REPORT ND FILM	√	P	W	V/W	FILMS TO BE REVIEWED BY BHEL & END CUSTOMER/THIRD PARTY. DPT SHALL BE CHP .
2.4	GEAR BOXES												
	COMPLETE ASSEMBLY	OVERALL DIMENSIONS. LEAK TEST, REDUCTION RATIO, BACK LASH AND CONTACT PATTERN	MA	MEAS./VISUAL	100%	MFG. DRG./KERSON E TEST	MFG. DRG./NO LEAKAGE WHEN FILLED	INSPN. REPORT	√	P	V		
	NO LOAD RUN TEST FOR 4 HRS	CHECK FOR OIL LEAKAGE, VIBRATION, NOISE ,TEMP. RISE. REDUCTION RATIO, BACKLASH , CONTACT PATTERN	MA	PERFORMANCE	100%	APPROVED DRGS /No leakage,Noise 85dbA maxat 1 mtrs, vibration 75 microns max, oil temp rise 20 deg above ambient max		- DO -	√	P	V	V	
3.0	ELECTRICALS												
1	MOTORS & CABLES	Make, type , rating	MA	Visual /measurment	100%	Apprvd drg	IS 325 / IS:3938	IR, MTC	√	P	V	V	For motor refer Note: 2
		ROUTINE TESTS											
3	LIMIT SWITCHES,SFU, ISOLATOR/ O/L RELAY, MCB, FUSES,PUSH BUTTONS,CONTACTOR, INDICATING LAMBS etc	Make , type , rating, functional, Continuity	MA	Review of TC	100%	Approved drgs		IR	√	P	V	V	
4	BRAKES	Make , type , rating, HV/IR, Functional test	MA	Review of TC	100%	Approved drgs		IR, MTC	√	P	V	V	
5	DSL	Make , type , rating, dimension	MA	Review of TC	100%	Approved drgs		IR	√	P	V	V	
6	Control transformer	Make , type , rating, input/output	MA	Review of TC	100%	Approved drgs		IR	√	P	V	V	

		MANUFACTURERS NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT		1X660 MW UPRVUNL PANKI TPS EXTN.			
		AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE		ELECTRIC WIRE ROPE HOIST			
						REV	0	CONTRACT No					
						DATE	Mar, 2017	CONTRACTOR		BHEL-PEM			
						PAGE	1 of 4						
Sl.No	COMPONENT & OPERATIONS	CHARACTERISTICS	CATEGORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
									D*	M	C	N	
1	2	3	4	5	6	7	8	9		**	10		11
7	CONTROL PANEL, PENDANT SWITCH	* FIXING OF COMPONENTS WIRING MARKING CONTINUITY * FUNCTIONAL TEST * IR & H.V. TEST * IP - PROTECTION TEST * PAINT SHADE, THICKNESS, SHEET THICKNESS, ADHESION TEST	MA	VISUAL/MEASUR	100%	APPD.DRG. WIRING DIAGRAM,	APPD. DRG. WIRING DIAGRAM,	IR	√	P	V	V	
8	VVVF DRIVES (IF APPLICABLE)	MAKE , TYPE , RATING , ROUTINE TESTS	MA	VISUAL/ VERIFY	100%	APPROVED DRAWINGS	APPROVED DRAWINGS	MTC	√	P	V	V	
4.0	FINAL INSPECTION												

		MANUFACTURERS NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT		1X660 MW UPRVUNL PANKI TPS EXTN.			
		AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO		PACKAGE	ELECTRIC WIRE ROPE HOIST				
						REV	0	CONTRACT No					
						DATE	Mar, 2017	CONTRACTOR	BHEL-PEM				
						PAGE	1 of 4						
Sl.No	COMPONENT & OPERATIONS	CHARACTERISTICS	CATEGORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY				REMARKS
1	2	3	4	5	6	7	8	9	D*	M	C	N	11
4.1	COMPLETELY ASSEMBLED HOIST	1. COMPLETENESS, CORRECTNESS, WELD QUALITY, OVERALL DIMENSIONS	MA	VISUAL, MEAS	100%	APPD. DRG.	APPD. DRG.	MNFRS' TEST CERT.	√	P	W	V	CHP
4.2	ASSEMBLED HOIST PERFORMANCE WITH ACTUAL CONTROL PANEL, AND PENDENT PUSH BUTTON	1. LOAD TEST	CR	LOAD TEST at SWL	100%	IS:6547 / IS:39	IS:6547 / IS:3938	MNFRS' TEST CERT.	√	P	W	V	CHP
		2. HOISTING & LOWERING SPEED, PERFORMANCE OF CONTROLLERS SWITCHES CONTACTORS, RELAYS AND OTHER CONTROL DEVICES CORRELATIONS OF CIRCUITS AND INTERLOCKS AND SEQUENCES OF OPERATION , CURRENT MEASUREMENT,LIMIT SWITCH OPERATION.	CR	MEAS & VISUAL	100%	IS:3938, TECH SPEC.	TECH SPEC.	MNFRS' TEST CERT.	√	P	W	V	CHP
		3. OPERATION OF ALL PROTECTIVE DEVICES	CR	VISUAL	100%	TECH SPEC	TECH SPEC.	MNFRS' TEST CERT.	√	P	W	V	CHP
4.3	OVER LOAD TEST	OVER LOAD TEST INCLUDING HOLDING CAPACITY OF BRAKES, LIFTING LOAD FROM MID AIR, SOUNDNESS OF WELD AFTER OVERLOAD	CR	TEST AT 125 % OF-SWL	100%	IS:3938	IS:3938	INSPN. REPORT	√	P	W	V	CHP
5	PAINING												
5.1	PRIMER & FINISHING AND SHADE	Examination - Shade , DOP by paper insertion method	MI	visual	100%	DRG. & DATA SHEET & RELV. IS SPEC.		MNFRS' TEST CERT.		P	V		
		DFT	MA	measurement	Sample					P	V		
6	PACKING	STURDINESS, PROTECTION MARKING	MA	VISUAL	100%	MFG STD	MFG STD			P			
NOTE:													
1	When back wall echo is set to 100% in sound area then a) defect echo shall not exceed 20% b) Back echo shall be minimum 80% in any area.												
2	Less than 30 KW. Acceptance of motor less than 30 KW is based on COC of the manufacturer & the contractor confirming as follows : It is hereby confirmed that the above mentioned motor/motors was/were manufactured taking care of specific requirement regarding ambient temp, voltage & frequency variation, hot start, pull out torque, starting KVA/KW, temp rise, distance between centerof stud and gland plate and tested in accordance with approved drawing/data sheet.												
		LEGNDS											
		* RECORDS IDENTIFIED WITH 'TICK' SHALL BE ESSENTIALLY INCLUDED BY MANUFACTURER IN QA DOCUMENTATION.											
		** M: MANUFACTURER/SUBCONTRACTOR											
		C: BHEL/BHEL NOMINATED THIRD PARTY INSPECTION AGENCY											
MANUFACTURER/ SUB CONTRACTOR		N: CUSTOMER/CUSTOMER'S CONSULTANT/CUSTOMER'S APPOINTED THIRD PARTY											
		'P'- PERFORM", 'W'- WITNESS AND 'V'- VERIFICATION											
SIGNATURE		' CHP' CUSTOMER HOLD POINT					REVIEWED BY		NAME & SIGN OF APPROVING AUTHORITY &SEAL				



**1x660MW PANKI STPP
AIR CONDITIONING SYSTEM
CUSTOMER SPECIFICATIONS**

SPECIFICATION No: PE-TS-426-553-A001

SECTION : I

SUB-SECTION : C 2

REV. 00

**SECTION: I
SUB-SECTION: C 2
CUSTOMER SPECIFICATIONS**



**1x660MW PANKI STPP
AIR CONDITIONING SYSTEM
CUSTOMER SPECIFICATIONS
TECHNICAL REQUIREMENT**

SPECIFICATION No: PE-TS-426-553-A001

SECTION : I

SUB-SECTION : C 2A

REV. 00

SECTION: I

SUB-SECTION: C 2A

**CUSTOMER SPECIFICATIONS
TECHNICAL REQUIREMENT**

25.0 AIR CONDITIONING AND VENTILATION SYSTEM**25.1 General**

The air conditioning and ventilation system shall be provided so as to achieve inside design conditions for proper performance of equipment and personnel.

The extent of supply under this contract includes all items required to complete the intent of the contract notwithstanding the fact that such items may have been omitted from the specification or drawings.

The air conditioning and ventilation system shall also meet the requirements specified elsewhere in the specification.

25.2 Codes and Standards

The design, manufacture and performance of equipment shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipments are to be installed. Nothing in this specification shall be considered to relieve the bidder of this responsibility.

Unless otherwise specified, equipment shall conform to the latest applicable Indian or IEC standard. Equipment complying with other authoritative standards such as British, USA, ASHRAE etc. will also be considered if it ensures performance equivalent or superior to Indian Standard.

25.3 Design Criteria for Air conditioning system**25.3.1 Design ambient conditions**

Season	Dry Bulb Temp (° C)	Wet Bulb Temp (° C)
Summer	42.8	25
Monsoon	36.1	28.3
Winter	7.2	5.6

For other details of ambient conditions, refer published documents for meteorological data for Plant site. (Refer Volume II)

25.3.2 All equipments of air conditioning system shall be designed for continuous duty.

25.3.3 All air conditioned areas like control room, control equipment rooms, service building, administrative building shall be maintained as per conditions indicated below :.

Dry bulb temperature : 24± 1.0°C
Relative humidity : 50± 5%

25.3.4 One Common Central chilled water plant to serve the different air conditioned areas of the Turbine building areas consisting of :

- 1 x 100% capacity VAM with all accessories, PRDS with plunger pump and piping, Motorized Steam flow regulating valve with strainer, Condensate tank with steam trap and other accessories Condensate transfer pumps with accessories, associated steam piping with thermal insulation, all fittings and control valve. This VAM will operate normally.
- 2 x 50% capacity Water cooled Semi- hermetic Screw Chillers, which will be kept as stand-by units.
- 3 x 50% capacity Condenser Water (CW) Pumps (2R+1S)
- 3 x 50% capacity Chilled Water (CHW) Pumps (2R+1S) with VFD
- 3 x 50% capacity Induced Draft Cooling Towers of FRP construction with FRP basin (2R+1S)
- One no. Make-up water tank with two nos. (1R+1S) Make-up water booster Pumps, if required, with associated piping & valves
- One no. Non Chemical water treatment device at the common outlet of CW pumps.
- One no. insulated Chilled Water Expansion tank
- Condenser Water piping and insulated Chilled Water piping with valves & other accessories
- Fan coil units (FCU's) for AC Plant Control room and small rooms (if any), with all standard accessories
- Required nos. of suitable capacity Tube Axial Exhaust fans shall be provided for Ventilation system of Chilled water Plant room
- Necessary electrical equipment like MCC, Local Starter Panels (LSP) and Push-button Stations, power cabling, control & Instrumentation cabling, grounding and controls and instrumentation including Central Control cum Annunciation Panel (CCAP)

Of these water chilling units, VAM will be normally operating and Screw Chillers will remain as stand-by. Of these three chilled water pumps, condenser water pumps and Cooling Towers, one unit will act as stand-by. Clarified water shall be used as the make-up of cooling tower after being treated in the Non-Chemical Water Softening equipment.

The condenser cooling water shall be circulated through the Condensers of VAM / Chiller Units and Cooling Towers by means of Centrifugal type Condenser Water (CW) Pump sets. The chilled water produced by the chilling unit/s shall be circulated to the Air Handling Units (AHU) / FCUs by centrifugal type Chilled Water (CHW) Pump sets. At the AHUs / FCUs, air from the service space will be cooled by exchanging heat with the chilled water through cooling coil to maintain the specified design conditions, as indicated above. The flow of chilled water through the cooling coil of each

AHU/FCU will be controlled by means of a motorized 3-way mixing valve / 2-way diverting valve (for FCU only) provided with the cooling coil outlet. Such control valve will operate with the sense of the Temperature sensors placed in the RA path / room (in case of FCU) through Central Control Panel.

The Cooling capacity of the VAM will be controlled with the automatic operation of Steam flow regulating valve with the sense of chilled water temperature at inlet to the chiller. Such control will be actuated by the Built-in Microprocessor based Control panel of VAM.

- 25.3.5 The fresh air quantity for air conditioned areas like control room/ control equipment rooms/ UPS etc shall be 0.45 m³/ min/ person or 1 air change per hour whichever is greater. However for areas like service building, administrative building etc, quantity of fresh air shall be minimum 1.5 air changes per hour.
- 25.3.6 Lighting load shall be minimum 2 Watts per Ft² or actual whichever is higher.
- 25.3.7 The occupancy for general area shall be minimum one person per 3 Sq. M and for conference room the same shall be one per 1.5 Sq. M. In the control rooms, control equipment rooms etc, the occupancy may be one person per 20 Sq. M (Minimum).
- 25.3.8 In air conditioning system the return air shall be through ducts and use of plenum space for return air shall be avoided. Further, for Service / Administrative / Training Centre Building where various floors are air conditioned and no intermediate or intervening floor are left non air conditioned, the space above false ceiling shall be used as return air plenum.
- 25.3.9 The supply & return air ducts shall be provided with automatic (motorised) fire dampers (of 90 minutes fire rating) at locations where ducts pass through walls & floors. Operation of these dampers shall be interlocked with the fire alarm system and shall also be possible to operate manually from the remote control panel. Required electrical contacts shall be provided in control panel of A/C plant by the contractor for further wiring upto fire alarm panels.
- 25.3.10 Soft water make up for complete air conditioning ; system shall be provided by the bidder.
- 25.3.11 Design Chilled water flow shall not be less than 0.7 Cu. M / Hr per TR of air-conditioning load and design Condenser cooling water flow shall not be less than 1.0 Cu. M / Hr per TR air-conditioning load.
- 25.3.12 Coil face area of Air Handling Units shall be designed considering a face velocity of not more than 2.5 M/ Sec. Water piping shall be sized for a maximum velocity of 2.0 m/sec. However gravity flow/pump suction line shall be sized for a maximum water velocity of 1.5 m/sec. Air distribution system shall be sized to have constant frictional drop along its length and velocity through ducts shall not exceed 7.6 m/s.
- 25.3.13 Requirement of under deck Insulation (for A/C area)

- 25.3.14 Under deck insulation of 50 mm nominal thickness of glass wool (32 kg/cum) or rock wool (48 kg/cum) shall be provided if
- Non A/ C area is located just above the A/C area. In this case, under deck insulation shall be provided underneath the ceiling of A/C area.
 - Non A/ C area is located just below the A/C area. In this case, under deck insulation shall be provided underneath the ceiling of Non A/C area.
- 25.3.15 **For air handling unit (AHU) serving air conditioned area, the dehumidified air shall be filtered at two different stages i.e. pre(coarse) filter (with efficiency 90% down to 10 microns) followed by fine filter (efficiency 99.5% down to 5 microns) before discharge it to air conditioned space. All fresh air supply shall also be filtered using pre & fine filter.**
- 25.3.16 A minimum design margin of 10% shall be considered in design of AC Plant capacity for each area, 20% design margin shall be considered for the cooling tower capacity over the selected A/C capacity provided. Head of the pumps shall take into account minimum 10% margin on friction head. For pumps continuous motor rating (at 50 Deg C ambient) shall be at least 10% above the maximum load demand of the pump in the entire operating range.
- 25.3.17 For areas like ESP control rooms, water system control room, where A/C load is of the order 25-60 TR, direct expansion (D-X) type condensing unit shall be provided depending on the availability of space/ layout etc. For areas where A/C load is of the order of 15-25 TR, duct able split/ packaged A/C shall be provided. Smaller areas which are away from the D-X type condensing unit/ central chilling units which may require air conditioning upto 15 TR rating shall be served with Hi – Wall split/ Cassette air conditioner units as per requirement. For static excitation Control Room (if applicable) precision air conditioners of required capacity shall be provided.
- 25.3.18 Valves at discharge of pumps, outlet of chillers and inlet of cooling towers or any other valve in the system shall be motor operated type for remote operation of the air conditioning system.
- 25.3.19 Air conditioning system for Service Building, Administration Building & Training Centre Building shall be designed with ECBC code to make it "Green Building". Mandatory requirements of ECBC to be followed for A/C equipments of Service Building Administration Building & Training Centre Building:
- Coefficient of performance (COP) of the chillers (water cooled and rotary screw & scroll chillers)

S. No.	Chiller Capacity	Min. COP
1	Upto 150 TR	4.7
2	$\geq 150 \text{ TR} < 300 \text{ TR}$	5.4
3	$\geq 300 \text{ TR}$	5.75

- Coefficient of performance (COP) of air cooled chiller

S. No.	Chiller Capacity	Min. COP
1	Upto 150 TR	2.9
2	≥ 150 TR	3.05

- c) Pumping System : chilled water and condenser water pumping system should be variable flow type. i.e pumps should be VFD driven.
- d) AHU : AHU should be variable flow type. i.e should be VFD driven.
- e) Refrigerant : refrigerant should be CFC/ HCFC free.
- f) Controls & sensors : sensors like occupancy sensors, CO2 sensors, daylight sensors etc shall be provided for optimum use of A/C system.
- g) Insulation for supply and return air ducts : Supply and return ducts shall be insulated.
- h) All types of insulation used for HVAC application shall be CFC/ HCFC free.

25.3.20 During normal operation period, all the working equipment shall run on AC power supply. However, in case of complete black out condition, DG sets being provided are required to cater the load of some of the air conditioning equipment so that control rooms and CER remain air conditioned. The equipment to run on the DG set are :

- 1 no. Chilling machine
- 1 no. Chilled water pump
- 1 no. Condenser water pump
- 1 no. Cooling tower fan
- AHU's for CR & CER
- 1 no. Fresh air fan.

25.3.21 Redundancy of Equipments

- **For main plant areas (control room, control equipment room, UPS room and SWAS room)**
- Vapour compression type Chilling Units - 2 x 50%
- Condensing Unit - 3 x 50%
- Condenser water pumps - 3 x 50%
- Chilled water pumps - 3 x 50%
- FRP cooling towers - 3 x 50%
- Air handling units (DX type) - 2 x 100% (Per AHU room)
Air Handling Units 2 x 100% Multiple – AHUs of similar (Chilled water type) capacities per AHU room. AHU shall be Variable

Voltage Frequency Driven
(VVVFD).

- **ESP Control Building**

- Water Cooled ,
Condensing units - 2 x 100%
- Condenser water pumps - 2 x 100% (if applicable)
- FRP cooling towers
(With VVFD Fan) - 2 x 100% (if applicable)
- Air handling units variable
voltage frequency driven (VVVFD) - 2 x 100% AHU shall be

- **Service Building**

- Screw/ Centrifugal Type Water Chilling units 2 x 100%
- Condenser water pumps (with VVFD) - 2 x 100%
- Primary Chilled water pumps - 2 x 100%
- FRP cooling towers (with VVFD Fan)- 2 x 100%
- Air handling units – No Standby- AHU shall be variable voltage
frequency driven (VVVFD)

- **Administration Building**

- Screw/ Centrifugal Type Water Chilling units 2 x 100%
- Condenser water pumps (with VVFD) - 2 x 100%
- Chilled water pumps - 2 x 100%
- FRP cooling towers (with VVFD Fan)- 2 x 100%
- Air handling units – No Standby- AHU shall be variable voltage
frequency driven (VVVFD)

- **Training Centre Building**

- Water cooled condensing unit 2 x 100%
- Condenser water pumps (with VVFD) - 2 x 100%
- FRP cooling towers (with VVFD Fan)- 2 x 100%
- Air handling units – No Standby- AHU shall be variable voltage
frequency driven (VVVFD)

- 100% standby shall be provided for areas served by precision/ cassette/ Hi wall split type AC for all other offsite control rooms.
- Fresh air fans shall be 2 x 100% for each AHU room.

25.3.21 The AHU Rooms shall be located in the TG building appropriately as per layout developed. AHU rooms shall be provided on each floor for service building & administration building. AC Plant Room shall be located in TG building and ground floor of service building & administration building.

25.5 Systems to be Furnished**25.5.1 Air Conditioning System**

The areas to be air conditioned shall be as follows :

- a) Control rooms/ Central Control rooms, Control Equipment rooms, UPS & Battery Charger Room, SWAS Room etc.
- b) ESP Control Rooms
- c) FGD CONTROL ROOM
- d) ~~Switchyard Control Room.~~
- e) Service Building: Various office areas, entrance lobbies, visitor & VIP lounge, reception area etc.
- f) Administration Building: Various office areas, entrance lobbies, visitor & VIP lounge, reception area, Canteen etc.
- g) Training Centre
- h) Fire Water Pump House Control room.
- i) CPU Regeneration Control room.
- j) ~~Ash Water Pump House control Room.~~
- k) ~~Ash Slurry Pump House control room.~~
- l) Raw Water Intake Pump House Control Room
- m) Fuel Oil Pump House Control Room.
- n) ~~HCSB Pump House Control Room~~
- o) ~~Ash Handling Electrical~~
- p) CT Switchgear Control Room.
- q) ~~Static Excitation Control room~~ (if applicable).
- r) ~~Coal Handling Control rooms.~~
- s) All Laboratories (chemical, C&I, Electrical etc.)
- t) Various remote I/O rooms with ~~PT Plant~~, Raw Water service water, ~~DM & CW Chemical Plant~~, CPU Service Vessels, ~~CW Chlorination & CW Treatment, ETP etc.~~

25.7 EQUIPMENT DESCRIPTION**25.7.1 VAPOUR ABSORPTION MACHINE (CHILLER UNIT)**

Package type Steam fired, Double effect / stage Vapour Absorption Machine (Chiller Unit) consisting of Evaporator, Absorber, High temperature Generator, Low temperature Generator, Condenser, Heat Exchangers, Refrigerant Pump with Drive Motor, Absorbent Pump with Drive Motor, Purge Unit, all internal pipes with valves, Steam trap, fully charged with refrigerant and Lithium Bromide Absorbent and built in Electrical and Controls etc.

Evaporator and Absorber section shall be thermally insulated as per manufacturer's standard.

Following accessories are to be provided with the Vapour Absorption Machine :

- a) Steam flow regulating valve (modulating type) and operating thermostat (modulating type)/ operating temperature sensor.
- b) Necessary Pressure Reducing and De-superheating Station (PRDS) with Plunger pump and associated piping with fittings.
- c) Steam piping with isolating valve, fittings, strainer, safety valve, pressure gauges and other accessories as required and as shown in the Schematic Diagram, 50mm thick fibre-glass / mineral wool / equal thermal insulation covered with 30G GI sheet, hangers/supports.
- d) Condensate from the unit shall be collected in a condensate storage tank and shall be returned to the desired point through Pumps (one running & one stand by). Condensate piping with isolating valve, fittings, steam trap, 25mm thick thermal insulation of fibre glass / mineral wool or equal covered with 30 G GI sheet and hangers / supports.

25.7.2 VAPOUR COMPRESSION TYPE MACHINES

Each chilling unit shall comprise of compressor with drive motor, Condenser, Water Chiller/evaporator, and other accessories such as supporting structure, vibration isolators, insulation, piping, valves, instrumentation, microprocessor / ^{DCS} based Control etc. Chilling unit shall have stepless capacity control. The screw/centrifugal compressor based chilling unit to be supplied shall be ARI /Eurovent/Equivalent standard certified.

25.7.3 Chilling Unit/Condensing Unit

Type		Water cooled type (Chillers for main plant shall be with multiple compressors)
Vibration isolators	:	Steel spring/ Neoprene rubber cushy foot/ neoprene serrated rubber pad type with isolation efficiency not less than 85%.
Compressor Type	:	a) Compressor shall be open/ semi hermetic/ multiple hermetic in case of Screw or centrifugal type operating on R134a/R407C refrigerant complete with accessories and automatic control facilities
Type of drive	:	Motor driven, through direct/ V Belt along with star delta/ double delta starter
Accessories	:	High / Low pressure cut outs, Oil pressure switches, relief valves, Pressure gauges at each stage, lube oil/Control oil pressure gauges, Suction and discharge stop valves, Muffler, Crank Case heaters, Oil filters, Magnetic oil Separators, Temperature indicators for Lube oil/ Heaters, Oil level indicators, Safety thermostat for crank case heater, Vibration Isolators etc.
Condenser		
Type	:	Water cooled, shell and tube type.
Fluid	:	Shell side – Refrigerant
	:	Tube side - Water
Capacity	:	To match with respective compressor and to provide at least 2°C sub-cooling. To store full charge of refrigerant.
Design fouling Factor	:	Not less than 0.0002 (in MKS units)
Shell material	:	Mild steel (IS:2062)/ SA 106 Gr B
Tube material	:	Replaceable seamless copper (ASME B-111)
Fin material	:	Copper
Accessories	:	Purge and drain connections, relief valves, liquid line shut-off valves, refrigerant filling charging, flow switches, Isolating valves, Pressure & temperature indicators at inlet and outlet etc.
Refrigerant	:	For chilling Unit- R 134a/ R – 410A/ R 407-C

		or any other environment friendly refrigerant.
Steel structure	:	The complete condensing/ chilling unit shall be mounted on steel structure and shall be provided with necessary vibration isolators
Inlet Temperature	:	33 Deg C
Leaving Temperature Differential	:	Maximum 5 Deg C
Chiller		
Type	:	Shell and tube type
Superheating of	:	At least 2 ⁰ C
Design Fouling Factor	:	Minimum 0.0001 (MKS units)
Fluid	:	Shell side - Refrigerant
	:	Tube side - Water
Capacity	:	To match with respective plant capacity.
Shell material	:	Mild steel (IS:2062)/ SA 106 Gr B
Tube material	:	Plain Tube internally/ externally finned copper as per manufacturer's standard
Fin material	:	Integral
Accessories	:	Purge and drain connections, Isolating valves, flow switches, Pressure & temperature indicators at inlet and outlet, Anti-freeze thermostats, thermostatic expansion valve or float assembly as applicable, pilot solenoid valve, Relief valves, Operating thermostats for capacity control, supporting frame etc.
Steel Structure	:	The complete condensing/ chilling unit shall be mounted on steel structure and shall be provided with necessary vibration isolators.

25.7.3

Condensing Unit (Air Cooled/ Water cooled D-X Type)

Type	Air Cooled/Water cooled type.
Vibration isolators	: Steel spring/ Neoprene rubber cushy foot/ neoprene cushy rubber pad type with isolation efficiency not less than 85%.
Compressor Type	: Compressor shall be screw / scroll, serviceable, either open type or hermetic type or semi hermetic type with load, unload and

	:	automatic capacity control (minimum 3 steps)
Type of drive	:	Motor driven, direct or through V belt.
Refrigerant	:	For chilling Unit- R 134a/ R – 410A/ R 407-C or any other environment friendly refrigerant.
Accessories	:	High / Low pressure cut outs, Oil pressure switches, relief valves, Pressure gauges at each stage, lube oil/Control oil pressure gauges, Suction and discharge stop valves, Muffler, Crank Case heaters, Oil filters, Magnetic oil Separators, Temperature indicators for Lube oil/ Heaters, Oil level indicators, Safety thermostat for crank case heater, Vibration Isolators etc.
Capacity	:	Minimum capacity shall be suitable for the identified/ selected at evaporating temperature and shall be indicated.

Note : upto 50 TR capacity chilling/ condensing unit can be of air/ water cooled type. However beyond this capacity unit shall be water cooled type only.

25.7.4 Air Handling Unit (AHU)

- a) Each AHU shall consist of casing, fan impeller section, cooling coil section, damper section, steel frame with anti vibration mountings (AVMs) having minimum 85% vibration dampening efficiency and flame retardant, water proof neoprene impregnated flexible connection on fan discharge. Isolation dampers at the suction and discharge of each AHU shall be provided, in case return air duct is directly connected to AHU. However, in case AHU room is used for return air, isolation dampers are required to be provided only at AHU discharge of each AHU. Pre-filter at the suction and fine (micro-vee type) filters at the discharge of each individual AHU, and heater section in the common discharge of AHUs.
- b) The casing of AHUs shall be of double skin construction. Double skin sandwich panels (inside and outside) shall be fabricated using minimum 0.63 mm (24g) galvanized steel sheet (thickness of galvanization as per manufacturer's standard) , with 25mm thick polyurethane foam insulation of minimum 38 Kg/Cum density in between. Suitable reinforcements shall be provided to give structural strength to prevent any deformation/buckling.
- c) Face and bypass dampers (motor operated for DX type plant) of opposed blade type shall be provided. Dampers shall be made of 16 gauge G.S sheet metal (class 275 of IS: 277). The area of the bypass section shall be minimum 30% of the coil face area. Damper operating linkage and the operating motor shall be located outside the casing. Each AHU shall be provided with motorized volume control damper at air discharge.

- d) Cooling coil shall be of seamless copper tubes with Aluminium fins firmly bonded to copper tubes and shall be provided with suitable drains and vents connections.
- e) All filter plenum shall be provided with a walking platform inside the plenum chamber for filter cleaning purpose. Inspection door shall be provided at the plenum chamber and a removable type ladder shall be attached to plenum.
- f) Air handling units/centrifugal fans shall be provided with Variable frequency drive (VFD) and velocity sensor/static pressure sensor in supply air path to adjust air flow automatically. The minimum efficiency of VFD at full load shall not be less than 96%.
- g) Sloping condensate drain pan shall be made of minimum 1.2 mm thk stainless steel sheet. It shall be isolated from bottom floor panel through 25 mm thk heavy duty treated for fire (TF) quality expanded polystyrene or polyurethane foam. Drain pan shall extend beyond the coil.

25.7.5 Centrifugal Fan for AHU

a)	Fan Type	:	Double width double inlet (DWDI) centrifugal type.
b)	Fan impeller	:	Backward curved blade & centrifugal type.
c)	Casing material	:	GI/ Mild steel with minimum thickness of 3 mm.
	Impeller material	:	Carbon Steel
d)	Shaft	:	EN 8 Steel
e)	Fan bearings	:	Self aligning type, permanently lubricated, heavy duty with a design life of 10,000 operating hours.
f)	Critical speed	:	First critical speed of rotating assembly shall be at least 25% above the operating speed.
g)	Drive	:	Motor driven. With removable belt guard.

25.7.6 Mixing Box

Mixing box shall be complete with fresh and return air dampers. Mixing box shall be provided whenever the return air is ducted back to the AHU.

25.7.7 Pan Humidifier

Pan humidifier shall be made of 22 gauge SS 304 tank, duly insulated with 25 mm thick resin bonded fibre glass insulation (min 24 kg/cum density) with 0.5 mm GSS cladding. The humidifier shall be complete with stainless steel immersion heaters, safety thermostat, float valve with stainless steel ball, sight glass, overflow and drain connections, steam outlet nozzle and float switch. Step controller shall be provided for switching on/ off heater banks as per system requirement.

25.7.8 HI- Wall Split/ Cassette/ precision air Conditioners

25.7.8.1 Hi Wall split/ Cassette air conditioners shall in general consist of the following :

1. Casing.
2. Hermetically sealed rotary/ scroll compressor.
3. Condenser.
4. Evaporator and condenser cooling fan.
5. Cooling coil.
6. Filters.
7. Piping, valves, refrigerant strainer etc.
8. Control, instruments, control panel/ starter panels.
9. Vibration isolation pads as required.
10. Refrigerant as per manufacturer's standard.

25.7.8.2 Indoor unit of ceiling mounted Cassette type unit (Multi Flow Type):

The housing of the unit shall be powder coated galvanized steel. All the indoor units regardless of their difference in capacity should have same decorative panel size for harmonious aesthetic point of view.

Unit shall have four way supply air grills and return air grill in centre.

Each unit shall have high lift drain pump and very low operating sound.

25.7.8.3 Precision Packaged Air Conditioners

Precision air conditioning system shall be designed for high sensible heat ratio. The system shall contain scroll compressor, evaporator blower & coil, heater, humidifier, air cooled condenser, externally equalized electronic expansion valve etc. All items except condenser shall be contained within the cabinet of the unit, which shall be placed inside room. Air cooled condenser shall be located outdoor.

- i. Compressor shall be high efficiency (EER should be not less than 3.5) scroll design and shall have inbuilt overloads. It shall be mounted on anti vibration mountings.
- ii. The condenser shall be water cooled shell and tube type having replaceable seamless copper tubes with integral fins and removable head. The condenser shall be provided with fusible relief plug and all other accessories as required.
- iii. The air handling fan shall be centrifugal type with forward curved blades and complete with belt drive and electric motor. Each PAC shall be provided with motorized volume control damper at air discharge.
- iv. Evaporator coil : The unit shall be fitted with large surface area cooling coil with split coil mechanism/ or any other equivalent method for dehumidification. The distance between fins shall not be less than 1.8 mm and face velocity shall not exceed 2.5 m/s.
- v. Filters- Filter chamber shall be integral part of the system & withdraw able from the unit. Filter shall be capable of filtering air to 95% down to 5 micron efficiency.
- vi. Refrigerant piping shall be heavy gauge copper or IS:1239 heavy class seamless MS pipe complete with thermostatic expansion valve, liquid line shut-off valve, high and low pressure gauges.
- vii. Refrigeration Circuit : The circuit shall be direct expansion type. It shall include a manual reset HP and auto reset LP switch, filter drier, charging port, electronic expansion valve, sight glass etc.
- viii. The indoor unit shall have forward/ backward curved centrifugal type double inlet width statically and dynamically balanced fans. Fan shall be electronically commutated type fan.
- ix. Electrical heating : The heating circuit shall include dual safety protection through loss of air and temperature controls.
- x. Air Cooled Condensers : The equipments shall be designed for 47 Deg C outside ambient condition. Low ambient refrigeration controls (LARC) shall also be available. The condenser frame shall be constructed from heavy duty galvanized steel and in corporate copper tube & aluminium fins.
- xi. Cabinet Construction:

The frame & panel shall be constructed of heavy gauge Zinc annealed corrosion resistant sheet steel. The fan section shall be insulated with fire retarded insulation. The cabinet shall be powder coated and have a textured finish.
- xii. Humidifier

Humidification shall be provided by boiling water in a polypropylene steam generator. The steam shall be distributed evenly into bypass air stream of precision air conditioning unit. Humidifier shall be fitted with an auto flushed cycle activated on demand from the control system. Further, humidifier shall be fully serviceable with replaceable electrodes. Waste water shall be flushed from the humidifier by initiation of water supply solenoid valve.

- xiii. The Units shall be designed for 68 DBA at 1 meter from the unit outlet quiet operation with all moving parts mounted on anti-vibration mounting and carefully balanced to ensure minimum vibration.
- xiv. The refrigerant shall be R-407C/ R-134a/ R-410A or any other environment friendly refrigerant.
- xv. All necessary operating and safety controls shall be provided including the following:

Controls:

The controls shall be of microprocessor based programmable with PID (Proportional, integral and derivative control logic) controller. The controller shall have a LCD display screen, which shall be visible from the front of the unit without removing any covers/external panels. This LCD display screen should show the following information / data:

- a) Modes of operation (cooling, heating, humidification & de-humidification).
- b) Simultaneous graphical displays of set temperature and actual temperature and set Relative Humidity and actual Relative Humidity.
- c) Date, time and unit identification display.
- d) System component Auto / Manual status display on the controller screen.
- e) Backup battery charge status display on the controller screen.
- f) Visual system alarm indication (along with mutable audio alarm as well).
- g) Alarm display menu (incorporating various system alarms like temperature high / low, humidity high / low, Compressor HP/LP, Wet floor and loss of air flow conditions).
- h) 48 Hours temperature and relative humidity graph display menu.

- i) Programmable services interval indication display / alarm.

There should be a feature to enable operator to program the start-up and shut off of the system components (blower fan start / stop delay, first compressor start / stop delay, second compressor start / stop delay, etc.). Access to the controller settings shall be protected with passwords to prevent against unauthorized access.

Safety Protections:

The unit shall also incorporate the following protections:

- a) High pressure trip- Manual reset for each compressor
- b) Low pressure trip- Manual reset for each compressor.
- c) Single phasing preventers.
- d) Reverse phasing
- e) Phase unbalancing
- f) Phase failure
- g) Overload tripping (MPCB) of all components

Safety Interlocks:

Operation of heaters & humidifiers shall be possible only when blower fan is in operation.

Fire detection signal from fire detector system shall be able to switch off the package unit operation in event of fire in conditioned space.

- xvi. A suitable number of vibration isolation pads shall be provided for the packaged units.

25.7.9 Centrifugal Pumps

a) Type	:	Horizontal Centrifugal, Axially split type casing pump
b) Impeller	:	Closed type
c) Material of Construction	:	
i) Casing	:	2% Ni Cast Iron : IS:210 Gr. FG-260
ii) Impeller	:	Bronze IS:318 Gr-2
iii) Wearing rings	:	Bronze
iv) Shaft	:	SS 410
v) Shaft sleeve	:	SS 316
vi) Lantern ring	:	Brass / Bronze
vii) Packing	:	Asbestos free

viii) Base Plate	:	Carbon steel as per IS:2062
ix) Speed	:	Maximum 1500 rpm

For other requirements of pumps refer Chapter 34 of this volume.

25.7.10

Air Filters

a) Pre Filter

1)	Filter medium :		
	i)	Washable non-woven synthetic fibre or high density Polyethylene (HDPE) media having 18G GSS/ 16G Al alloy frame. The filter media shall be supported with HDPE mesh on air inlet side & Aluminium expanded metal on exit side or GI wire mesh on both sides.	
2)	Type		
		Flange/ Cassette	
3)	Other requirements (as applicable) :		
	a)	Suitable aluminium spacers be provided for uniform air flow;	
	b)	Casing shall be provided with neoprene sponge rubber sealing.	
	c)	Capable of being cleaned by water flushing.	
	d)	Density of filter medium shall increase in the direction of air flow in case of metallic filter.	
	e)	Filter media shall be fire retardant and resistant to moisture, fungi, bacteria & frost.	
4)	Efficiency :		
		Average arrestance of 90% to 10µm when tested in accordance with BS:6540/ASHRAE – 52 – 76/ EN-779.	
5)	Minimum thickness	:	50 mm
6)	Face Velocity	:	Not more than 2.5 m/sec.
7)	Pressure drop	:	Initial pressure drop - Not to exceed 5.0 mm WC at rated flow. Final pressure drop - Upto 7.5 mm WC.
8)	Location		
	a) Fabric type	:	1) At the suction of each AHUs
		:	2) At the suction of each Fresh air fan
		:	3) At suction of each supply air fan
		:	4) at suction of air washer & UAF (Water repellent nylon type)

b) Fine Filters (Microvee type)

1)	Type	:	Flange/ Cassette
2)	Construction	:	Washable non-woven synthetic fibre or high density Polyethylene (HDPE) media having 18G GSS/ 16G Al alloy frame. The filter media shall be supported with HDPE mesh on air inlet side & Aluminium expanded metal on exit side or GI wire mesh on both sides.
3)	Frame	:	Aluminium alloy of (minimum 16 gauge conforming to IS:737)
4)	Other requirements	:	a) A neoprene sponge rubber sealing shall be provided on either face of the filter frame. b) Capable of being cleaned by air or water flushing. c) Filter media shall be fire retardant and resistant to moisture, fungi, bacteria & frost.
5)	Efficiency	:	Average arrestance of > 99.5% to 5 μ m when tested in accordance with BS:6540/ASHRAE-52-76/ EN-779.
6)	Minimum thickness	:	150 mm or 300 mm.
7)	Face Velocity	:	Not more than 1.2 m/sec for 150 mm and not more than 2.4 m/sec. for 300 mm.
8)	Pressure drop	:	Initial pressure drop - Not to exceed 10 mm WC at rated flow ; Final pressure drop-Up to 25 mm WC.
	Location	:	i) At the discharge of each individual AHU. ii) At the discharge of each Fresh air fan. iii) At the discharge of each supply air fan having static pressure of 30 mm WC or more.

25.7.11 **Cooling Towers**

Type	Induced draft, cross or counter flow.
Capacity	120% of rated capacity of each cooling water pump.
Material of construction of Casing & Sump tank	F.R.P/ GRP
Fan	Cast Aluminium / FRP Propeller type and multi-blade aerofoil construction with adjustable pitch.
Fill	Non combustible PVC or Equivalent of light grey, cream or white colour.
Louvers	F.R.P / PVC / Aluminium.
Nozzles	Brass with chrome plating/Polypropylene.
Eliminators	In removable sections to reduce the drift loss to 0.2% of water flow.
Supporting structure	Mild steel with spray galvanisation or epoxy painting.
Strainer at water outlet	Plate strainer made of GI /SS wire mesh of 16 gauge.
Bird screen on top of tower	25 mm square made of GI/SS wire mesh of 16 gauge.
Ladder	Hot dip galvanised steel ladder for each tower.
Distribution Pipe (if any)	Galvanised MS pipe.
Accessories	a) Drain connection with isolation valve b) Make up connection with ball - float valve, back up gate valve and a bypass with a gate valve for manual operation. c) Overflow connection d) Equalizing connection to connect sump of all the towers wherever applicable. e) Access door in louvers / fan deck.

25.7.12 **Non- Chemical Type Scale Preventer**

The unit should be a non-chemical on-line type scale preventer not requiring any chemicals. Non-chemical water treatment system should prevent the formation of hard scale in cooling circuits of air conditioning equipment. It should work with a combination of Adsorption, and Turbulence. The inner core should be able to convert the hardness salts into colloidal particles. The unit should not require any electricity or any other source of energy. The unit should not have any recurring, operating and maintenance cost. The size of the unit shall be determined based on the water quality and water flow rate. The unit shall be installed in the condenser water circuit. The outer casing should be of stainless steel. The method of checking the performance of system through computer simulation shall be provided

25.7.13 Low Pressure Air Distribution System

- I) Through Galvanized sheet steel fabricated rectangular ducting shall be provided for the low pressure air distribution system. The Galvanised sheets shall confirm to 275 GSM IS-277 or Aluminium alloy (grade 19000/ SIC or 3100/ NS 3 of IS 737).

The thickness of rectangular ducts shall be as follows :

	Larger dimensions of Duct, mm	Thickness of GI sheet (mm)	Thickness of Aluminium sheet (mm)
a.	Upto 750	0.63 (24 G)	0.8
b.	751 to 1500	0.80 (22 G)	1.00
c.	1501 to 2250	1.00 (20 G)	1.50
d.	2251 & above	1.25 (18 G)	1.80

The thickness of round ducts shall be as follows :

	Diameter of Round Duct, mm	Thickness of GI sheet (mm)	Thickness of Aluminium sheet (mm)
a.	150 to 500	0.63	0.8
b.	501 to 750	0.80	1.00
c.	751 to 1000	0.80	1.00
d.	1001 to 1250	1.00	1.50
e.	1251 & above	1.25	1.80

25.7.13.1 Duct Fabrication & Supports

- Duct fabrication shall be as per the latest relevant BIS/ SMACNA standard.
- Ducts for AC system may be site fabricated or factory fabricated and installed at site. However in case of partly used factory fabricated ducts, vendor shall take back the unused ducts.
- The ducts routed inside the buildings with larger side greater than 2250 mm shall be supported by 16mm MS rods and 50x50x3 mm MS double Angles while those below 2250 mm shall be supported

by 10mm MS Rods and 40x40x3 MS angles. The duct supports shall be at a distance of not more than 2000 mm for A/C system. The MS rods for these ducts routed inside the building shall be hung from the existing floor beams/wall beams / roof beams/columns as provided by the owner with provision of necessary auxiliary or special steel members or by hooks or can be provided by contractor by dash fasteners fixed to the ceiling slab. No supports shall be taken from horizontal/vertical bracings of the structures. All items of duct support including MS rods, MS angles and double angles, auxiliary or special steel members, hooks, dash fasteners coach screws and all other supporting material required shall be provided by the bidder.

- d. Where the sheet metal duct connects to the intake or discharge of fan units, a flexible connection of fire retarding, at least 150 mm width shall be provided of closely woven, rubber impregnated double layer canvas or neoprene coated fibre glass.
- e. All curves, bends, offsets and other transformations shall be made for an easy and noiseless flow of air. The throat of every branch duct shall be sized to have the same resistance in the main duct to which the branch duct is connected. All elbows shall have the throat radius of at least seventy five (75) percent of the duct width. In case the throat radius is smaller, suitable single thickness vanes of approved details shall be provided.
- f. Wherever duct passes through wall, all the openings between masonry and duct work shall be neatly caulked or sealed to prevent movement of air from one space to the adjoining space. Where duct passes through the floor, at the lowest point in the elbow a drain trap of 100 mm width across the width of the duct and 50 mm deep shall be provided with suitable gauge valve.
- g. Access doors shall be provided in the duct work or casing on the both sides of the equipment to be serviced. All access doors shall be of adequate size and shall be lined with substantial felt edging to prevent air leakage. Access doors shall be of built up construction, structurally strong and each shall have at least two hinges. Access doors shall have two rust proof window sash of approved type. All doors shall be set so as to flush with insulation or plaster finish on the duct.
- h. Splitters and dampers shall be provided for equipment/area isolation and for proportional volume control of system. The same shall be minimum 16 gauge GS sheet of quadrant type with suitable locking device, mounted outside of duct in accessible position.
- i. All the plenum chambers or connections to fans, dampers etc, shall be constructed in 18 gauge GSS, supported on 40x40x6 mm MS angle frames. All vertical angles shall be rivetted at approximately 125 mm centres to the casing. 'Pecora' or equivalent caulking compound shall be inserted between the base of angle and all masonry construction to which angles are fastened.

- j. Wherever pipe hangers or rods pass through the ducts, light and stream lined casement around the same shall be provided to maintain smooth flow of air.
- k. All air terminals shall be of mill finish extruded aluminium profile construction.
- l. The proposed ducting scheme, duct sizes, location of supply air grilles etc shown on the enclosed drawings is tentative and subject to finalisation during detailed engineering by the contractor. The bidders shall furnish in their proposal quantities of ducting, duct insulation, supply air grilles. However, these quantities may increase or decrease depending upon the final layout.
- a. Each branch line shall have dampers to isolate the branch for maintenance purpose.

25.7.13.2 Factory Fabricated Ducts

- a. All ducting shall be fabricated of LFQ (Lock forming quality) grade prime GI.
- b. Unless otherwise specified here, the construction, erection, testing & performance of the ducting system shall conform to SMACNA – 1995 standards ("HVAC Duct Construction Standards – Metal and Flexible – second Edition – 1995" SMACNA)
- c. All ductworks including straight sections, tapers, elbows, branches, show pieces, collars, terminal boxes and transformation pieces must be factory fabricated by utilizing the machines and processes as specified in SMACNA or by equivalent technology. In equivalent method, the fabrication shall be done by utilizing the following machines and process to provide the requisite quality of ducts and speed of supply :
 - i. Coil lines to ensure location of longitudinal seams at corners/ folded edges only to obtain the required duct rigidity and low leakage characteristics. No longitudinal seams permitted along any face side of the duct.
 - ii. All ducts, transformation pieces and fittings to be made on CNC profile cutters for required accuracy of dimensions, location and dimensions of notches at the folding lines.
 - iii. All edges to be machine treated using lock formers, flanges and roll bending for turning up edges.
 - iv. Sealant dispensing equipment should be used for applying built in sealant in Pittsburg lock where sealing of longitudinal joints are specified. Sealing of longitudinal joints are specified. Sealing of longitudinal joint is compulsory for ducts over 2" w.g static pressure.
- d. All traverse connectors shall be 4-bolt slip on flange system with built in sealant, if any. To avoid any leakage additional sealant shall be used.

25.7.13.3 Diffusers, Grills & Dampers



Supply air diffusers/ grills with factory fitted volume control dampers to be provided for all air conditioned areas.

Return air diffusers of air conditioned areas shall be without volume control dampers.

The diffusers/ grills shall be extruded Aluminium of minimum 2mm thk with powder coating. The colour of powder coating shall be as per the interior decor.

Supply air grills shall be double deflection type and return air grills shall be single deflection type.

The nozzle type diffusers shall be fabricated from minimum 1.5 mm Aluminium sheet. The base shall be fixed type. The nozzle shall be of volute design with the spout diameter being half the base diameter and designed for low noise and long throw. The nozzle shall be able to rotate to any angle within the base. The whole assembly shall be powder coated as per interior decor.

All volume control (VC) dampers shall be operated by a key from the front of the grills/ diffusers and shall be of GI sheet.

The thickness of VC dampers shall be minimum 20 gauge and thickness of louvers shall be minimum 22 gauge.

Suitable vanes shall be provided in the duct collar to have uniform and proper air distribution. Bank of baffles wherever required shall be provided.

Fire dampers shall be motor operated type and shall have fire rating of minimum 90 minutes.

All plenum chambers of connections to fans, dampers, etc shall be constructed in 18 gauge GS sheet and supported in MS angle frames.

All ducting surfaces coming in contact with corrosive fumes or gases shall be painted with three coats of epoxy paint over a coat of suitable primer.

25.7.14 Thermal & Acoustic Insulation

Application

- a. All surfaces to be insulated both thermally and acoustically shall be thoroughly cleaned, dried and an adhesive be applied @ 1.5 kg/ sq m on the surface (CPRX compound of Shalimar Tar products or equivalent).
- b. Insulation material (either expanded polystyrene foam or glass wool/ glass fibre or equivalent) shall be struck to the surface. All the joints shall be sealed with bitumen.
- c. Insulation mass to be covered with 500 gauge polythene sheet with 50 mm overlaps and sealing all joints on hot side.
- d. Insulation finish of types specified under shall be provided thereafter.

25.7.14.1 Type of Insulation & Finish

S. No.	Surfaces	Insulation Material	Insulation Form	Thick, (mm)	Finish, (mm)
1	Supply & Return air duct of AC system	Resin bonded glass wool or closed cell elastomeric Nitrile rubber	Roll/ Slab Sheet	50	F-3
2	Refrigerant (Suction & Liquid Lines)	Closed cell elastomeric Nitrile rubber	Tube	19	As per manufacturer's std.
3	AHU Drain pipe	Closed cell elastomeric Nitrile rubber	Tube	19	As per manufacturer's std.
4	AHU Condensate pan (insulation if required)	Mineral wool or resin bonded glass wool.	Slab	25	As per manufacturer's std.
5	Chilled water piping, valves & specialties	Resin bonded mineral wool or resin bonded glass wool.	Pipe section	75	F-1
6	Chiller (Insulation if required)	As per manufacturer's std.			
7	Chilled Water Pumps	Resin bonded mineral wool or resin bonded glass wool.	Slab	50	F-1
8	Expansion tank with associated piping	Resin bonded mineral wool or resin bonded glass wool.	Slab/ pipe section	50	F-1
9	Acoustic Insulation of duct	Resin bonded glass wool	Slab	25	As per spec
10	Exposed air duct	Resin bonded glass wool	Roll	50	F-4

25.7.14.2 Specification for insulation shall be as follows :

Insulation Material	Code	Thermal Conductivity (w/m/Deg C)	Density, kg/m ³
Resin bonded glass wool	IS:8183	0.049 at 50 Deg C	i) 24 (for thermal

Insulation Material	Code	Thermal Conductivity (w/m/Deg C)	Density, kg/m ³
			insulation) ii) 48 (for acoustic insulation)
Mineral wool pipe section Min Gr 2	IS 9842	0.043 at 50 Deg C	144
Closed cell Elastomeric Nitrile rubber		0.036 at 20 Deg C	60-70

Note : Insulation for HVAC application shall be CFC/ HCFC free.

25.7.14.3 The specification for various finishes shall be as follows :

a) **Finish F-1**

- Step – 1 Wrapping of Poly- Bonded Hessian (PBH- to act as vapour seal) on outer surface of insulation with 50 mm overlap stitching and sealing of overlap with synthetic adhesive like CPRX or equivalent compound.
- Step – 2 The surface then shall be wrapped with 19 mm mesh 24 SWG GI wire netting, butting all the joints and laced down with 22 SWG lacing wire.
- Step – 3 Sand cement (4:1) plaster shall be applied in two layers totalling to 12.5 mm thk. The second layer being brought to a smooth finish. A water proofing compound shall be added to cement before its application.

b) **Finish F-2**

- Step – 1 Insulation shall be covered with 500 g polythene with 50 mm overlap and sealing of overlap with synthetic adhesive like CPRX or equivalent compound.
- Step – 2 Same as Step-2 of Finish F-1 above.
- Step – 3 Same as Step-3 of Finish F-1 above.

c) **Finish F-3**

- Step – 1 Same as Step-1 of Finish F-2 above.
- Step – 2 The polythene shall be covered with 30 gauge Aluminium sheet and locking of joints with self locking screws at a pitch of minimum 100 mm.

d) **Finish F-4**

- Step – 1 Same as Step-1 of Finish F-1 above.
- Step – 2 Same as Step-2 of Finish F-1 above.
- Step – 3 Same as Step-3 of Finish F-1 above.
- Step – 4 Application of 3 mm thk coat of water proofing compound "SHALIKOTE 30" or equivalent and wrapped with fibre glass RP tissue followed by final coat of 3 mm thk water proofing compound "SHALIKOTE 30" or equivalent over thr RP tissue.
- Step – 5 After the above treatment, 22G Aluminium sheet cladding, properly stitched at all joints shall be provided over the external surface.

For all inspection covers and hatches on equipment, pump casing, valve bodies and flanges (100 mm & above), insulation shall be applied so as to facilitate removal without minimum damage to the insulation in 24 gauge GI box or 22 gauge Aluminium sheet metal boxes which are bolted together around the equipment. However continuity of the vapour seal between the static and removable portions of the insulation is maintained.

25.7.14.4 **ACOUSTIC INSULATION**

- a) All ducts up to a distance of 5 m from AHU shall be acoustically lined from inside with 25 mm thk resin bonded glass wool of 48 kg/ cum density with 30 gauge perforated Aluminium sheet having 5 mm dia perforation at 8 to 10 mm centre to centre distance. Insulation shall be fixed on wooden frame of 600 x 600 mm dimension.
- b) Fibre glass tissue sheet shall be applied over the outer surface of insulation before applying perforated Aluminium sheet. Application of acoustic insulation shall be in line with requirements specified above.

25.7.15 **Piping and Fittings**

Material of Construction for Piping & Fittings

a)	Piping for Chilled and Condenser water	Heavy grade-IS:1239 or Equivalent upto150 NB and IS:3589 or Equivalent for pipes beyond 200 lines NB with thickness as indicated
b)	Refrigerant piping	Seamless steel tubes conforming heavy grade IS:1239 or copper tubes as per IS:2501 (copper material as per IS:191 hard copper grade).
c)	Drain piping	Same as (a) above & galvanized as per IS:4736
d)	Fittings	1) The steel fittings shall

		conform to ASTM A234 Gr. WPB and dimensional standard to ANSI 16.9/ANSI B16.11 / equivalent for sizes 65 NB and above. 2) For sizes 50 NB and below, the material shall conform to ASTM A-105. 3) All steel flanges shall be of slip on type and shall conform to ANSI B 16.5 4) For pipe sizes above 350 NB, fabricated fittings from sheets of adequate thickness may be used. The bend radius in case of mitre bends shall be minimum 1.5 times the nominal pipe diameter and angle between two adjacent sections shall not be more than 22.5 deg and shall be as per BS:2633/BS:534. 5) Fittings, flanges and pipe joints of refrigerant piping shall conform to ANSI B31.5
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25.7.10

Valves

- i. Valves shall have full size port and Suitable for horizontal and as well as vertical installation.
- ii. Valves for regulating duty shall be of Globe type suitable for controlling through out its lift.
- iii. Gate, Globe and stop Check valves shall have bonnet back seat to facilitate easy replacement of packing with the valves in service.
- iv. All Safety / relief valves shall be so constructed that the failure of any part does not obstruct the free discharge.
- v. Manual gear operator be provided for valves of size 200 NB and above.
- vi. All valves with rising stem shall have position indicators.
- vii. All valves shall be provided with locking arrangement.

- viii. The refrigerant line valves shall have steel or brass body with TEFLON gland packing. The construction of disc shall be either globe or angle type. The valve seat shall have white metal lining or equivalent.
- ix. The butterfly valves shall be designed as per AWWA C 504 and designed to fit between flanges. The butterfly valves shall be provided with flow control lever, black nitrile rubber integrally moulded seating, disc of aluminium bronze to BS 1400 Gr. AB2/AB1, shafts of stainless steel AISI 410. The butterfly valve shall be rated for 16 bar; body/disc tested at 24 bar and seat at 14 bar.
- x. Balancing / Controller Valves:

The valves of sizes 32 mm to 65 mm dia shall be of gun metal / cast iron construction with screwed ends angular design digital hand wheel with locking facility. Whereas valves of sizes 75 mm and above shall be of cast iron construction with internal parts of SS 410 and EPDM / Nitrile seat with flanged ends

25.7.11

Instruments, Protective Devices and Interlock

On-off thermostat with adjustable setting shall be provided with temperature control. Interlocks shall be provided such that compressor can start only after starting the air handling fan. Provision shall also be made to interlock the compressor with condenser water flow switch, chilled water flow switch / circulation pump. Safety devices such as high/low pressure cut out, hermetic motor winding thermostat etc. shall be provided. HP cut out shall be manual reset type while LP cut out shall be auto reset type. The control system shall be DCS based with redundant processor, power supply and communication modules, with CRT operator interface and peripherals serial link shall be provided for transfer of important signals to the DCS in the central control room.

Strip heaters shall be provided with an adjustable thermostat to control the temperature and a safety thermostat and safety interlock shall be incorporated to cut-off the electrical supply to the heater whenever there is failure of airflow.

Fire dampers (motor operated) shall be installed at places where supply air duct crosses fire barrier wall, floor slab, return air space (near the wall separating AHU rooms / PAC rooms and A/C area). The fire damper shall be of the same fire resistance as the structure but in no case less than 90 minutes and should be energized to close and the air conditioning equipment shall be tripped off in the event of fire.

25.7.12

Gravity Damper

Gravity dampers (self acting dampers) are provided to ensure pressurization of electrical rooms, switch gears rooms, substations etc. Dampers shall be of gravity type designed such as not to allow infiltration of air from outside. The louvers of the dampers shall be freely mounted on Spindles to allow the damper to open freely with the pressure developed in the premises. The damper shall be provided with flange at the inlet, the pressure inside the premises shall be 1-2mm WC.

25.7.13

Fresh Air Unit for Air Conditioning system

The fresh air unit shall consist of:

- Wall cowl with bird screen, tube axial fan with motor.
- Pre-filter made up of HDPE and efficiency 90% down to 10 microns and maximum face velocity of 2.25 m/sec.
- Fine filter made up of HDPE and efficiency 99.5% down to 5 microns and maximum face velocity 2.25 m/sec.
- Volume control damper, ducting, fixing frame and necessary supports.
- Filter frame shall be of aluminium and shall be flanged.

25.8

Plant Control for Air conditioning system

a) General

Brief scheme of controlling the operation is described below. Detailed description of the control system for safe and efficient operation of the plant shall be elaborated, got approved from Bidder. The descriptions in the sub-sections of the Control & Instrument sections shall also be referred to.

b) Control Scheme of Air Conditioning System

- i. The Air Conditioning System control system shall be DCS based. The DCS configuration and detailed specification of the same shall be as per Control & Instrumentation requirements specified elsewhere in the specification.
- ii. Each system shall be provided with required I/O modules and two numbers of Operator Work (OWS) Stations. All the functional requirements specified below and general control logic specified under this section shall be implemented in the respective DCS ;.
- iii. The basic function of the system shall be to closely control and monitor temperature and humidity conditions inside the air-conditioned spaces, to optimize/minimize energy consumption by automated operation, to provide remote centralized monitoring & control for various mechanical facilities including sequential start/stop of the whole HVAC System, automatically calculate record and cooling load for each hour/ day/season, to generate maintenance data & alarms, to maintain records of plant operation & energy consumption for varying loads, duty cycling to operate all the equipment including standby equipment for equal duration, automatic start-up of standby equipment in case of failure of operating unit and displaying fault alarm status of the tripped unit, activating/ deactivating water valves to start-up/stop water flow through chiller/condenser circuit. For sequential operation /duty cycling, Programmed start-up/stop of individual AHU as per operating requirements and inside room temperature and humidity of CR, CER, ESP Control Room, UPS and battery charger room shall be maintained by controlling the chilled water flow by means of motor operated three way

modulating valve and by varying the air flow of AHU through VFD driven motor, humidified system and duct heater. For service building & administrative building inside room temperature and humidity shall be maintained by varying the chilled water flow of chilled water pumps through VFD driven motor and by varying the air flow of AHU through VFD driven motor, humidified system and duct heater. For sequential operation/ duty cycling, programmed start up/ stop of individual AHU's, pumps and cooling towers as per operating requirements and inside room temperature and humidity.

- iv. DCS provided for the Control of AC system shall suitably interface with integral microprocessor based controls of Chiller units.
- v. The DCS based control system of Air Conditioning system shall also interface with Wide Area Network of the Station to be supplied by the Bidder.

c) **Water Chilling Plant Control**

- i. Microprocessor based controls shall be provided along with facilities to interface with central DCS and to meet the requirement of all system operations and controls.
- ii. Water chilling unit control system shall be designed to have a constant chilled water outlet from evaporator at all load condition by means of controlling ON-OFF thermostat (one for each compressor). The closure of liquid line solenoid valve and tripping of compressor at lower water temperature and opening of solenoid valve and starting of compressor at high set point shall be automatic through the thermostat. Between the above set points the compressor capacity shall be controlled automatically.
- iii. Water chilling unit shall be equipped with superheat control of water chilling unit through thermostatic expansion valve, which gets its impulse from temperature element connected with suction line after chiller outlet.
- iv. High discharge pressure cut-out and oil pressure (OP) differential cut-out shall be of manual reset type and low pressure cut-out shall be automatic reset type. The OP cut-out shall trip the compressor in case of low oil pressure.
- v. On-off toggle switch to close the liquid refrigerant line solenoid valve shall be provided to shut the compressor by the operation of the operation of low pressure cut-out (after the refrigerant has been pumped to the condenser).
- vi. Switching of Crank case heaters shall be interlocked with starting and stopping/tripping of compressor motor. Further, the safety thermostat shall switch off the crank-case heater in the event temperature rises above safe limit.
- vii. Provision shall also be made for the manual restarting of the compressor.

- viii. On-off type anti-freeze thermostats, one for each chiller shall be provided in addition to the controlling on-off thermostat for safety purpose and shall act in the event of failure of on-off thermostat to close the liquid line solenoid valve and also to trip the compressor simultaneously.
 - ix. Compressor starting/running shall be interlocked with the flow switches to be provided at the outlet of each chiller and each condenser and as well as with pressure in the inlet of the condensers. In addition closure or open status of various valves through limit switches shall be used for interlock, alarm and control of Air Conditioning System.
 - x. The standby condenser water pumps, standby chilled water pumps, & standby AHU shall be started automatically when the working equipments are stopped/ tripped. Auto/Manual selector Switches and working/ Standby selector switches for the pumps/AHU/fresh air fan shall be provided in the panel.
 - xi. Closure of fire dampers shall raise an annunciation in the panel.
 - xii. There shall be provision in control panel for temperature and flow readings in chilled water inlet and outlet line across AHUs to monitor the air conditioning load of each area.
 - xiii. Operation of Air conditioning system shall be interlocked with the required minimum pressure and temperature of cooling water at inlet to the condenser through pressure and temperature transmitters. Status indication of Station auxiliary Cooling water pumps & associated cooling towers shall be provided in the control panel of air conditioning plant.
- d) **Air Handling Unit**
- i. Control of the inside room temperature and humidity shall be by controlling the chilled water flow by means of motor operated three way modulating valve and by varying the flow by means of VFD driven AHU's which shall get signal from the control system for main plant A/C system. For service building & Administrative building inside room temperature & humidity shall be controlled by varying the chilled water flow of chilled water pumps through VFD driven motor and by varying the air flow of AHU through VFD driven motor.
 - ii. Humidity sensor & Geyzer stat located in the return air duct shall actuate the pan humidifier to obtain the desired degree of humidification.
 - iii. Separate Humidistat and thermostats shall be provided and interlocked in steps with winter heater / re-heater / strip heaters for monsoon and winter re-heating or heating as the case may be.
 - iv. Heater banks shall be interlocked with the running of AHU, temperature of return air, humidity of return air and safety thermostat (Geyser stat located in front of the each heater in the supply air duct)

- v. AHU shall be started either from its local panel or from the main control panel of AC system by means of Remote/Manual selector switches.
- vi. The closure of fire dampers, automatic tripping of AHU fans and fresh air fans shall be interlocked with fire Detection System.
- vii. Each AHU shall be provided with temperature indicators and flow indicator in the chilled water piping inlet and outlet to monitor the air-conditioning load of each area.
- viii. Miscellaneous control requirements
- ix. Separate emergency local stop push button shall be provided for each pump, compressor, fans etc. of AC system.
- x. Lamps shall be provided for indicating the status of each pump, compressor, fans etc. of AC system in the main and local panel.
- xi. All the annunciation related to failure of equipments, tripping of equipments, source of failure / reason due to which the equipment is stopped / tripped, low & high limits of parameters such as level, temperature, pressure drop, pressure etc shall be provided for each pump, fan, compressor, AHU, PAC etc. in the respective panel.
- xii. Fully wired, twenty percent (20%) spare annunciation windows shall be provided in all the panels.

e) D-X Air Conditioning System

- The control and interlocks described above for water chilling plants are applicable for this system also.
- Further the compressor starting/ running shall be interlocked with the flow switches in condenser water circuit as well as with AHU motors.
- The standby condenser water pumps, fresh air fan & standby AHU shall be started automatically when the working equipments are stopped/ tripped. Auto/ Manual selector switches and working/ standby selector switches for the pumps, fresh air fans and AHU shall be provided in the panel.

f) Cassette/ Hi- wall Split Air Conditioners

The control and interlocks for these type of units shall be as per manufacturer's standard practice.

g) General

- Separate emergency local stop push button shall be provided for each pump, compressor, fans etc of A/C system.
- Status shall be provided of each pump, compressor, fans etc of A/C system system on HMI system at control room.
- All the annunciations related to failure of equipments, tripping of equipments, source of failure/ reason due to which the equipment is stopped/ tripped, low & high limits of parameters such as level, temperature, pressure drop, pressure etc shall be provided for each pump, fan, compressor, AHU, PAC, AWY etc.
- The fans (both supply & exhaust fans) associated with mechanical ventilation system shall be operated locally.
- Relative humidity and temperature measurement of all control rooms and CER's, ESP control room and all major air conditioned areas shall be available in DDCMIS. Relative humidity and temperature measurement for main plant control room and CRE's to be available in multiple numbers.
- Vibration and noise level of screw chillers, condensing units, pumps with motor shall be measured during PG test. Permissible limit of vibration for pumps shall be 75 micron peak to peak. For fans/ screw chillers/ condensing units, the same shall be in line with VDI-2056 Group-T machines (maximum vibration level 7.1 m/s r.m.s.
- The maximum noise level shall be 85 dBA at 1.5 m elevation and at a horizontal distance of 1 m from the equipment.



**1x660MW PANKI STPP
AIR CONDITIONING SYSTEM
PROJECT SPECIFIC GENERAL
REQUIREMENTS**

SPECIFICATION No: PE-TS-426-553-A001

SECTION : I

SUB-SECTION : C 2B

REV. 00

SECTION: I
SUB-SECTION: C 2B
CUSTOMER SPECIFICATIONS
PROJECT SPECIFIC GENERAL REQUIREMENTS

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

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



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



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



- 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:
- a) Manufacturer's identification.
 - b) Nominal inlet and outlet sizes in mm.
 - c) Set pressure in Kg/cm² (abs).
 - d) Blowdown and accumulation as percentage of set pressure.
 - e) Certified capacity in Kg of saturated steam per hour or in case of liquid certified capacity in litres of water per minute.
- 16.8 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 performed 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



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.

IS: 1838 (Part-I)	Specification for preformed fillers for expansion joints in concrete pavements and structures (non-extruding and resilient type).
IS: 2204	Code of practice for construction of reinforced concrete shell roof.
IS: 2210	Criteria for the design of reinforced concrete shell structures and folded plates.
IS: 2438	Specification for roller pan mixer.
IS: 2502	Code of practice for bending and fixing of bars for concrete reinforcement.
IS: 2505	General requirements for concrete vibrators, immersion type.
IS: 2506	General requirements for concrete vibrators, screed board type.
IS: 2514	Specification for concrete vibrating tables.
IS: 2645	Specification for Integral cement water proofing compounds.
IS: 2722	Specification for portable swing weigh batches for concrete. (single and double bucket type)
IS: 2750	Specification for Steel scaffolding.
IS: 2751	Code of practice for welding of mild steel plain and deformed bars for reinforced concrete construction.
IS: 3025	Methods of sampling and test waste water.
IS: 3366	Specification for Pan vibrators.
IS: 3370 (Part I to IV)	Code of practice for concrete structures for the storage of liquids.
IS: 3414	Code of practice for design and installation of joints in buildings.
IS: 3550	Methods of test for routine control for water used in industry.
IS: 3558	Code of practice for use of immersion vibrators for consolidating concrete.
IS: 4014 (Parts I & II)	Code of practice for steel tubular scaffolding.
IS: 4326	Code of practice for earthquake resistant design and construction of buildings.
IS: 4461	Code of practice for joints in surface hydro-electric power stations.
IS: 4656	Specification for form vibrators for concrete.
IS: 4925	Specification for batching and mixing plant.

IS: 4990	Specification for plywood for concrete shuttering work.
IS: 4995 (Parts I & II)	Criteria for design of reinforced concrete bins for the storage of granular and powdery materials.
IS: 5256	Code or practice for sealing joints in concrete lining on canals.
IS: 5525	Recommendations for detailing of reinforcement in reinforced concrete work.
IS: 5624	Specification for foundation bolts.
IS: 6461	Glossary of terms relating to cement concrete.
IS: 6494	Code of practice for water proofing of underground water reservoirs and swimming pools.
IS: 6509	Code of practice for installation of joints in concrete pavements.
IS: 7861	Code of practice for extreme weather concreting. (Parts I & II)
IS: 9012	Recommended practice for shot concreting.
IS: 9103	Specification for admixtures for concrete.
IS: 9417	Recommendations for welding cold worked steel bars for reinforced concrete construction.
IS: 10262	Recommended guidelines for concrete mix design.
IS: 11384	Code of practice for composite construction in structural steel and concrete.
IS: 11504	Criteria for structural design of reinforced concrete natural draught cooling towers.
IS: 12118	Specification for two-parts poly sulphide.
IS: 12200	Code of practice for provision of water stops at transverse contraction joints in masonry and concrete dams.
IS: 13311	Method of non-destructive testing of concrete.
Part-1	Ultrasonic pulse velocity.
Part-2	Rebound hammer.
SP: 23	Handbook of concrete mixes
SP: 24	Explanatory Handbook on IS: 456-1978
SP: 34	Handbook on concrete reinforcement and detailing.

Precast Concrete Works

SP: 7(PartVI/Sec.7) National Building Code- Structural design of prefabrication and



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



systems building.

IS: 10297 Code of practice for design and construction of floors and roofs using precast reinforced/prestressed concrete ribbed or cored slab units.

IS: 10505 Code of practice for construction of floors and roofs using pre-cast reinforced concrete units.

Masonry and Allied Works

IS: 1905 Code of Practice for Structural Safety of Buildings-Masonry walls.

IS: 2212 Code of Practice for Brickwork.

IS: 2250 Code of Practice for Preparation and use of Masonry Mortar.

SP: 20 Explanatory hand book on masonry code.

Sheeting Works

IS:277 Galvanised steel sheets (plain or corrugated).

IS: 459 Unreinforced corrugated and semi-corrugated asbestos cement sheets.

IS: 513 Cold-rolled carbon steel sheets.

IS: 730 Specification for fixing accessories for corrugated sheet roofing.

IS: 1626 Specification for Asbestos cement building pipes and pipe fittings, gutters and gutter fittings and roofing fittings.

IS: 2527 Code of practice for fixing rain water gutters and down pipe for roof drainage.

IS: 3007 Code of practice for laying of asbestos cement sheets.

IS: 5913 Methods of test for asbestos cement products.

IS: 7178 Technical supply conditions for tapping screw.

IS: 8183 Bonded mineral wool.

IS: 8869 Washers for corrugated sheet roofing.

IS: 12093 Code of practice for laying and fixing of sloped roof covering using plain and corrugated galvanised steel sheets.

IS: 12866 Plastic translucent sheets made from thermosetting polyster resin (glass fibre reinforced).

IS: 14246 Specification for continuously pre-painted galvanised steel sheets and coils.

Fabrication and Erection of Structural Steel Work

IS: 2016	Specification for plain washers.
IS: 814	Specification for covered Electrodes for Metal Arc Welding for weld steel.
IS: 1852	Specification for Rolling and Cutting Tolerances for Hot rolled steel products.
IS: 3502	Specifications for chequered plate.
IS: 6911	Specification for stainless steel plate, sheet and strip.
IS: 3757	Specification for high strength structural bolts
IS: 6623	Specification for high strength structural nuts.
IS: 6649	High Tensile friction grip washers.
IS: 800	Code of practice for use of structural steel in general building construction.
IS: 816	Code of practice for use of Metal Arc Welding for General Construction.
IS: 4000	Code of practice for assembly of structural joints using high tensile friction grip fasteners.
IS: 9595	Code of procedure of Manual Metal Arc Welding of Mild Steel.
IS: 817	Code of practice for Training and Testing of Metal Arc Welders.
IS: 1811	Qualifying tests for Metal Arc Welders (engaged in welding structures other than pipes).
IS: 9178	Criteria for Design of steel bins for storage of Bulk Materials.
IS: 9006	Recommended Practice for Welding of Clad Steel.
IS: 7215	Tolerances for fabrication steel structures.
IS: 12843	Tolerance for erection of structural steel.
IS: 4353	Recommendations for submerged arc welding of mild steel and low alloy steels.
SP: 6 (Part 1 to 7)	ISI Hand book for structural Engineers.
IS: 1608	Method of Tensile Testing of Steel products other than sheets, strip, wire and tube.
IS: 1599	Method of Bend Tests for Steel products other than sheet, strip, wire and tube

IS : 228	Methods of chemical Analysis of pig iron, cast iron and plain carbon and low alloy steel.
IS : 2595	Code of Practice for Radio graphic testing.
IS : 1182	Recommended practice for Radiographic Examination of fusion welded butt joints in steel plates.
IS : 3664	Code of practice for Ultra sonic Testing by pulse echo method.
IS : 3613	Acceptance tests for wire flux combination for submerged Arc Welding.
IS : 3658	Code of practice for Liquid penetrant Flaw Detection.
IS : 5334	Code of practice for Magnetic Particle Flaw Detection of Welds.

Plastering and Allied Works

IS : 1635	Code of practice for field slaking of Building lime and preparation of putty.
IS : 1661	Application of cement and cement lime plaster finishes.
IS : 2333	Plaster-of-paris.
IS : 2402	Code of practice for external rendered finishes.
IS : 2547	Gypsum building plaster.
IS : 3150	Hexagonal wire netting for general purpose.

Acid and Alkali Resistant Lining

IS : 158	Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali & heat resisting.
IS : 412	Specification for expanded metal steel sheets for general purpose.
IS : 4441	Code of practice for use of silicate type chemical resistant mortars.
IS : 4443	Code of practice for use of resin type chemical resistant mortars.
IS : 4456	Method of test for chemical resistant tiles. (Part I & II)
IS : 4457	Specification for ceramic unglazed vitreous acid resistant tiles.
IS : 4832	Specification for chemical resistant mortars.
	Part I Silicate type
	Part II Resin type
	Part III Sulphur type

IS : 4860	Specification for acid resistant bricks.
IS : 9510	Specification for bitumasitc, Acid resisting grade.

Water Supply, Drainage and Sanitation

IS : 458	Specification for concrete pipes.
IS : 554	Dimensions for pipe threads, where pressure tight joints are made on thread.
IS : 651	Specification for salt glazed stoneware pipes.
IS : 774	Flushing cisterns for water closets and urinals.
IS : 775	Cast iron brackets and supports for wash basins and sinks.
IS : 778	Copperalloy gate, globe and check valves for water works purposes.
IS : 781	Cast copper alloy screw down bib taps and stop valves for water services.
IS : 782	Caulking lead.
IS : 783	Code of practice for laying of concrete pipes.
IS : 1172	Basic requirements for water supply, drainage and sanitation.
IS : 1230	Cast iron rain water pipes and fittings.
IS : 1239	Mild steel tubes, tubulars and other wrought steel fittings.
IS : 1536	Centrifugally cast (Spun) iron pressure pipes for water, gas and sewage.
IS : 1537	Vertically cast iron pressure pipes for water, gas and sewage.
IS : 1538	Cast iron fittings for pressure pipe for water, gas and sewage.
IS : 1703	Ball valves (horizontal plunger type) including float for water supply purposes.
IS : 1726	Cast iron manhole covers and frames.
IS : 1729	Sand cast iron spigot and socket, soil, water and ventilating pipes, fittings and accessories.
IS : 1742	Code of practice for building drainage.
IS : 1795	Pillar taps for water supply purposes.
IS : 1879	Malleable cast iron pipe fittings.
IS : 2064	Code of practice for selection, installation and maintenance of

	sanitary appliances.
IS : 2065	Code of practice for water supply in building.
IS : 2326	Automatic flushing cisterns for urinals.
IS : 2470 (Part-I & II)	Code of practice for installation of septic tanks.
IS : 2501	Copper tubes for general engineering purposes.
IS : 2548	Plastic seat and cover for water-closets.
IS : 2556 (Part 1 to 15)	Vitreous sanitary appliances (vitreous china).
IS : 2963	Non-ferrous waste fittings for wash basins and sinks.
IS : 3114	Code of practice for laying of cast iron pipes.
IS : 3311	Waste plug and its accessories for sinks and wash basins.
IS : 3438	Silvered glass mirrors for general purposes.
IS : 3486	Cast iron spigot and socket drain pipes.
IS : 3589	Electrically welded steel pipes for water, gas and sewage (200mm to 2000mm nominal diameter).
IS : 3989	Centrifugally cast (Spun) iron spigot and socket soil, waste and ventilating pipes, fittings and accessories.
IS : 4111 (Part I to IV)	Code of practice for ancillary structure in sewerage system.
IS : 4127	Code of practice for laying of glazed stone-ware pipes.
IS : 4764	Tolerance limits for sewage effluents discharged into inland-surface waters.
IS : 4827	Electro plated coating of nickel and chromium on copper and copper alloys.
IS : 5329	Code of practice for sanitary pipe work above ground for buildings.
IS : 5382	Rubber sealing rings for gas mains, water mains and sewers.
IS : 5822	Code of practice for laying of welded steel pipes for water supply.
IS : 5961	Cast iron grating for drainage purpose.
IS : 7740	Code of practice for road gullies.
IS : 8931	Cast copper alloy fancy bib taps and stop valves for water services.

IS : 8934	Cast copper alloy fancy pillar taps for water services.
IS : 9762	Polyethylene floats for ball valves.
IS : 10446	Glossary of terms for water supply and sanitation.
IS : 10592	Industrial emergency showers, eye and face fountains and combination units.
IS : 12592	Specification for precast concrete manhole covers and frames.
IS : 12701	Rotational moulded polyethylene water storage tanks.
SP: 35	Hand book on water supply and drainage.
-	Manual on Sewerage and sewage treatment (Published by CPH & EEO) As updated.

Doors, Windows and Allied Works

IS : 204	Tower Bolts
Part-I	Ferrous metals.
Part-II	Nonferrous metals.
IS : 208	Door Handles.
IS : 281	Mild steel sliding door bolts for use with padlocks.
IS : 362	Parliament Hinges.
IS : 420	Specification for putty, for use on metal frames.
IS : 1003 Part-I door	Specification for timber panelled and glazed shutters- (Part-I) shutters.
IS : 1038	Steel doors, windows and ventilators.
IS : 1081	Code of practice for fixing and glazing of metal (steel and aluminium) doors, windows and ventilators.
IS : 1341	Steel butt hinges.
IS : 1361	Steel windows for industrial buildings.
IS : 1823	Floor door stoppers.
IS : 1868	Anodic coatings on Aluminium and its alloys.
IS : 2202 (Part-II)	Specification for wooden flush door shutters (solid core type); particle board face panels and hard board face panels
IS:2209	Mortice locks (vertical type).

IS:2553	Safety glass
IS:2835	Flat transparent sheet glass.
IS:3548	Code of practice for glazing in buildings.
IS:3564	Door closers (Hydraulically regulated).
IS : 3614	Fire check doors; plate, metal covered and rolling type.
IS:4351	Steel door frames.
IS:5187	Flush bolts.
IS:5437	Wired and figured glass
IS:6248	Metal rolling shutters and rolling grills.
IS:6315	Floor springs (hydraulically regulated) for heavy doors.
IS:7196	Hold fasts.
IS:7452	Hot rolled steel sections for doors, windows and ventilators.
IS:10019	Mild steel stays and fasteners.
IS:10451	Steel sliding shutters (top hung type).
IS:10521	Collapsible gates.

Roof Water Proofing and Allied Works

IS:1203	Methods of testing tar and bitumen.
IS:1322	Specification for bitumen felts for water proofing and damp proofing.
IS:1346	Code of practice for water proofing of roofs with bitumen felts.
IS:1580	Specification for bituminous compound for water proofing and caulking purposes.
IS:3067	Code of practice for general design details and preparatory work for damp proofing and water proofing of buildings.
IS:3384	Specification for bitumen primer for use in water proofing and damp proofing.

Floor Finishes and Allied Works

IS:1237	Specification for cement concrete flooring tiles.
IS:1443	Code of practice for laying and finishing of cement concrete flooring tiles.
IS:2114	Code of practice for laying in-situ terrazzo floor finish.
IS:2571	Code of practice for laying in-situ cement concrete flooring.



IS:3462	Specification for unbacked flexible PVC flooring.
IS:4971	Recommendations for selection of industrial floor finishes.
IS:5318	Code of practice for laying of flexible PVC sheet and tile flooring.
IS:8042	Specification for white portland cement.
IS:13801	Specification for chequered cement concrete flooring tiles.

Painting and Allied Works

IS:162	Specification for fire resisting silicate type, brushing, for use on wood, colour as required.
IS:1477	Code of practice for painting of ferrous metals in buildings.
Part-I	Pretreatment.
Part-II	Painting.
IS:1650	Specification for colours for building and decorative finishes.
IS:2074	Specification for red oxide-zinc chrome, priming, ready mixed paint air drying.
IS:2338	Code of practice for finishing of wood and wood based materials.
Part-I	Operations and workmanship
Part-II	Schedules
IS:2395	Code of practice for painting concrete, masonry and plaster surfaces.
Part-I	Operations and workmanship.
Part-II	Schedule.
IS:2524	Code of practice for painting of nonferrous metals in buildings.
Part-I	Pretreatment.
Part-II	Painting.
IS:2932	Specification of synthetic enamel paint, exterior, under-coating and finishing.
IS:2933	Specification enamel paint, under coating and finishing.
IS:4759	Code of practice for hot dip zinc coating on structural steel and other allied products.
IS:5410	Specification for cement paint

IS:5411 (Part-I) Specification for plastic emulsion paint-for exterior use

IS:6278 Code of practices for white washing and colour washing.

IS:10403 Glossary of terms relating to building finishes.

Piling and Foundation

IS:1080 Code of practice for design and construction of simple spread foundations.

IS:1904 Code of practice for design and construction of foundations in Soils; General Requirements.

IS:2911 Code of practice for designs and construction of Pile foundations (Relevant Parts).

IS:2950 (Part-I) Code of practice for designs and construction of Raft foundation.

IS:2974 (Part-I TO V) Code of practice for design and construction of machine foundations.

IS:6403 Code of practice for determination of Allowable Bearing pressure on Shallow foundation.

IS:8009 Code of practice for calculation of settlement of foundation subjected to symmetrical vertical loads.

Part-I Shallow foundations.

Part-II Deep foundations.

IS:12070 Code of practice for design and construction of shallow foundations on rocks.

DIN:4024 Flexible supporting structures for machines with rotating machines.

VDI:2056 Criteria for assessing mechanical vibrations of machines.

VDI:2060 Criteria for assessing rotating imbalances in machines. Stop Log and Trash Rack

IS:4622 Recommendations for fixed - wheel gates structural design.

IS:5620 Recommendations for structural design criteria for low head slide gates.

IS:11388 Recommendations for design of trash rack for intakes.

IS:11855 General requirements for rubber seals for hydraulic gates. Roads

IRC:5 Standard specifications and Code of practice for road bridges, section-I general Features of Design.



IRC:14	Recommended practice of 2cm thick bitumen and tar carpets.
IRC:16	Specification for priming of base course with bituminous primers.
IRC:19	Standard specifications and code of practice for water bound macadam.
IRC:21	Standard specifications and Code of practice for road bridges, section-III - Cement concrete (plain and reinforced).
IRC:34	Recommendations for road construction in waterlogged areas.
IRC:36	Recommended practice for the construction of earth embankments for road works.
IRC:37	Guidelines for the Design of flexible pavements.
IRC:56	Recommended practice for treatment of embankment slopes for erosion control.
IRC:73	Geometric design standards for rural (non-urban) highways.
IRC:86	Geometric Design standards for urban roads in plains.
IRC:SP:13	Guidelines for the design of small bridges & culverts.
IRC - Publication	Ministry of Surface Transport (Roads Wing), Specifications for road and bridge works.
IS:73	Specification for paving bitumen
Loadings	
IS:875 (Pt. I to V)	Code of practice for design loads other than earthquake) for buildings and structures.
IS:1893	Criteria for earthquake resistant design of structures.
IS:4091	Code of Practice for design and construction of foundation for transmission line towers & poles.
IRC:6	Standard specifications & code of practice for road bridges, Section-II Loads and stresses.
M.O.T.	Deptt. of railways Bridge Rules.
Safety	
IS:3696 (Part I & II)	Safety code for scaffolds and ladders.
IS:3764	Safety code for excavation work.
IS:4081	Safety code for blasting and related drilling operations.
IS:4130	Safety code for demolition of buildings.

IS:5121	Safety code for piling and other deep foundations.
IS:5916	Safety code for construction involving use of hot bituminous materials.
IS:7205	Safety code for erection on structural steelwork.
IS:7293	Safety code for working with construction machinery.
IS:7969	Safety code for handling and storage of building materials
IS:11769	Guidelines for safe use of products containing asbestos.
-	Indian Explosives Act. 1940 as updated.

Architectural design of buildings

SP:7	National Building Code of India
SP:41	Hand book on functional requirements of buildings (other than industrial buildings)

Miscellaneous

IS:802	Code of practice for use of structural steel in (Relevant parts) overhead transmission line towers.
IS:803	Code of practice for design, fabrication and erection of vertical mild steel cylindrically welded in storage tanks.
IS:10430	Criteria for design of lined canals and liner for selection of type of lining.
IS:11592	Code of practice for selection and design of belt conveyors.
IS:12867	PVC handrails covers.
CIRIA	Design and construction of buried thin-wall pipes. Publication

REFERENCE CODES AND STANDARDS FOR CONTROL AND INSTRUMENTATION

The design, manufacture, inspection, testing & installation of all equipment and system covered under this specification shall conform to the latest editions of codes and standards mentioned below and all other applicable VDE, IEEE, ANSI, ASME, NEC, NEMA, ISA AND Indian Standards and their equivalents.

Temperature Measurements

1. Instrument and apparatus for temperature measurement - ASME PTC 19.3 (1974).
2. Temperature measurement - Thermocouples ANSI MC 96.1 - 1982.
3. Temperature measurement by electrical Resistance thermometers - IS:2806.
4. Thermometer - element - Platinum resistance - IS:2848.

Pressure Measurements

1. a) Instruments and apparatus for pressure measurement - ASME PTC 19.2 (1964).



- b) Electronic transmitters BS:6447.
- 2. Bourdon tube pressure and vacuum gauges - IS:3624 - 1966.
- 3. Process operated switch devices (Pr. Switch) BS-6134.

Flow Measurements

Instruments and apparatus for flow measurements - ASME PTC 19.5 (1972) Interim supplement, Part-II.

Measurement of fluid flow in closed conduits - BS-1042.

Electronic Measuring Instrument & Control Hardware / Software

1. Automatic null balancing electrical measuring instruments - ANSI C 39.4 (Rev. 1973): IS:9319.
2. Safety requirements for electrical and electronic measuring and controlling instrument - ANSI C 39.5 - 1974.
3. Compatibility of analog signals for electronic industrial process instruments - ISA - S 50.1 (1982) ANSI MC 12.1 - 1975.
4. Dynamic response testing of process control instrumentation ISA - S 26 (1968).
5. Surge Withstand Capability (SWC) tests - ANSI C 37.90 a/IEEE-472 or suitable class of IEC-255-4 equivalent to ANSI C37.90a/IEEE-472.
6. Printed circuit boards - IPC TM - 650, IEC 326 C.
7. General requirement and tests for printed wiring boards - IS 7405 (Part-I) 1973.
8. Edge socket connectors - IEC 130-11.
9. Requirements and methods of testing of wire wrap terminations DIN 41611 Part-2.
10. Dimensions of attachment plugs & receptacles - ANSI C 73 - 1973 (Supplement ANSI C 73 a - 1980).
11. Direct acting electrical indicating instrument - IS:1248 - 1968 (R).
12. Standard Digital Interface for Programmable Instrumentation - IEEE-488.2 - 1990.
13. Information Processing Systems - Local Area Networks - Part 2 : Logical Link Control - IEEE-802.2 - 1989.
14. Standard for Local Area Networks : Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1985.
15. Supplements A, B, C and E to Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1988.

16. Standard for Local Area Networks : Token - Passing Bus Access Method - IEEE-802.4 - 1985.
17. Standard for Local Area Networks : Token - Ring Access Method and Physical Layer Specification - IEEE-802.5 - 1985.
18. IEEE Guide to Software Requirements Specifications - IEEE-830 - 1984.
19. Hardware Testing of Digital Process Computers - ISA RP55.1 - 1983.
20. Electromagnetic Susceptibility of Process Control Instrumentation - SAMA PMC 33.1 - 1978.
21. Interface Between the Data Terminal Equipment and Data Circuit - Terminating Equipment Employing Serial Binary Data Interchange - EIA-232- D-1987.
22. Electromagnetic Compatibility for Industrial Process Measurement and Control Equipment, Part 3 : Radiated Electromagnetic Field Requirements - IEC 801-3-1984.

Instrument Switches and Contact

1. Contact rating - AC services NEMA ICS 2 - 1978 (with revision through May 1983), Part - 2-125, A6000.
2. Contact rating - DC services NEMA ICS 2-1978 Part-2 125, N600.

Enclosures

1. Type of Enclosures - NEMA ICS Part - 6 - 1978 (with Rev. 1 4/80) through 110.22 (Type 4 to 13).
2. Racks, panels and associated equipment - EIA : RS - 310 C- 1983 (ANSI C 83.9 - 1972).
3. Protection class for Enclosures, cabinets, control panels & desks - IS:2147 - 1962.

Apparatus, enclosures and installation practices in hazardous area

1. Classification of hazardous area - NFPA 70 - 1984, Article 500.
2. Electrical Instruments in hazardous dust location - ISA - 512.11, 1973.
3. Intrinsically safe apparatus - NFPA 493 1978.
4. Purged and pressurised enclosure for electrical equipment in hazardous location - NFPA 496-1982.
5. Enclosures for Industrial Controls and Systems - NEMA IS 1.1 - 1977.

Sampling System

1. Stainless steel material of tubing and valves for sampling system - ASTMA 296-82, Grade 7 P 316.
2. Submerged helical coil heat exchangers for sample coolers ASTM D11 92-1977.



3. Water and steam in power cycle - ASME PTC 19.11.
4. Standard methods of sampling system - ASTM D 1066-99.

Annunciators

1. Specifications and guides for the use of general purpose annunciators - ISA S 19.1, 1979.
2. Surge withstand capability tests - ANSI C 37.90a - 1989/IEEE-472 or suitable class of IEC 255-4 equivalent to ANSI C37.90a 1989/IEEE-472
3. Damp heat cycling test - IS:2106
4. Specification for Electromagnetic Susceptibility - SAMA DMC 33, 1/78

Protections

1. Relays and relay system associated with electric power apparatus. ANSI C 37.90, 1 - 1989.
2. General requirements & tests for switching devices for control and auxiliary circuits including contactor relays - IS:6875 (Part-I) - 1973.
3. Turbine water damage prevention - ASME TDP-1-1980.
4. Boiler safety interlocks - NFPA Section 85 B - 1984, 85 C - 1991.

UPS System

1. Practices and requirements for semi-conductor power rectifiers - ANSI C 34.2, 1973.
2. Relays and relays system associated with electrical power apparatus - ANSI C 3.90 - 1983.
3. Surge withstand capability test - ANSI C 37.90 1 -1989.
4. Performance testing of UPS - IEC 146.
5. Stationary cells & Batteries Lead Acid type (with tubular positive plates) specification IS-1651-1991.
6. Recommended practice for sizing large lead storage batteries for generating stations & sub-stations - IEEE-485-1985.
7. Printed Circuit Board - IPC TM 650, IEC 326C.
8. General Requirements & tests for printed wiring boards, IS:7405 (Part-I) 1973.

Control Valves

1. Control valve sizing - Compressible & Incompressible fluids - ISA S 75.01-1985.
2. Face to face dimensions of control valves - ANSI B 16.00 - 1973.
3. ISA Hand Book of Control Valves - (ISBN : B: 1047-087664-234-2).



4. Codes for pressure piping - ANSI B 31.1
5. Control Valve leak class - ISA RP 39.6

Process Connection & Piping

1. Codes for pressure piping "power piping" - ANSI B 31.1.
2. Seamless carbon steel pipe ASTM - A - 106.
3. Forged & Rolled Alloy steel pipe flanges, forged fittings and valves and parts - ASTM - A - 182.
4. Material for socket welded fittings - ASTM - A - 105.
5. Seamless ferritic alloy steel pipe - ASTM - A - 335.
6. Pipe fittings of wrought carbon steel and alloy steel - ASTM - A - 234.
7. Composition bronze of ounce metal castings - ASTM - B - 62.
8. Seamless Copper tube, bright annealed - ASTM - B - 168.
9. Seamless copper tube - ASTM - B - 75.
10. Dimension of fittings - ANSI - B - 16.11.
11. Valves flanged and butt welding ends - ANSI - B - 16.34.

Instrument Tubing

1. Seamless carbon steel pipe - ASTM - A 106.
2. Material of socketweld fittings - ASTM - A105.
3. Dimensions of fittings - ANSI - B - 16.11.
4. Code for pressure piping, welding, hydrostatic testing - ANSI B 31.1.

Cables

1. Thermocouples extension wires/cables - ANSI MC 96.1 - 1992.
2. Requirements for copper conductor-Wiring cables for telecommunications & information processing system - VDE:0815.
3. Colour coding of single or multi-pair cables - ICEA - S - 61-402 (third edition) NEMA WCS - 1979 with revisions through 2/83.
4. Insulation & Sheathing compounds for cables : VDE 0207 (Part-4, 5 & 6).
5. Guide design and installation of cable systems in power generating stations (insulation, jacket materials) - IEEE Std. 422-1977.
6. Rules for Testing insulated cables and flexible cables : VVDE - 0472
7. Requirements of vertical flame propagation test - IEEE 383 - 1974 (R 1980)
8. Standard specification for tinned soft or annealed copper wire for electrical purpose



- ASTM B-33-81.
- 9. Oxygen index and temperature index test - ASTM D - 2863.
- 10. Smoke density measurement test - ASTM D - 2843.
- 11. Acid gas generation test - IEC - 754 - 1.
- 12. Swedish Chimney test - SEN - 4241475 (F3).
- 13. Teflon (FEP) insulation & sheath test - ASTM D - 2116.
- 14. Thermocouple compensating cables - Testing requirements & sampling plan IS:8784.
- 15. PVC insulated electric cables for working voltage upto and including 1100 V - IS:1554 (Part-I).

Cable Trays, Conduits

- 1. Guide for design and installation of cable systems in power generating station (Cable trays, support systems, conduits) - IEEE Std. 422, 1977, NEMA VE-1 1979, NFPA 70-1984.
- 2. -do- Test Standards. NEMA VE-1-1979.
- 3. Zinc coating "hot dip" on assembled products for galvanising of carbon steel cable trays - ASTM A - 386-78.

Public Address System

- 1. Specifications for loud speakers - IS:7741 (Part-I, II and III)
- 2. Code of safety requirement for electric mains operated audio amplifiers - IS:1301
- 3. Specification for Public Address Amplifiers - IS:10426.
- 4. Code of practice for outdoor installation of PA system - IS:1982.
- 5. Code of practice for installation for indoor amplifying and sound distribution system - IS:1881.
- 6. Basic environmental testing procedures for electronic and electrical items - IS:9000.
- 7. Characteristics and methods of measurements for sound system equipment - IS:9302
- 8. Code of practice of electrical wiring installations (System voltage not exceeding 650 volts) - IS:732
- 9. Rigid steel conduits for electric wiring - IS:9537 (Part-I and II)
- 10. Fittings for rigid steel conduits for electrical wiring - IS:2667
- 11. Degree of protection provided by enclosure for low voltage switchgear and control gear - IS:2147.

Vibration Monitoring System

1. API 670 - 1994
2. BS : 4675 Part-2

ANNEXURE-I

MFGR.'s LOGO	MANUFACTURER'S NAME AND ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT : PACKAGE : CONTRACT NO. : MAIN-SUPPLIER :							
			ITEM :		QP NO.: REV.NO: DATE: PAGE: OF....									
SL. NO	COMPONENT & OPERATIONS	CHARACTERI STICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK		REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD		AGENCY			REMARKS
					M	C/N					M	C	N	
1.	2.	3.	4.	5.	6.		7.	8.	9.	D*	** 10.			11.
				LEGEND: * RECORDS, IDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. ** M: MANUFACTURER/SUB-SUPPLIER C: SUPPLIER/NOMINATED INSPECTION AGENCY, N: THE OWNER P: PERFORM W: WITNESS AND V: VERIFICATION. AS APPROPRIATE, CHP: THE OWNER SHALL IDENTIFIED IN COLUMN "N"				  DOC. NO.: REV..... CAT.....						
MANUFACTURER / SUB-SUPPLIER		MAIN- SUPPLIER						FOR THE OWNER USE						
SIGNATURE										REVIEWED BY		APPROVED BY		APPRO VAL SEAL

ANNEXURE-II

SUPPLIER'S LOGO		SUPPLIER'S NAME AND ADDRESS		FIELD QUALITY PLAN			PROJECT :				
				ITEM :	QP NO.:		PACKAGE :				
				SUB-SYSTEM :	REV.NO.:		CONTRACT NO. :				
					DATE:		MAIN-SUPPLIER:				
				PAGE: OF....							
S. N O	ACTIVITY AND OPERATION	Characteristics / instruments	CLASS# OF CHECK	TYPE OF CHECK	QUANTU M OF CHECK	REFERENC E DOCUMENT	ACCEPTA NCE NORMS	FORMAT OF RECORD		REMARK S	
1.	2.	3.	4.	5.	6.	7.	8.	9.	D*	10.	
		LEGEND: * RECORDS , INDENTIFIED WITH "TICK" (✓) SHALL BE ESSENTIALLY INCLUDED BY SUPPLIER IN QA DOCUMENTATION. LEGEND TO BE USED: CLASS #: A = CRITICAL, B=MAJOR, C=MINOR; 'A' SHALL BE WITNESSED BY THE OWNER FQA, 'B' SHALL BE WITNESSED BY OWNER'S ERECTION / CONSTRUCTION DEPTT. AND 'C' SHALL BE WITNESSED BY ERECTION SUPPLIER (A & B CHECK SHALL BE OWNER CHP STAGE)				 DOC. NO.: REV.....					
MANUFACTURER / SUB-SUPPLIER						MAIN- SUPPLIER		FOR THE OWNER USE			
SIGNATURE											

ANNEXURE-III

		Project : Stage :		LIST OF ITEMS REQUIRING QUALITY PLAN AND SUB-SUPPLIER APPROVAL						DOC. NO.:	
		Package :								REV. NO.:	
		Supplier :		DATE :							
		Bidder No. :		SUB-SYSTEM:						PAGE : OF	
S. N.	Item	QP / Insp. Cat.	QP No.	QP Sub. Schedule	QP approval schedule	Proposed sub-supplier	Place	Sub-suppliers approval status / category	Sub-supplier Details submission schedule	Remarks	

LEGENDS

1. SYSTEM SUPPLIER / SUB-SUPPLIER APPROVAL STATUS CATEGORY (SHALL BE FILLED BY the Owner)

A – For these items proposed vendor is acceptable to the Owner. To be indicated with letter “A” in the list alongwith the condition of approval, if any.

DR – For these items “Detailed required” for the Owner review. To be identified with letter “DR” in the list.

NOTED – For these items vendors are approved by Main Supplier and accepted by the Owner without specific vendor approval from the Owner. To be identified with “NOTED.”

2. QP / INSPN CATEGORY:

CAT-I: For these items the Quality Plans are approved by the Owner and the final acceptance will be on physical inspection witness by the Owner.

CAT-II: For these items the Quality Plans approved by the Owner. However no physical inspection shall be done by the Owner. The final acceptance by the Owner shall be on the basis review of documents as per approved QP.

CAT-III: For these items Main Supplier approves the Quality Plans. The final acceptance by the Owner shall be on the basis certificate of conformance by the main supplier.

UNITS / WORKS: Place of manufacturing Place of Main Supplier of multi units/works.

[illegible]

ANNEXURE-V

		Project : Stage :		FIELD WELDING SCHEDULE (To be raised by the Bidder) Welding Code:									DOC. NO.:			
		Bidder :											REV. NO.:			
		Bidder No. :											DATE :			
		System :											PAGE : OF			
Sl. No.	DRG No. for Weld Location and Identification mark	Description of parts to welded	Matl. Spec.	Dimensions		Process of welding	Type of Weld	Electrode filler spec.	WPS. No.	Min. pre-heat	Heat treatment		NDT method / Quantum	REF		Remarks
											Temp.	Holding time		Spec. No.	ACC Norm Ref.	
NOTES:																
SIGNATURE																

ANNEXURE-VI
DOCUMENTS DISTRIBUTION SCHEDULE

S.No.	Description of Document	DESEIN				UPRVUNL			
		HO		SITE		HO		SITE	
		HC	CC	HC	CC	HC	CC	HC	CC
1.	Drawings, Data Sheets, Calculation, all equipment / Instrument Schedule, BOM etc. a) For Approval b) Resubmission c) For Information	6*	1	-	-	2	1	-	-
2.	Final Approved Documents	2	1 + 1 CD	1	1	1	1 + 2 CD	4	1 + 1 CD
3.	Drawings / Documents 'As Built'	2	1 + 1 CD	1	1	2	1 + 2 CD	4	1 + 1 CD
4.	Type Test Reports (Initial)	4*	1 + 1 CD	-	-	2	1 + 2 CD	-	-
5.	Type Test Report (Final)	2	1 + 1 CD	1	1	2	1 + 2 CD	4	1 + 1 CD
6.	Piping / Equipment Analysis (Transient) etc., Model Study Report (Draft) including Input / Output date etc.	4*	1	-	-	2	1 + 1 CD	-	-
7.	Piping / equipment Analysis (Transient) etc. Model Study Report (Final Approval) including Input / Output date	2	1 + 1 CD	-	-	2	1 + 2 CD	2	1 + 1 CD
8.	Erection Manual (Draft)	3*	1CD	-	-	1	1CD	-	-



1 x 660 MW - Panki Thermal Power Station

Bidding Doc. No. : 14A14-SPC-G-0001



S.No.	Description of Document	DESEIN				UPRVUNL			
		HO		SITE		HO		SITE	
		HC	CC	HC	CC	HC	CC	HC	CC
9.	Erection Manual 'Final'	1	1CD	1	-	1	1CD	2	1CD
10.	O&M Manual 'Draft'	3*	1CD	+	-	1	1CD	-	-
11.	O&M Manual 'Final'	1	1CD	1	-	1	1CD	2	2CD
12.	Commissioning Procedure 'Draft'	3*	1CD	-	-	1	1CD	-	-
13.	Commissioning Procedure 'Final'	1	1CC	1	-	1	1CD	2	1CD
14.	PG Test Procedure "Draft"	3*	1	-	-	1	1	-	-
15.	PG Test Procedure 'Final'	1	1 + 1 CD	1	-	2	1 + 1 CD	2	1 + 1 CD
16.	Progress Report	3	1CD	1	-	2	1CD	1	1CD
17.	PG Test Report for Approval	4*	1	-	-	2	1 + 1 CD	-	-
18.	Approved PG Test Report	1	1 + 1 CD	1	-	2	1 + 1 CD	4	1 CD
19.	Project Completion Report	1	1 + 1 CD	1	-	1	1CD	1	1CD
20.	Vendor Details in respect of proposed vendors including Contractor's evaluation Report	1	1CD	-	-	1	1CD	-	-
21.	Monthly Vendor / QP Approval Status	1	1	-	-	2	1	1	1
22.	Manufacturing QPs, Field QPs for review / comments	6*	1	-	-	2	1CD	-	-
23.	Manufacturing QPs, Field QP, Final	1	1CD	1	-	2	1CD	2	1CD
24.	QA documents Package for equipment / field activities etc.	1	1CD	1	-	1	1CD	1	1CD

- * - Consultant will return one (1) commented document to Vendor and CE (UPRVUNL), Lucknow
- HC - Hard Copy
- CC - Soft Copy thru e-mail
- CD - CD ROM
- HO - Head Office of Consultant / UPRVUNL



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ANNEXURE-VII

PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant

QUALITY ASSURANCE & INSPECTION QA SYSTEM & PROGRAMME	Integrated QA Management System for enhanced reliability of equipments	Operational feedback Co-relationn of reliability and performance of the equipment with implementation of QA system. Appreciation of use of	Appreciation of implementation of QA Programmes in various manufacturing, assembly and testing activities. Appreciation of developmental	
	QA system in design, procurement, manufacturing, installation and operation of the equipments/ systems			
	QA system for developing and establishing new processes and vendors.			

ANNEXURE-VII

PRODUCT	AREAS OF TRAINING REQUIREMENT			
	Product Design	Plant Visit	Visit To Manufacturer's Work	Operation & Maintenance Of Plant
		structured Engg./QA documentation during Operational phase of plant and during RLA studies of plant	activities for new processes and vendors. System of prequalification of special processes	
	System of structured documentation of Engg. And test records			
MANDAYS	16	3		
PLC	Hardware organization		Manufacturing process of PLC hardware	
	Operating system features		Integration & testing facilities	
	Data base organization			
	Logic/loop algorithm			
	Development of control logic & loop s/w & MMI application development			



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Chapter 27: LP PIPING, VALVES & SPECIALITIES**27.0 LP PIPING, VALVES & SPECIALITIES****27.1 Equipment sizing Criteria**

27.1.1 All the piping systems and equipment supplied under this package shall be designed to operate without replacement and with normal maintenance for a plant service life of 30 years, and shall withstand the operating parameter fluctuations and cycling which can be normally expected during this period.

27.1.2 For all LP piping system covered under this specification, sizing and system design shall be to the requirements of relevant codes and standard indicated elsewhere. In addition to this, requirements of any statutory code as applicable shall also be taken into consideration.

27.1.3 Inside diameters of piping shall be calculated for the flow requirements of various systems. The velocities for calculating the inside diameters shall be limited to the following.

a) Water Application**Water Velocity in m/sec**

	Pipe Size	Below 50 mm	50-150 mm	200 mm & above
a)	Pump suction	-----	1.2 - 1.5	1.2 - 1.8
b)	Pump discharge and recirculation	1.2-1.8	1.8 - 2.4	2.1 - 2.5
c)	Header	----	1.5 - 2.4	2.1 - 2.4

The pipes in CW, ACW & DMCW system shall be designed to maintain a maximum velocity of 2 m/s inside the pipelines at pump discharge.

Pipe line under gravity flow shall be restricted to a flow velocity of 1 m/sec generally. Channels under gravity flow shall be sized for a maximum flow velocity of 0.6 m/sec.

WILLIAM & HAZEN formula shall be used for calculating the friction loss in piping systems with the following "C" value.

i)	Carbon steel pipe	100
ii)	CI Pipe/Ductile Iron	100
iii)	Rubber lined steel pipe	120
iv)	Stainless steel pipe	100

For calculating the required pump head for pump selection, at least 10% margin shall be taken over the pipe friction losses and static head shall be calculated from the minimum water level of the tank/sump/reservoir from which the pumps draw water.

b) Compressed Air Application

Compressed air – 15.0 m/sec. (under Average Pressure & Temp. conditions)

- 27.1.4 The pipes shall be sized for the worst (i.e. maximum flow, temp. and pressure values) operating conditions.
- 27.1.5 Based on the inside dia. so established, thickness calculation shall be made as per ANSI B 31.1 OD and thickness of pipes shall than be selected as per ANSI B 36.10/IS-1239 Heavy grade/IS-3589/ASTM-A-53/API-5L/ANSI B 36.19 as the case may be.
- 27.1.6 Corrosion allowance of 1.6 mm will be added to the calculated thickness being considered.
- 27.1.7 Bend thinning allowance/manufacturing allowance etc. shall be as per the requirement of the design code provision.
- 27.1.8 High points in piping system shall be provided with vents alongwith valves as per the system requirement. Low points shall be provided with drains alongwith drain valves as per the system requirement. Drain lines shall be adequately sized so as to clear condensate in the lines. Material for drain and vent lines shall be compatible with that of the parent pipe material.
- 27.1.9 Material of construction for pipes carrying various fluids shall be as specified elsewhere.
- 27.1.10 Compressed air pipe work shall be adequately drained to prevent internal moisture accumulation and moisture traps shall be provided at strategic locations in the piping systems.
- 27.1.11 Depending upon the size and system pressure, joints in compressed air pipe work shall be screwed or flanged. The flange shall be welded with the parent pipe at shop and shall be hot dip galvanized before dispatch to site. Alternatively, the flanges on GI pipes may be screwed-on flanges also.
- 27.1.12 Threaded joints shall be provided with Teflon sealant tapes.
- 27.1.13 Following types of valves shall be used for the system/service indicated.

System	Type of Valves					
	Butterfly	Gate	Globe	Check	Ball	Plug
Water	X	X	X	X	X	
Air		X	X	X	X	
Drains & Vents			X	X	X	
Fuel oil		X	X	X	X	X

In water service, valves above 200 NB size may be butterfly valves.

27.1.14 Recirculation pipes alongwith valves, breakdown orifices etc. shall be provided for important pumping systems as indicated in respective process and instrumentation diagrams (P&IDs). The recirculation pipe shall be sized for minimum 30% design flow of single pump operation or the recommended flow of the pump manufacturer whichever is higher.

27.1.15 All Piping 450 NB & Above shall be designated as Large dia Piping.

27.2.00 TECHNICAL SPECIFICATION

27.1.00 GENERAL

Specific technical requirements of low-pressure piping, fittings, supports, valves, specialties and tanks etc. have been covered under this Sub-section. It includes details pertaining to design and material of construction for piping, fittings, valves, equipment, etc. cleaning/surface preparation application of primer and painting on over ground piping. It also includes detailed technical requirement of laying underground/buried piping including water proofing/anti corrosive protection. It also covers design, engineering, manufacturing, fabrication, technical details of piping, valves, specialties, piping hangers/supports, tanks etc.

27.2.00 Pipes and fittings

27.2.1 All low pressure piping systems shall be capable of withstanding the maximum pressure in the corresponding lines at the relevant temperatures. However, the minimum thickness shall be adhered to. The bidder shall furnish the pipe sizing / thickness calculation as per the criteria mentioned above under LP piping equipment sizing criteria of this Technical Specification.

27.2.2 Piping and fittings coming under the purview of IBR shall be designed satisfying the requirements of IBR as a minimum.

27.2.3 Supporting arrangement of piping systems shall be properly designed for systems where hydraulic shocks and pressure surges may arise in the system during operation. Bidder should provide necessary protective arrangement like anchor blocks/anchor bolt etc. for the safeguard of the piping systems under above mentioned conditions. The requirement will be, however, worked out by the contractor and he will submit the detailed drawings for thrust/anchor block to the Employer. External, and internal, attachments to piping shall be designed so as not to cause flattening of pipes and excessive localized bending stresses.

27.2.4 Bends, loops, off sets, expansion or flexible joints shall be used as required in order to prevent overstressing the piping system and to provide adequate flexibility. Flexibility analysis (using software packages such as Caesar-II etc.) shall be carried out for sufficiently long piping (straight run more than 300M).

27.2.5 The hot lines shall be supported with flexible connections to permit axial and lateral movements. Flexibility analysis shall be carried out for pipelines which have considerable straight run as indicated above and necessary loops/expansion joint etc. shall be provided as may be necessary depending on layout.

- 27.2.6 Piping and fittings shall be manufactured by an approved manufacturer of repute. They should be truly cylindrical of clear internal diameter, of uniform thickness, smooth and strong, free from dents, cracks and holes and other defects.
- 27.2.7 For rubber lined ERW pipes, beads shall be removed.
- 27.2.8 Inspection holes shall be provided at suitable locations for pipes 800 NB and above as required for periodic observations and inspection purposes.
- 27.2.9 At all intersection joints, it is Contractor's responsibility to design and provide suitable reinforcements as per the applicable codes and standards.
- 27.2.10 For large size pipes/duct, at high point and bends/change of direction of flow, air release valves shall be provided as dictated by the system requirement and operation philosophy & tripping conditions of pumping system. Sizing criteria for air release valves shall be generally on the basis of valve size to pipe diameter ratio of 1:8. Requirement shall be decided as per relevant code.

Transient analysis / surge analysis wherever specified and required shall be conducted in order to determine the location, number and size of the Air-Release valve on certain long distance/high volume piping systems such as CW/ ACW/ Raw Water etc.

27.3.00 Material

- 27.3.1 Alternate materials offered by Bidder against those specified shall either be equal to or superior to those specified, the responsibility for establishing equality or superiority of the alternate materials offered rests entirely with the Bidder and any standard code required for establishing the same shall be in English language.
- 27.3.2 No extra credit would be given to offers containing materials superior to those specified. Likewise no extra credit would be given to offers containing pipe thickness more than specified.
- 27.3.3 All materials shall be new and procured directly from the manufacturers. Materials procured from traders or stockiest are not acceptable.
- 27.3.4 All materials shall be certified by proper material test certificates. All material test certificates shall carry proper heat number or other acceptable reference to enable identification of the certificate that certifies the material.
- 27.3.5 Material of construction for pipes carrying various fluids shall be as follows:

1	Intake Water, Raw water, Ash water, Circulating Water (CW), Aux. Cooling water (ACW), clarified Water, CW blow down, *Effluent disposal, service water, AHP Seal Water, Air Pre-Heater Wash water, Passivated DM Water and clarifier sludge.	IS-2062 Gr. B/ASTM-A-36/ASTM A-53 type 'E' Gr. B/IS-3589 Gr. 410/IS-1239 Heavy. Buried CW pipes shall be encased in 500 mm thk RCC. At road crossings live loads should be considered and this encasing thickness shall vary accordingly. 150 NB & above pipes shall be spiral welded.
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2	Dematerialized water, (condenser Make up water, Boiler fill and Deaerator Fill water) & DMCW overhead tank make-up water	Stainless steel to ASTM A-312, Gr. 304 welded for sizes above 50mm NB Stainless steel to ASTM A312, Gr. 304 sch. 40 Seamless for sizes 50 mm and below
3.	*Drinking (potable) water	ASTM A-53 type E Gr. B galvanized /IS 1239 heavy galvanized/IS 3589 Gr 410 Galvanized to IS-4736 or equivalent.
4.	Instrument air & plant air.	ASTM A-53 type E Gr. B galvanized /IS 1239 heavy galvanized/IS 3589 Gr 410 Galvanized to IS-4736 or equivalent.
5.	Fuel Oil piping	API5L

NOTE: Bidder to note that for Effluent disposal system and potable water system for colony (* marked) Ductile Iron (DI) pipes conforming to IS 8329 and for fittings IS 9523 can be offered as an alternate to the mild steel/ galvanized mild steel pipes as specified above for standalone or outside plant boundary stretches. Various design aspects of DI piping has been discussed later in Annexure-I.

27.3.6 In water lines, pipes upto 150 mm NB shall conform to ANSI B36.10/ASTM-A-53, Type-E Gr. B/IS:1239 Gr. Heavy and minimum selected thickness shall not be less than IS: 1239 Grade heavy except for demineralised water, drinking water and condensate spill lines.

27.3.7 Pipes of above 150 mm NB shall be to AWWA-C200/ANSI B 36.10/ASTM A-53/IS 3589 Gr. 410. Pipe to be fabricated by the bidder shall be rolled and butt welded from plates conforming to ASTM A-53 type 'E' Gr. B/IS 2062 Gr. B/ASTM-A-36. However, larger pipes, i.e. 1000 mm NB and above shall be made from plates conforming to ASTM A 36/IS 2062 Gr. B and shall meet the requirements of AWWA-M-11(for deflection & buckling criteria considering water filled pipe as well as vacuum condition that may prevail during transient/ surge conditions, truck-load, rail-load and weight density for compacted soil or any other load as the case may be).

27.3.8 In demineralised water service, the pipes upto 50 NB shall be of stainless steel ASTM A 312, Gr. 304 sch. 40 Seamless. The size for these pipes shall be to ANSI B 36.19. These shall be socket welded. The material for pipe from 65 mm NB upto and including 400 NB shall be to ASTM A 312, Gr. 304 (welded). In no case the thickness of fittings shall be less than parent pipe thickness.

Bidder/Contractor shall note that pipes offered as per a particular code shall conform to that code in all respects i.e. Dimension, tolerances, manufacturing methods, material, heat treatment, testing requirements, etc. unless otherwise mentioned elsewhere in the specification.

27.3.9 Instrument air, Plant (service) air lines and Drinking water lines shall be to ASTM A 53 type E grade B/ANSI B 36. 10/IS 3589, Gr. 410/IS: 1239 Heavy (in case thickness calculated is more than gr. Heavy, ANSI B 36.10 Schedule numbers shall be followed) and galvanized to IS 4736 or any equivalent

internationally reputed standard. The material of the pipes shall be to ASTM A 53 type 'E' Gr. B/IS: 3589, Gr. 410/IS: 1239 Gr. Heavy. The fittings shall be of either same as parent material or malleable iron to IS-1879 (galvanized).

- 27.3.10 Spiral welded pipes as per API-5L/IS-3589 are also acceptable for pipe of size above 150 NB. However minimum thickness of the pipes shall be as elaborated in above clauses.
- 27.3.11 Condensate lines shall be to ASTM A 106 Gr. B and dimension to ANSI B 36.10 schedule "standard" as minimum to be maintained.
- 27.3.12 If carbon steel plates of thickness more than 12 mm are used for manufacture of pipes, fittings and other appurtenances, then the same shall be control-cooled or normalized as the case may be following the guidelines of the governing code.
- 27.3.13 Buried CW Pipes/ headers shall be minimum 12 mm thick, encased in 500 mm thk RCC. However this thickness shall be reviewed for live loads at road crossings according to AWWA M11 and increased adequately, if required.

27.4.0 Piping Wall Thickness

- 27.4.1 The calculation of wall thickness required for pipelines subject to internal and/or external pressure shall be based on the formulae and recommendations as given in the applicable codes. Adequate allowances shall be made towards thinning due to bending, weakening at branch connections, threading, commercial tolerances on pipe wall thickness, corrosion and erosion, etc., and the same shall be subject to approval by Purchaser. In any case a minimum corrosion allowance of 1.6 mm shall be considered while selecting the thickness.
- 27.4.2 In case of carbon steel materials, the nominal wall thickness of pipeline shall not be less than the minimum acceptable values given below:

NB mm (inch)	15 (1/2)	30 (3/4)	25 (1)	32 (1¼)	40 (1.5)	50 (2)	65 (2.5)	80 (3)	100 (4)	125 (5)
Min. thickness, mm	3.2	3.2	3.6	3.6	3.6	3.6	3.6	4.0	4.5	5.4
NB mm (inch)	150 (6)	200 (8)	250 (10)	300 (12)	350 (14)	400 (16)	450 (18)	500 (20)	600 (24)	
Min. thickness, mm	5.4	6.35	6.35	6.35	7.1	7.1	7.1	8.0	8.0	

> NB 600 mm to NB 900 mm	-	8.0 mm
> NB 900 mm to NB 1200 mm	-	10.0 mm
> NB 1200 mm to 1400 mm	-	12.0 mm
> NB 1400 mm to 1600 mm	-	14.0 mm
> NB 1600 mm to NB 2200 mm	-	16.0 mm
> NB 2200 mm	-	18.0 mm

NOTE: For buried CW pipe with 500 mm thick RCC encasing (as detailed in cl. no. 27.3.5), the minimum acceptable thickness shall be as indicated below.

> NB 600 mm to NB 900 mm	-	8.0 mm
> NB 900 mm to NB 1200 mm	-	10.0 mm
> NB 1200 mm	-	12.0 mm

27.5.00 Piping Layout

- 27.5.1 Piping shall be grouped together where practicable and routed to present a neat appearance.
- 27.5.2 Piping routing shall be such as to provide sufficient clearance for removal and maintenance of equipment, easy access to valves, instruments and other accessories. The piping shall not encroach on the withdrawal space of various equipments.
- 27.5.3 Over head piping shall have a normal minimum vertical clearance of 2.5 meters above walkways and working areas and 8 m above roadways/railways. When several pipelines are laid parallel, flanged joints must be staggered. Welded and flanged joints should as far as possible be located at one third span from supports. If the support is situated right under the welded joints this joint must be reinforced with a strap. Flanged and welded joints must be avoided in the middle of the span. Valves should be located in such a manner so as to ensure their convenient operation from the floor or the nearest platform.
- 27.5.4 Pipelines of NB 50 size and below are regarded as field run piping. It is Bidder's responsibility to plan suitable layouts for these system insitu. Bidder shall prepare drawings indicating the layout of field run pipe work. These drawings shall be approved by Project Manager to the installation of the field run pipe work. Based on these approved layouts the Bidder shall prepare the BOQ of field run-pipe and submit to Employer for approval.
- 27.5.5 All piping shall be routed so as to avoid interference with other pipes and their hangers and supports, electrical cable trays, ventilation ducting, structural members, equipment etc.
- 27.5.6 Adequate clearance shall be ensured with respect to the above to accommodate insulation and pipe movements, if any.
- 27.5.7 Piping shall generally be routed above ground but where specifically indicated / approved by the project Manager the pipes may be arranged in trenches or buried. Pipes at working temperature above the ambient shall however not be buried.
- 27.5.8 Sufficient up stream and down stream lengths shall be provided for flow measuring devices, control valves and other specialties.
- 27.5.9 All local instruments shall be located on pipelines as to render them observable from the nearest available platforms.
- 27.5.10 Openings provided in the wall for pipelines must be closed with bricks and mortar with 10-12 mm clearance between brick work and pipe after taking care of insulation and thermal movement, if any. The clear space must be filled with felt or asbestos or approved filling compound.

27.6.00 Slope / Drains and Vents

27.6.1 Suitable slope shall be provided for all pipelines towards drain points. It is Bidder responsibility to identify the requirements of drains and vents, and supply the necessary pipe work, valves, fittings, hangers and supports etc. As per the system requirement low points in the pipelines shall be provided with suitable draining arrangement and high points shall be provided with vent connections where air or gas pockets may occur. Vent shall not be less than 15 mm size. Drains shall be provided at low points and at pockets in piping such that complete drainage of all systems is possible. Drain shall not be less than 15 mm for line size up to 150 mm, not less than 20 mm up to 300 mm and not less than 25 mm for 350 mm to 600 mm pipes and not less than 50 mm for 600 mm and above pipes.

27.6.2 Air piping shall be sloped so that any part of the system can be drained through the shut-off drain valve or drain plugs.

27.7.0 Pipe Joints

In general all water lines 65 mm NB and above, are to be joined generally by butt welding except the locations where valves/fittings are to be installed with flanged connections and 50 mm and below by socket welding unless mentioned otherwise specifically. All air lines shall be of screwed connection and rubber lined pipes of flanged connections.

27.7.1 Screwed Joints

- (a) Threading of pipes shall be carried out after bending, heat treatment etc. If not possible, threading may be done prior to these operations but proper care should be taken to protect them from damage. Threads shall be to ANSI B 2.1 (taper) NPT/IS:554 unless specified otherwise.
- (b) Galvanized pipe shall generally be joined by screwing into sockets. The exposed threaded portion on the outside of the pipes shall be given a zinc silicate coating. Galvanized pipes shall not be joined by welding. Screwed ends of GI pipes shall be thoroughly cleaned and painted with a mixture of red and white lead before jointing. For galvanized pipe sizes above 150 mm NB, screw & socket jointing as per ASTM-A-865 shall be employed for both pipe-to-pipe and pipe-to-fitting jointing. For pipe to fitting connection since no direct threading can be done on the fittings (supplied as per ASTM-A-234 Gr. WPB and ANSI B-16.9) necessary straight pipe lengths acting as match pieces shall be welded to the fitting at both ends and subsequently the free ends of the straight lengths shall be threaded as per ASTM A-865 for jointing with main pipe. Once welding of fittings with match pieces and threading of free ends of match pieces are over, the entire fabricated piece shall be galvanized, or in case match pipes and fittings are already galvanized before the above mentioned fabrication then suitable application of Zinc-Silicate paste adequately at the welded surface (both in side & out side) after welding with zinc rich electrode, alongwith the nascent threaded metal portion at both free ends given the same application of Zinc Silicate paste. Alternatively flanged jointing may be employed for pipe sizes 100 NB and above. However, the bidder shall ensure the galvanized pipe joints do not fail during hydro test.

- (c) Teflon tapes shall be used to seal out screwed joints and shall be applied to the male threads only. Threaded parts shall be wiped clean of oil or grease with appropriate solvent if necessary and allowing proper time for drying before applying the sealant. Pipe ends shall be reamed and all chips shall be removed. Screwed flanges shall be attached by screwing the pipe through the flange and the pipe and flange shall be refaced accurately.
- (d) For pipe sizes from 350 mm NB to 550 mm NB (including 350 NB & 550 NB) the GI pipes shall be of flanged connection. However, the pipes after welding of flanges shall be completely galvanized. Any site welding done on galvanized pipes shall be done with zinc-rich special electrodes and the welded surfaces whether inside or outside shall be coated with zinc-silicate pasts. Seal welding of flanges with zinc-rich electrode will be permitted only when any flange is leak-prone during hydro testing.
- (e) For pipe sizes 600 mm NB and above, the GI pipes shall be of welded connection (with zinc-rich special electrodes) followed by application of zinc silicate coating at welded surfaces both inside and outside the pipe, except for the last blank/blind flange, or, equipment connection where application of zinc-silicate paste after welding cannot be done due to inaccessibility of the inside welded surface and where galvanic protection has been impaired due to welding of pipe-to-pipe joint. Thus the last erection joint shall be flanged joint.

27.7.2 Welded Joints

- (a) For making up welded joints (butt weld or socket weld) the welding shall be performed by manual shielded metal arc process in accordance with the requirements specified elsewhere in the spec. Any welder employed for carrying butt welding shall be qualified as per ASME section IX for the type of joints he is going to weld. Jointing by butt weld, or socket weld shall depend upon the respective piping material specifications.

27.7.3 Flanged Joints

- (a) Flanged connections for pipes are to be kept to the minimum and used only for connections to vessel, equipments, flanged valves and other fittings like strainer/traps/orifices etc. for ease of connection and maintenance etc. Rubber lined pipes shall be flange joined only.
- (b) All flanged valves intended for installation on steel piping system, shall have their flanges drilled to ANSI B 16.5 (or equivalent) and according to the pressure class stated in their respective piping material specification.
- (c) Drilling on flanges of flanged valves must correspond to the drilling of flanges on the piping system on which the valves are installed.

27.8.00 Bends / elbows / mitre bends / Tees / Reducers & other fittings

27.8.1 Unless otherwise specified elbows shall be of long radius type.

- 27.8.2 For pipe sizes up to 65 Nb, long radius forged elbows or seamless pipe bends shall be used. Pipe bends, if used, shall be cold bent to a radius measured to the centre line of pipe of 3 to 5 times the pipe diameter.
- 27.8.3 For steel pipes 80 Nb and above, seamless long radius forged elbows shall be used. For pipe size 250 Nb and above mitre bends may be used for all pipes except rubber lined pipes. The bend radius shall be $1\frac{1}{2}$ times the nominal pipe diameter. 90 deg. Bends (mitre) shall be in 4 pieces (3 cuts) and 45 deg. mitre bends shall be in 3 pieces $22\frac{1}{2}$ deg. Fabrication of mitre bends shall be as detailed in BS 2633/BS534.
- 27.8.4 Mitre bends are not acceptable in case of rubber lined mild steel pipes.
- 27.8.5 For pipe fittings such as reducers and tees, the material shall be to ASTM-A-234 gr. WPB up to 300 NB. For pipe reducers and tees above 300 NB, the fittings may be fabricated conforming to parent pipe material. Provision of compensation pads shall be kept as per ANSI B 31.1. The fittings shall conform to the dimensional standard of ANSI B-16.9.
- However, for pipes upto 150 NB, pipe fittings may be supplied with material and dimension conforming to IS 1239 in case parent pipes also conform to IS 1239.
- For pipes, above 1200 NB, reducer and tees shall be to dimensional standard of AWWA-C-208.
- 27.8.6 Stainless steel fittings shall conform to either ASTM-A-182, Gr. 304 (316 for Sea water application, if any) or ASTM-A-403, Gr. WP 304 (316 for Sea Water application, if any) Class-S, for sizes upto and including 50 mm NB, i.e. the fitting shall be of seamless construction.
- However, for stainless steel fittings above 50mm NB, the same shall conform to ASTM-A-403, Gr. WP 304 (316 for Sea water application, if any), Class W i.e. the fittings shall be of welded construction strictly in accordance with ASTM-A-403.
- 27.8.7 In no case, the thickness of fittings shall be less than the thickness of parent pipe, irrespective of material of construction.

27.9.00 Flanges

- 27.9.1 Flanges shall be slip on type. Welding of flanges in tension is not permitted.
- 27.9.2 All flanges and-flanged drilling shall be to ANSI B 16.5/BS EN-1092 of relevant pressure/temperature class. Flanges shall be fabricated from steel plates conforming to ASTM A 105/IS 2062 Gr. B. However stainless steel flanges shall be fabricated from SS plates to ASTM-A-240, Gr. 304 (316 for Sea water application, if any) or equivalent.

27.10.00 Specific technical requirement of laying buried pipe with anti corrosive treatment

The pipe in general shall be laid with the top of the pipe minimum 1.0 (one) meter below finished general ground level.

27.10.1 Trenching

- (a) The trench shall be cut true to the line and level and shall follow the gradient of the pipeline. The width of the trench shall be sufficient to give free working space on each side of the pipe. Trenches shall conform to IS 5822 or any international standard.
- (b) Free access shall be provided for the welding of the circumferential joints by increasing the width and depth of the trench at these points. There should be no obstruction to the welder from any side so that good welded joint is obtained.
- (c) The free working space shall conform to IS: 5822. The trench shall be excavated so as to provide minimum cover of 1000 mm between the top of the pipe and finished grade.
- (d) Prior to lowering and laying pipe in any trench, the bidder shall backfill and compact the bottom of the trench or excavation in accordance with IS: 5822 to provide an acceptable bed for placing the pipe.
- (e) Coating and Wrapping shall be done as under.

27.10.2 Preparation and cleaning of piping

- (a) The pipeline shall be thoroughly cleaned of all rust, grease, dirt, weld scales and weld burrs etc. moisture or other foreign matter by power cleaning method such as sand blasting, power tool cleaning, etc. Grease or heavy oil shall be removed by washing with a volatile solvent such as gasoline. Kerosene will not be permitted for cleaning. This cleaning operation shall be immediately followed by priming with the mechanical priming machine.
- (b) Certain inaccessible portions of the pipeline (which otherwise not possible to be cleaned by power cleaning methods) may be scrubbed manually with a stiff wire brush and scrapped where necessary with specific permission of the Project Manager.
- (c) On the internal surface for pipes 1000 NB and above, a coat of primer followed by a hot coal-tar enamel or coal tar epoxy painting (cold) shall be applied.
- (d) The cleaning and priming operation shall be carried out at site. The entire pipe length shall be cleaned but the ends of the pipes shall be left without coating for a distance of 230 mm for joints, which shall be coating manually at site after laying, welding and testing the pipe.

27.10.3 Coating and wrapping / Anti corrosive Protection Coal tar tape

- a. Buried piping shall be coated and wrapped, as per specification, after completion of welded and/or flanged connections, and after completion and approval of Hydro testing. Materials to be used for coating and wrapping of underground pipelines are:

- (1) Coating primer (coal tar primer)
- (2) Coating enamel (coal tar enamel)
- (3) Wrapping materials.

All primer/coating/wrapping materials and methods of application shall conform to IS: 10221 except asphalt/bitumen material. Materials (primer/coating/wrapping) as per AWWA-C-203 are also acceptable.

Protective coating shall consist of coal tar primer, coal tar enamel coating, glass fiber, tissue inner wrap followed by glass fiber or coal tar impregnated Kraft outer wrap or finish coat.

Number of coats and wraps, minimum thickness for each layer of application shall be as per IS-10221. Number of Coats and wraps shall be decided based on soil corrosivity/resistivity as indicated in IS-10221. Soil data-for this purpose shall be made available.

Total thickness of completed coating and wrapping shall not be less than 4.0 mm.

- b. Alternatively, the anti-corrosive protection for buried pipes can consist of anti-corrosive protection Coal-tar tapes. Material and application of tapes shall conform to IS 15337 or equivalent. These-tapes shall be applied hot over the cold coal tar primer in steps of 2 mm thickness so as to cover the spiral edges of the first tape by the application of second tape. The total thickness of the finished protective coating shall be 4.0 mm min.

27.10.4 Trench bed preparation and back filling

Prior to lowering and laying pipe in any excavated trench, the bottom of the trench may require to be back filled and compacted (or as the case may be) to provide an acceptable bed for placing the pipe. Bed preparation in general shall be as per IS: 5822.

27.10.5 Laying of galvanized steel (GI) pipes

All the joints shall be screwed with socket or flanged. Screwed ends of GI pipes shall be thoroughly cleaned and painted with a mixture of red and white lead before jointing. Threaded portion on either side of the socket joints shall be applied with Zinc silicate paste.

All the provisions for trenching' bed preparation' laying the pipe application of primer' coating' wrapping with tapes and back filling etc. as indicated for "laying of buried piping" and "anti corrosive protection for buried piping" are applicable for buried galvanized steel (GI) pipes also.

27.11.00 Cleaning and Flushing

- 27.11.1 All piping shall be cleaned by the Bidder before and after erection to remove grease, dirt, dust, scale and welding slag.
- 27.11.2 Before erection all pipe work, assemblies, sub-assemblies, fittings, and components, etc. shall be thoroughly cleaned internally and externally by blast cleaning or by power driven wire brushes and followed by air-blowing. The brushes shall be of the same or similar material as the metal being cleaned. Cleaning of Galvanized pipes shall be done in such a manner that the coating on MS pipe is not affected.
- 27.11.3 After erection, all water lines shall be hydro tested at 1.5 times the design pressure.
- 27.11.4 All compressed air pipe work shall be cleaned by blowing compressed air.

27.12.00 Painting of Pipes**27.12.1 Buried Piping****Internal surfaces**

- (i) Surface cleaning by sand blasting.
- (ii) Two (2) coats of epoxy primer coats. The minimum DFT of each coat shall be 35 microns.
- (iii) Finish coat-Two (2) coats of high build epoxy paint. The minimum DFT of each coat shall be 35 microns.

The total dry film thickness of 150 microns.

Tests to be carried out after application : Bond/ Adhesion test, Holiday test

External surfaces

- (i) Surface cleaning by Sand Blasting.
- (ii) Coal tar primer compatible with coal tar enamel grade. The number of coats shall be two with a DFT of 35 microns each.
- (iii) Coal tar enamel shall be applied. A single spiral inner wrap of glass fibre tissues shall be applied overlapping at least 25 mm ensuring impregnation of glass fibre tissues in the first coat. The second coat of enamel and second outer wrap of glass fibre felt, Type – I to IS: 7193-1974 will be applied in the same way confirming to Table – 10 of IS – 10221 – 1982.

The total thickness of the coating will not be less than 4.0 mm

- (iv) Alternatively Wrapping with coal tar based anticorrosion tape conforming to IS 15337: 2003 is also acceptable in lieu of s.no. (iii) above. Wrapping thickness shall be 4.0 mm.

NOTE : CW piping shall be encased in 500 mm thk RCC.

Tests to be carried out after application : Bond/ Adhesion test, Holiday test

27.12.2 Overground Piping

Internal surfaces

- (i) Surface cleaning by sand blasting.
- (ii) Two (2) coats of epoxy primer coats. The minimum DFT of each coat shall be 35 microns.
- (iii) Finish coat-Two (2) coats of high build epoxy paint. The minimum DFT of each coat shall be 35 microns.

The total dry film thickness of 140 microns (min).

External surfaces

- (i) Surface cleaning by Sand Blasting.
- (ii) Two (2) coats of epoxy primer coats. The minimum DFT of each coat shall be 35 microns.
- (iii) Finish coat-Two (2) coats of high build epoxy paint. The minimum DFT of each coat shall be 35 microns.

The total dry film thickness of 140 microns (min).

27.12.3 Other requirements

- (a) Paint manufacturers instructions shall be followed in method of application, handling, drying time etc.
- (b) The color of the finish paint shall be as per approved color-coding.
- (c) If finish paint was applied in shop, one coat of finish paint shall be applied at site.
- (d) The dry film thickness of paint shall not be less than 0.15 mm.

27.12.4 Color code for identification

The pipes shall be color painted/banded for identification as per the approved color-coding scheme and shall be generally as per IS-9404.

27.13.00 Specification for hangers and supports

27.13.1 All supports and parts shall conform to the requirement of power piping code ANSI B 31.1 or approved equivalent.

27.13.2 While designing supports for rubber lined pipes special consideration should be given. Any kind of welding on these pipes is not allowed after rubber lining.

- 27.13.3 Hanger for piping 65 mm Nb and larger and all spring support assemblies regardless of size shall be completely engineered in conformance with the provisions of power piping code ANSI B 31.1.
- 27.13.4 Hangers, saddles, supports etc. shall be fabricated from plates/pipes sections conforming to ASTM A 53/IS: 2062/IS:226/ or equivalent. They shall be designed to provide the required supporting effects and allow pipeline movements as necessary. The structural steel work shall be as per IS: 800/BS:4360. Insulation protection saddles shall be used at support point of all insulated piping.
- 27.13.5 The support shall be so interspaced as to minimize sagging of the pipes and to keep them within permissible limits where pipes are full with the conveying media.
- 27.13.6 The maximum spans of the supports of straight length shall not exceed the recommended values indicated in ANSI B 31.1.
- 27.13.7 All pipe supports shall be designed to provide an absolute minimum head room of 2.5 m from floor in passages/walkways.
- 27.13.8 At all sliding surfaces of supports suitable arrangement is to be provided to minimize sliding friction.
- 27.13.9 All components of hangers/support shall be provided with two coats of primer (red oxide paint) at shop before dispatch to site. After erection they shall be given finish coat of Long Oil Synthetic enamel to IS: 2932 of total DFT 100 to 140 microns. CLH & VLH will be primed with Epoxy Zinc rich primer of 50 micron followed by finish painting of Aliphatic Acrylic Polyurethane or equivalent of DFT 65 microns.
- 27.14.00 Design/Construction/Material Particulars of Gate/Globe/Check Valves/Globe Stop Valve/Butterfly Valve**
- 27.14.1 GENERAL**
- (a) All valves shall be suitable for the service conditions i.e. flow, temperature and pressure, at which they are required to operate.
- (b) General requirement of valves are as indicated below:
- (1) The valves as well as all accessories shall be designed for easy disassembly and maintenance.
 - (2) Valves to be installed outside shall be required to have the stem properly protected against atmospheric corrosion.
 - (3) All rising stem valves shall be provided with back seat to permit repacking (of glands) with valves in operation. All valves shall preferably be of outside screw and yoke type.
 - (4) All valves shall be closed by rotating the hand wheel in the clockwise direction when looking at the face of the hand wheel. In case where the hand wheel is not directly attached to the valve spindle suitable gearing shall be introduced.

- (5) All valves shall have indicators or direction clearly marked on the hand-wheel so that the valves opening/closing can be readily determined.
 - (6) Special attention shall be given to operating mechanism for large size valves with a view to obtaining quick and easy operation ensuring that a minimum of maintenance is required. For valves of size 350 mm and above either bevel or spur gearing shall be provided to facilitate manual operation.
 - (7) The valves coming in vacuum lines shall be of extended gland type and / or water sealed.
- (c) The actuator-operated valves shall be designed on the basis of the following:
- (1) The internal parts shall be suitable to support the pressure caused by the actuators.
 - (2) The valve-actuator unit shall be suitably stiff so as not to cause vibrations, misalignments, etc.
 - (3) All actuator-operated valves shall be provided with hand operated gearing mechanism also.
 - (4) All actuators operated valves shall open/close fully within time required by the process.
- (d) Valves coming under the purview of IBR shall meet IBR requirements.
- (e) Gate/sluice valves shall be used for isolation of flow. Gate valves shall be provided with the following accessories in addition to other standard items:
- (1) Hand wheel
 - (2) Position indicator (for above 50 mm NB valve size)
 - (3) Draining arrangement wherever required.
- (f) Globe valves shall be used for regulation purposes. They shall be provided with hand wheel, position indicator, draining arrangement (wherever required) and arrow indicating flow direction.
- (g) Check valves shall be used for non-return service. They shall be swing check type or double door (Dual plate) check type with a permanent arrow inscription on the valve body indicating the fluid flow direction. In long distance pipes lines with possibility of surge-occurrence, dual plate check valves are preferable for its spring controlled opening/closing of flaps/doors against flow reversals. However, dual plate check valves shall not be used for sizes more than 600 mm NB.
- (h) All gate and globe valves shall be provided with back seating arrangement to enable on line changing of gland packing.

- (i) All gate and globe valves shall be rising stem type and shall have limit switches for full OPEN and full CLOSED indication wherever required. This will include motor-operated valves also wherever required. In such cases the limit switches shall form an integral part of the valve. Stop-gap arrangement in this respect is not acceptable.
- (j) All valves shall be provided with embossed name plate giving details such as tag number, type, size etc.
- (k) Wherever required valves shall be provided with chain operator, extension spindles and floor stands or any other arrangement approved by employer so that they can be operated with ease from the nearest operating floor. Wherever necessary for safety purpose locking device shall be provided. Further, necessary small platforms for facilitating easy valve operation shall be provided by the contractor wherever necessary in consultation with project manager within the bid price at no extra cost to employer.
- (l) All valves except those with rising stems shall be provided with continuous mechanical position indicator; rising stem valves shall have only visual indication through plastic/metallic stem cover for sizes above 50 mm nominal bore.
- (m) For CI gate, globe and check valves wherever thickness of body/bonnet is not mentioned in the valves standards, thickness mentioned in IS-1538 for fitting shall be applicable.

27.14.2 VALVE BODY MATERIAL

Valve body material for various services shall be as follows:

Valve body material for water application like circulating water, Secondary circuit auxiliary cooling water of ECW system, Raw water, Ash water make-up, service water, clarified water, DM cooling water (pH corrected) & drinking water shall be cast iron for sizes 65 NB and above; gun-metal for sizes 50 NB and below.

For compressed air application, valve body material shall be cast carbon steel or forged carbon steel for sizes 65 mm NB & above and Gun metal for sizes 50 NB and below.

DM water: SS body and disc alongwith SS internals.

Condensate: Cast Carbon Steel/Forged Carbon Steel.

- 27.14.2.1 The design, material, construction, manufacture, inspection, testing and performance of valves shall comply with all currently applicable statutes, regulations and safety codes and the locality where the valves will be installed. The valves shall conform to the latest editions of applicable codes and standards as mentioned elsewhere. Nothing in this specification shall be construed to relieve the Bidder of his responsibility. Valves in general shall conform to the requirements of the following standards.

Standards and Codes

AWWA-C-504

Rubber seated butterfly valves

BS-5155/EN-593	Cast iron and steel body butterfly valves for general purpose.
IS-778	Gun-metal gate, globe and check valves for general purpose.
BS-5154	Copper alloy globe/globe stop and check and gate valves for general purpose.
IS-780	Sluice valves for water works purpose (50-300 mm size)
IS-2906	Sluice valves for water works purpose (350-1200 mm size)
IS-5150	Cast iron wedge and double disc gate for general purpose.
BS-5152	Specification for cast iron globe valves
BS-5153	Cast iron check valves for general purpose.
IS-5312	Swing check type reflux (non-return) valves
ANSI B 16.34	Standard for valves
API-594	Standard for Dual-check valves
API-600	Steel gate valves
ANSI-B-16.10	Valves face to face and other relevant dimension
API-598	Valves inspection test

27.14.2.2 End Connections

The end connections, shall comply with the following:

Socket welding (SW) – ANSI B 16.11

Butt Welding (BW) – ANSI B 16.25

Threaded (SC) – ANSI B 2.1

Flanged (FL) – ANSI B 16.5 & AWWA-C-207 (steel flanges), ANSI B 16.1 (Cast Iron flanges)

27.14.2.3 All cast iron body valves (gate, globe and non-return) shall have flanged end connections; (screwed ends for Ductile D.2NI body valves are not acceptable).

27.14.2.4 All steel and stainless steel body valves of sizes 65 mm and above shall have flanged or butt welding ends. Valves of sizes below 65mm shall have flanged or socket welded ends. Compatibility of welding between valve body material and connecting pipe material is a pre-requisite in case of butt-welded joints.

- 27.14.2.5 All gun metal body valves shall have screwed ends.
- 27.14.2.6 All flanged end valves/specialties shall be furnished alongwith matching counter flanges, fasteners, gaskets etc. as required to complete the joints
- 27.15.00 Check Valves**
- 27.15.1 Check valves shall comply with the following characteristics:
- (a) For bore greater than 2" the valves must be swing check type or dual plate check type suitable for installation in all positions (vertical and horizontal);
 - (b) For bore smaller than or equal to 2" the valves must be of the piston type to be installed, in horizontal position.
 - (c) In the case of swing check valves, the body seat shall be inclined at such an angle from the vertical as will facilitate closing and prevent chatter.
- 27.15.2 Drilling on flanges of flanged valves must correspond to the drilling on flanges of the piping system on which the valves are to be installed.
- 27.15.3 All flanged valves intended for installation in steel piping systems shall have their flanges drilled to ANSI B 16.5 (or equivalent) and according to the pressure class.
- 27.15.4 Counter flanges to be installed on air pipes shall be screwed-on type irrespective of size.
- 27.16.00 Globe Valves**
- 27.16.1 The globe valves shall have the following characteristics;
- Straight conveyed flow
- Right angle
- Preferably, the valves shall be of the vertical stem type.
- 27.16.2 Globe valves shall preferably have radiused or spherical seating and discs shall be free to revolve on the spindle.
- 27.16.3 The pressure shall preferably be under the disc of the valve. However, globe valves, with pressure over the disc shall also be accepted provided (i) no possibility exists that flow from above the disc can remove either the disc from stem or component from disc (ii) manual globe valves can easily be operated by hand. If the fluid load on the top of the disc is higher than 40-60 KN, bypass valve shall be provided which permits the downstream system to be pressurized before the globe valve is opened.
- 27.16.4 For the regulating valves, valves with regulating plug & parabolic outline disc type is preferred.

27.16.5 All motorized globe valves with regulating plug for which indication of percentage (%) opening are required in the control room shall be provided with necessary position transmitter.

27.17.00 Gate valves

All gate valves shall be of the full-way type, and when in the full open position the bore of the valve shall not be constricted by any part of the gate.

Gate valves shall be of the solid/elastic or articulated wedge disc and rising stem type.

27.18.00 Air Release Valve

- (a) The air release valves shall be of automatic double air valve with two orifices and two floats. The float shall not close the valve at higher air velocities. The orifice contact joint with the float shall be leak tight joint.
- (b) The valve shall efficiently discharge the displaced air automatically from ducts/pipes while filling them and admit air automatically into the ducts/pipes while they are being emptied. The valve shall also automatically release trapped air from ducts/pipes during operation at the normal working pressure.
- (c) Body material of automatic air release valves shall comply generally with BS 1452 Gr. 14/IS:210 Gr. FG 260 and spindle shall conform to high tensile brass.
- (d) Air release valves shall not have any integral isolation device within them. Each Air release valve shall be mounted, preceded by a separate isolation gate/butterfly valve.

125# ASA cast iron body, double ball construction air release valve with flanged ends to ASA B 16.10; and bolted cover to release the air. Construction materials shall be as below:

Body, cover	:	Cast iron to IS:210 Gr.FG 260
Bolts	:	Light weight leather/wooden balls
Seats	:	Bronze to ASTM-B-62
Cover packing	:	Braided asbestos
Float	:	Wood/rubber

27.19.00 Butterfly Valves**27.19.1 Design / Construction**

- (a) The valves shall be designed for the design pressure/temperature of the system on which it is installed and in accordance with AWWA-C-504, EN-593 or any other approved equivalent standard latest edition. Fabricated steel (IS: 2062 GR. B) butterfly valves instead of cast iron body valves are also acceptable for size above 300 mm nb diameter. In such a case, however, the bidder will have to necessarily submit thickness calculations, in order to establish the integrity of the fabricated valve body under the system operating pressure condition.
- (1) The valves shall be suitable for installation in any position (horizontal/vertical etc.) and shall be generally of double-flanged construction. However for sizes 600 NB and below the valves of Wafer construction are also acceptable.
 - (2) The seals, both on the body (sleeve) and on the disc shall be of the material specified. Necessary shaft seal shall be provided and adequately designed to ensure no leakage across the seal. This seal shall be designed so that they will allow replacement without removal of the valve shaft. The sealing ring on the disk shall be continuous type and easily replaceable.
 - (3) For all types of valves, the design with shaft eccentric to the disc is preferred. The shaft shall be solid type and shall pivot on bushings. Bushings/sleeve type bearings shall be contained in the hub of valve body. The bearing shall be self-lubricated type with low coefficient of friction and should not have any harmful effect on water and on valve components.
 - (4) The design of the shaft shall be such that it will safely sustain maximum differential pressure across the closed valve. The shaft and any key (taper pin etc.) for transmitting the torque between shaft and disc shall be capable of withstanding the maximum torque required to operate the valve. However, the shaft diameter shall not be less than the minimum shaft diameter specified in relevant code. Necessary Torque Calculation and the torque class selected on the basis of the same shall be furnished to the Employer for information.
 - (5) The disc shall rotate from the full open to the tight shut position. The disc shall be contoured to ensure the least possible resistance to flow and shall be suitable for throttling operation. While the disc is in the throttled position, valve shall not create any noise or vibration.
 - (6) The operating mechanism shall be mounted directly on or supported from the valve body.
 - (7) All valves shall be complete with:
 - Position indicator (located in a visible place)
 - Arrow indicating the flow direction;

Adjustable mechanical stop limiting devices to prevent over

Travel of valve disc in open/close position.

All valves shall be "tight shut off"

(8) Hand operated valves shall have the following

Local hand controls

The hand controls shall close the valve with clockwise rotation.

The hand controls shall be dimensioned to guarantee an easy maneuver under most severe conditions.

The hand controls shall be provided with locking systems suitable to avoid the disc assuming a non-desirable position during the operation.

Hand wheel shall be made of malleable iron with arms and rims of adequate strength. The hand wheel of diameters 300 mm or less shall be provided with handles for ease of operation. The pulling force required on the hand wheel rim shall not exceed 25 Kgf when operating the valve under full flow and operating pressure.

Valves-350 Nb and above shall have pressure equalizing bypass valves, wherever system parameters warrant the same.

Valves-350 Nb and above shall also be provided with gear operator arrangement suitable for manual operation. Manual operation of valve shall be through worm and gear arrangement having totally enclosed gearing with hand wheel diameter and gear ratio designed to meet the required operating torque. It shall be designed to hold the valve disc in intermediate position between full open and full closed position without creeping or fluttering. Adjustable stops shall be provided to prevent over travel in either direction.

Limit and torque switches (if applicable) shall be enclosed in water tight enclosures alongwith suitable space heaters for motor actuated valves, which may be either for On-Off operation or inching operation with position transmitter.

27.19.2 Material of Construction (Butterfly Valves)

Materials and other design details shall be as indicated below:

(a) Cast Iron Butterfly valves

Body & Disc	ASTM A48, Gr. 40 with 2% Ni/ IS: 210. Gr. FG-260, with 2% Ni and epoxy coated
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Shaft	BS 970 431 S: 291/EN 57, or AISI-410 or AWWA-permitted shaft material equivalent to EN-57/AISI-410 or better.
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Seat ring Seal	18-8 Stainless steel Nitrile Rubber
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(b) Stainless Steel Butterfly Valves

Body & Disc	ASTM A 351, Gr. CF8M/ASTM-A-182-Gr. 304
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Shaft	ASTM A 182, Gr. 316/ASTM-A-479 Gr. 316/Equivalent
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Disc & Seat Rings	EPT/BUNA-N/Neoprene
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(c) Carbon Steel Butterfly Valves

Body & Disc Shaft	ASTM A 216, Gr. WCB ASTM A 182, Gr. 304/ASTM-A-479 Gr. 304/Equivalent
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Disc & Seat Rings	EPT/BUNA-N/Neoprene
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27.19.3 Proof of Design Test (Type Test) for Butterfly Valves

Proof of Design (POD) test certificates shall be furnished by the bidder for all applicable size-ranges and classes of Butterfly valves supplied by him, in the absence of which actual POD test shall be conducted by the bidder in the presence of Employer's representative.

All valves that are designed and manufactured as per AWWA-C-504 shall be governed by the relevant clauses of POD test in AWWA-C-504. For Butterfly valves designed and manufactured to EN-593 or equivalent, the POD test methods and procedures shall generally follow the guidelines of AWWA-C-504 in all respect except that Body & seat hydro test and disc-strength test shall be conducted at the pressures specified in EN-593 or the applicable code. Actuators shall also meet requirements of POD test of AWWA-C-504.

27.20.00 MATERIAL OF CONSTRUCTION (GATE/GLOBE/CHECK VALVE)

(a) The materials shall generally comply with the following:

(1) Cast Steel Valves

Body & bonnet	ASTM A 216 Gr. WCB/ ASTM A 105
Disc for non-return Valves	ASTM A 216 Gr. WCB/ ASTM A 105
Trim.	ASTM A 182 Gr. F6 or Equivalent

(2) Stainless Steel Valves

Body & Bonnet	ASTM A 351 Gr. CF 8M/
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ASTM A 182 Gr. 304

Disc -do-

Trim. ASTM 182 Gr. F. 316
/ASTM-A-479 Gr. 316 or Integral
with body**(3) Cast Iron Valves**

Body & bonnet BS 1452 Gr. 14/IS-210 Gr. FG 260

Seating surfaces and rings 13% chromium steel/13% Chrome
overlay

Disc for non-return valves BS 1452 Gr. 14/IS-210 Gr FG 260

Hinge pin for non-return valves AISI 316

Stem for gate globe valves 13% chromium steel or Equivalent

Back Seat 13% chromium steel / 13%
Chrome overlay**(4) Gun Metal Valves**

Body and bonnet IS 318 Gr. 2/Equivalent Standard

Trim -do-

- (b) Cast iron body valves shall have high alloy steel stem and seat.
- (c) Material for counter flanges shall be the same as for the piping.

27.21.00 Float Operated Valves

- (a) Valve shall automatically control the rate of filling and will shut off when a predetermined level is reached and close to prevent over flow on pre-set maximum water level. Valve shall also open and close in direct proportion to rise or fall of water level.
- (b) **DESIGN AND CONSTRUCTION FEATURES**
The following design and construction feature of the valve shall be the minimum acceptable.
- (c) Valves shall be right-angled or globe pattern.
- (d) Valves shall be balance piston type with float ball.
- (e) Leather liner shall not be provided.
- (f) The body and cover material shall be cast iron conforming to ASTM-A 126 Grade 'B' or Is: 210 Grade 200 or equivalent, and float shall be of copper with epoxy painting of two (2) coats.
- (g) Valves shall be suitable for flow velocities of 2 to 2.5m/sec.
- (h) The valves shall have flanged connections.

27.22.00 PAINTING OF VALVES:

Two (2) coats of primer followed by three (3) coats of epoxy of approved color code/shade (usually same as that of connected piping) shall be applied to all exposed surfaces except stainless steel surface, Galvanized steel surface and gun metal surface at shop as required to prevent corrosion, before dispatch. The use of grease/oil other than light grade mineral oil, for corrosion protection is prohibited. The total DFT of painting shall be 150 micron (minimum). If during transport, unloading/unpacking or erection at site any part of the painted surface gets damaged, the same shall be made good by the contractor by repainting with compatible painting primer and enamel to the satisfaction of the project manager.

27.24.00 STRAINERS**27.24.1 Simplex type**

The strainers shall be basket type and of simplex construction. The strainer shall be provided with plugged drain/blow off and vent connections. The free area of the strainer element shall be at least four (4) times the internal area of the connecting pipe lines. The strainer element shall be 20 mesh. Pressure drop across the strainers in new condition fitted with a removable plug. The material of construction of various parts shall be as follows:

- | | | |
|-----|------------------|---|
| (a) | Body | IS: 318, Gr. 2 up to 50 mm Nb, and IS: 210 Gr. FG 260 above 50 mm Nb. (For DM water/ -Body: AISI 316 or equivalent) |
| (b) | Strainer Element | Stainless steel (AISI 316) |
| (c) | End connection | Screwed upto 50 mm Nb, and flanged above 50 mm Nb |

27.24.2 Duplex type

- (a) The strainers shall be basket type and of duplex construction. The strainer shall be provided with plugged drain/blow off and vent connections. The free area of the strainer element shall be at least four (4) times the internal area of the connecting pipe. The mesh of strainer element shall be commensurate with the actual service required. Pressure drop across the strainer in new condition shall not exceed 4.0 MWC at full flow.
- (b) Wire mesh (if applicable) of the strainers shall be suitably reinforced. The material of construction of various parts shall be as follows.

Body	IS: 318, Gr. 2 Up to 50 mm Nb, and IS:210,
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Gr. FG 260 of ASTM-A-515 Gr. 75/IS-2062
Gr. B and internally epoxy-painted above 50
mm NB.

Strainer element Stainless steel (AISI 316)

End connection Screwed up to 50 mm Nb, and
Flanged above 50 mm Nb.
Gasket shall be of full face type

- (c) The strainer will have a permanent stainless steel tag fixed on the strainer body indicating the strainer tag number and service and other salient data.
- (d) The size of the strainer and the flow direction will be indicated on the strainer body casting.
- (e) Thickness of the strainer element should be designed to withstand the pressure developed within the strainer due to 100% clogged condition exerting shut-off pressure on the element.

27.24.3 Three shop coats of paint preceded by two coats of primer shall be applied to all exposed surfaces as required to prevent corrosion. All parts shall be adequately protected for rust prevention. The use of grease or oil other than light grade mineral oils for corrosion protection is prohibited

ANNEXURE-I

SPECIFICATION FOR DUCTILE IRON (DI) PIPES, FITTINGS & SPECIALS

1.00.00 GENERAL

This specification covers the specific requirement of design, material, manufacture / fabrication, constructional features, inspection & testing, transportation, handling, laying, site testing and annual maintenance contract of Ductile Iron (DI) Pipes, Joints, fittings and specials.

2.00.00 CODES AND STANDARDS

The material, design, manufacture, dimensions, tolerances, mechanical properties, internal cement mortar lining, external zinc coating along with bituminous finished layer, inspection and testing of DI water pipes shall comply with the latest Indian Standard, "IS 8329 (Centrifugally cast (spun) ductile iron pressure pipes for water, gas and sewage – specification)" or equivalent international standard unless otherwise specified elsewhere in this Technical Specification.

Sl. No.	Code No.	Code Title
1	IS 8329	Centrifugally cast (spun) ductile iron pressure for water, gas and sewage - specification
2	IS 9523	Ductile iron fittings for pressure pipes for water, gas and sewage - specification
3	IS 5382	Rubber sealing rings for gas mains, water mains and sewers
4	IS 638	Specification for Sheet Rubber Jointing and Rubber Insertion Jointing
5	IS 12288	Code of practice for use and laying of Ductile Iron pipes
6	IS 11606	Methods of sampling of Cast Iron pipes and fittings
7	IS 455	Portland slag cement
8	IS 12330	Sulphate resisting Portland cement
9	IS 6452	Specification for high alumina cement for structural use
10	IS 6909	Specification for supersulphated cement
11	IS 8112	43 grade ordinary Portland cement
12	IS 1387	General requirements for supply of metallurgical materials
13	IS 1500	Methods for Brinell hardness test for metallic materials
14	IS 1608	Mechanical testing of metals – tensile testing
15	ISO 2531	Ductile iron pipes, fittings, accessories and their joints for water applications
16	ISO 4179	Ductile iron pipes and fittings for pressure and non-pressure pipelines – Cement mortar lining
17	ISO 4633	Rubber seals – Joint rings for water supply, drainage and sewerage pipelines – Specification for materials

18	ISO 8179	Ductile iron pipes – External zinc-based coating – Part 1: Metallic zinc with finishing layer
19	ISO 8179	Ductile iron pipes – External zinc coating – Part 2: Zinc rich paint with finishing layer
20	ISO 8180	Ductile iron pipelines – Polyethylene sleeving for site application
21	ISO 10802	Ductile iron pipelines – Hydrostatic testing after installation
22	ISO 10803	Design method for ductile iron pipes
23	ISO 16132	Ductile iron pipe and fittings – seal coats for cement mortar linings
24	AWWA M 41	Ductile iron pipe and fittings (guideline code for design, manufacturing, testing, jointing, laying & installation etc.)
25	BS EN 545	Ductile iron pipes, fittings, accessories and their joints for water pipelines – Requirements and test methods

3.00.0 DUCTILE IRON (DI) PRESSURE PIPES:

3.01.01 DESIGN REQUIREMENTS

Pipeline shall be sized considering C value as 140 and velocity 2-3m/sec.

3.01.01 Classification:

The class of DI pipes to be provided shall be as specified in the data sheet attached with this sub-section. The external diameter and wall thickness of socket and spigot pipes for the specified Class shall be as per IS 8329 or equivalent international standard.

3.02.00 Joints:

3.02.01 Generally push-on flexible joints shall be provided for pipe to pipe connection as per IS 8329 or equivalent international standard. However mechanical joints, flange joints and restrained joints can also be used.

3.02.02 Rubber gaskets

Rubber gasket used with push-on flexible joints shall conform to the requirements of IS: 5382 or equivalent international standard. Rubber gaskets for use with flanged joints shall conform to IS 638 or approved equivalent international standard.

4.00.00 DI FITTINGS & SPECIALS

4.01.0 Design Requirements

4.01.01 Classification

The DI fittings shall be as per IS 9523 or equivalent international standard.

4.02.00 External layer:

The DI fittings supplied shall be provided with external protection of metallic zinc coating or zinc rich paint coating with finishing layer of bituminous paint as per IS 9523 or equivalent international standard.

4.03.00 Internal lining:

The fittings shall be provided with suitable cement mortar internal lining as per IS 9523 or equivalent international standard.

4.04.00 Joints between pipe and fittings:

4.04.01 Generally , Push-on flexible joints shall be provided for pipe to fitting connection as per IS 9523 or equivalent international standard. Flange joints, wherever required, shall conform to the requirements of IS 9523 or equivalent international standard.

4.04.02 Rubber gaskets

All the DI fittings shall be provided with rubber gaskets for each socket. Rubber gasket used with push-on flexible joints shall conform to the requirements of IS: 5382/ IS 9523 or equivalent international standard.

Rubber gaskets for use with flanged joints shall conform to IS 638 or equivalent international standard.

5.00.00 TYPE TESTS

5.01.00 The contractor / manufacturer shall carry out the type tests as listed in this specification on the pipes to be supplied under this contract.

5.02.00 The type tests shall be carried out in presence of the Employer's representative, for which minimum 15 days notice shall be given by the contractor. The contractor shall obtain the Employer's approval for the type test procedure before conducting the type test. The type test procedure shall clearly specify the test set-up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.

5.03.00 In case the contractor / manufacturer has already conducted such specified type test(s), he may submit the type test reports to the Employer during detailed engineering for consideration of waiver of conductance of such type test(s) or otherwise as deemed fit by Employer. Such test(s) should have been either conducted at an independent laboratory or duly approved by accredited third party agency. The Employer reserves the right to waive conducting of any or all the specified type test(s) under this contract.

5.04.00 The type test shall be performed whenever a significant change is made in the design, material or process of manufacture or a new size or size range of the product is being supplied by the manufacturer.

5.05.00 THE FOLLOWING TYPE TESTS SHALL BE CARRIED OUT:

5.05.01 Joint Leak Tightness Test:

- a) Tests for joints (push-on flexible joints) shall be conducted as per the guidelines of ISO 2531 to establish adequate joint performance with respect to internal pressure, external pressure and vacuum pressure under both normal alignment of joints and deflected alignment of joints as dictated in ISO 2531.
- b) Tests for Leak tightness and mechanical resistance of flanged joints shall be conducted as per ISO 2531.

5.05.02 Cement Lining Smoothness Type Test:

The contractor / manufacturer should have carried out Cement Lining Smoothness test to establish C value (Hazen & William's constant) of the offered DI pipe as 140. Necessary certificate for the same shall be furnished to the employer.

In case the contractor / manufacturer has not carried out the test, the same shall be carried out by the contractor / manufacturer within the scope of this contract.

5.05.03 Ring bend test:

Ring bend test for 3% deflection with respect to external diameter of DI pipe offered shall be conducted by contractor / manufacturer to prove that internal cement mortar lining does not come off the substrate surface of Ductile Iron on random basis for each manufacturing lot.

If the contractor / manufacturer of pipes do not have the facility for this type test at his own works, the same can be arranged by him to conduct and demonstrate the test.

6.00.00 LAYING AND JOINTING OF DI PIPES:

6.01.00 Laying, erection and jointing of DI pipelines at field / site shall be under the direct supervision of Manufacturer (Supplier) from whom pipe is sourced / procured.

For underground laying, Special provisions in trench shall be made for accommodating socket (Bell) of each pipe, as applicable so that barrel is uniformly rested on even trench bed surface, which is well compacted as recommended in codes / standards.

6.02.00 Pipeline anchorage

Pipeline shall be securely anchored at dead ends, tees, bends, tapers and valves to resist thrust arising from internal pressure. Suitable thrust blocks made of concrete shall be designed and cast-in-situ.

7.00.00HYDRAULIC TESTING OF PIPELINES

After laying and jointing, the pipeline shall be tested for soundness and leak tightness of pipes, fittings and joints, and soundness of any construction work. The pipeline may be tested in sections.

Water and other facilities as required for such hydro testing shall be arranged by the Contractor.

7.01.00 Hydraulic Testing of Sections

The section under test shall be filled with water, taking care that all the air is displaced either through vents at the high points or by using a pig or a sphere. After filling, the pipeline shall be slightly pressurized for a period of time to achieve stable conditions.

The pipeline is then pressurized up to the full test pressure as per the relevant standard. The test pressure shall be maintained for a period of not less than 10 minutes to reveal any defects in the pipes, joints or anchorages. The test pressure shall be measured such as to ensure that the required test pressure is not exceeded at any point in the entire pipeline.

If the test is not satisfactory, the fault shall be found and rectified. Methods employed for finding faults shall be as per IS 12288.

7.02.00 Hydraulic Testing of Complete Pipeline

After all the sections have been joined together on completion of section testing, a test on the complete pipeline shall be carried out. This test shall be carried out at a pressure as specified in the data sheet attached with this sub-section. During the test, the pressure at any point in the pipeline shall not exceed the pressure as specified in the data sheet attached with this subsection.

8.00.00 DATA SHEET FOR DI PIPES, FITTINGS & SPECIALS

Sl.No.	Description	Units	Parameters
1	Pipe Material		Ductile Iron (DI) pipe internally cement mortar lined and externally coated with metallic zinc & finishing layer of bituminous paint.
2	Applicable standards		IS/ISO/AWWA/BS as listed in technical specification
3	Hazen & Wliiam's Constant		140
4	Pipe class		K7/K9 as per IS 8329 or equivalent international standard. Compatible with system pressure requirement.
5	Pipe Joint type		Push-on flexible joints as per IS 8329 / Flanged/ Restraint

6	Pipe Joint type at valves, pumps and other piping		Flange Joints as per IS 8329 & IS 9523
7	Welded-on Flange (as applicable) pressure class		Compatible with system pressure requirement.
8	DI fittings class		Compatible with system pressure requirement.
9	DI fittings flange (as applicable) class		PN 25
10	Restrain mechanism at bends, specials etc.		Thrust Blocks
11	Maximum field hydrostatic test pressure	N/mm ²	Shut-off pressure or (operating pressure+surge pressure) whichever is higher for not less than 10 minutes
	At each section (not exceeding 1000m)		
	Complete pipeline		As per IS: 12288 Table-1
12	Other requirements		As per technical specification

**Chapter 08 : FUNCTIONAL GUARANTEES, LIQUIDATED DAMAGES FOR
SHORTFALL IN PERFORMANCE AND PERFORMANCE GUARANTEE
TESTS****1.0 General**

- 1.01 The term "Performance Guarantees" wherever appears in the Technical Specifications shall have the same meaning and shall be synonymous to "Functional Guarantees". Similarly the term "Performance Tests" wherever appears in the Technical Specifications shall have the same meaning and shall be synonymous to "Guarantee Test(s)".
- 1.02 The term "BMCR" (Boiler Maximum Continuous Rating) appearing in the Technical Specification shall mean the maximum continuous steam output of Steam Generator ("As guaranteed") at superheater outlet at rated parameters.
- 1.03 The term "TMCR" (Turbine Maximum Continuous Rating) appearing in the Technical Specification shall mean 660 MW electrical power output at generator terminals (power at generator terminals as per clause indicated in this section) under 0% cycle make-up and guaranteed optimised condenser pressure unless used in conjunction with a different cycle make-up and/or a different condenser pressure

2.0 PERFORMANCE GUARANTEES / PERFORMANCE TESTS**2.1 General Requirements**

1. The Contractor shall guarantee that the equipment offered shall meet the ratings and performance requirements stipulated for various equipment covered in these specifications.
2. The guaranteed performance parameters furnished by the Bidder in his offer, shall be without any tolerance values whatsoever and all margins required for instrument inaccuracies and other uncertainties shall be deemed to have been included in the guaranteed figures.
3. The Contractor shall conduct performance test and demonstrate all the guarantees covered herein under Category I, II & III. The various tests which are to be carried out during performance guarantee tests are listed in this chapter. The guarantee tests shall be conducted by the Contractor at site in presence of EMPLOYER.
4. All costs associated with the tests including cost associated with the supply, calibration, installation and removal of the test instrumentation shall be included in the contract price.
5. It is the responsibility of the contractor to perform the Performance Guarantee / Acceptance test as specified in this chapter. The performance tests shall be performed using only the normal number of Employer supplied operating staff. Contractor, vendor or other subcontractor personnel shall be used only for instructional purposes or data collection. At all times during the Performance Tests the emissions and effluents from the Plant shall not exceed the Guaranteed Emission and Effluent Limits.

6. It shall be responsibility of the Contractor to make the plant ready for the performance guarantee tests. At all times during the Performance Tests the emissions and effluents from the Plant shall not exceed the Guaranteed Emission and Effluent Limits.
7. The Contractor shall make the plant ready for the performance guarantee tests.
8. All instruments required for performance testing shall be of the type and accuracy required by the code and prior to the test, the Contractor shall get these instruments calibrated in an independent test Institute approved by the Employer. All test instrumentation required for performance tests shall be supplied by the Contractor and shall be retained by him upon satisfactory completion of all such tests at site. All calibration procedures and standards shall be subject to the approval of the Employer. The protecting tubes, pressure connections and other test connections required for conducting guarantee test shall conform to the relevant codes.
9. Tools and tackle, thermowells (both screwed and welded) instruments/devices including flow devices, matching flanges, impulse piping & valves etc. and any special equipment, required for the successful completion of the tests, shall be provided by the contractor free of cost.
10. The Performance test shall be carried out as per the agreed procedure. The PG test procedure including demonstration tests shall be submitted within 90 days of the date of Notification of Award and finalization of the PG test procedure shall be done within 180 days from the date of Notification of Award. After the conductance of Performance test, the contractor shall submit the test evaluation report of Performance test results to Employer promptly but not later than one month from the date of conductance of Performance test. However, preliminary test reports shall be submitted to the Employer after completing each test run.
11. The P&G test procedures shall be submitted for equipment/ system & subsystem under Contractor's scope for all Guarantees under category I, II & III as mentioned below, as per latest International codes / standard including correction curves, meeting the specification requirements along with sample calculations & detailed activity plan of preparation (including test instrumentation), conductance and evaluation of Guarantees.
12. The contractor shall submit for Employer's approval the detailed Performance Test procedure containing the following:
 - a) Object of the test
 - b) Various guaranteed parameters & tests as per contract.
 - c) Method of conductance of test and test code.
 - d) Duration of test, frequency of readings & number of test runs.
 - e) Method of calculation.
 - f) Correction calculations & curves.
 - g) Instrument list consisting of range, accuracy, least count, and location of instruments.
 - h) Scheme showing measuring points.
 - i) Sample calculation
 - j) Acceptance criteria.

- k) Any other information required for conducting the test.

13. Test Reports

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

14. In case during performance guarantee test(s) it is found that the equipment/system has failed to meet the guarantees, the Contractor shall carry out all necessary modifications and/or replacements to make the equipment/system comply with the guaranteed requirements at no extra cost to the Employer and re-conduct the performance guarantee test(s) with Employer's consent. In case the specified performance guarantee(s) are still not met by the contractor even after modification and/or replacement but are achieved within the Acceptable Shortfall Limit as specified at clause 3.02 of this section, Employer will accept the equipment/system/plant after levying liquidated damages as per clause 3.02 of this section. However, if, the demonstrated guarantee(s) continue to be beyond the stipulated Acceptable Shortfall Limit, even after the above modifications / replacements within ninety (90) days or a reasonable period allowed by the Employer, after the tests have been completed, the Employer will have the right to either of the following:

A.) For Category-I Guarantees

Reject the equipment / system / plant and recover from the Contractor the payments already made.

OR

Accept the equipment /system/ plant after levying Liquidated Damages as indicated in clause 3.02 of this chapter. The liquidated damages shall be prorated for the fractional parts of the deficiencies. The performance guarantees coming under this category shall be called 'Category - I' Guarantees.

B.) For Category-II Guarantees

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

C.) For Category-III Guarantees

Reject the equipment /system / plant and recover from the Contractor the payments already made.

OR

Accept the equipment/system after assessing the deficiency in respect of the various ratings, performance parameters and capabilities and recover from the contract price an amount equivalent to the damages as determined by the Employer. Such damages shall, however be limited to the cost of replacement of the equipment(s)/system(s), replacement of which shall remove the deficiency so as to achieve the guaranteed performance. These parameters/capacities shall be termed as "Category-III" Guarantees.

3.0 GUARANTEES UNDER CATEGORY-I





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Auxiliary Power Consumption for all specified plant auxiliaries required for continuous unit operation at 660MW (i.e. 100% rated load) under rated steam conditions and at guaranteed optimised condenser pressure with 0% make up shall be guaranteed in line with the requirement stipulated in clause # 3.10 of this chapter.

Note: Power consumption of each of the pump / fan / compressors / coal pulveriser / heater etc. wherever mentioned shall be measured with its own drive.

3.2 AMOUNT OF LIQUIDATED DAMAGES (LD) APPLICABLE UNDER CATEGORY-I GUARANTEES

If the performance guarantee(s) specified at clause 3.1 are not met by the Contractor even after the modifications and/or replacements mentioned at clause 2.1 of this Chapter but are achieved within the stipulated Acceptable Shortfall Limit as indicated in this clause, Employer will accept the equipment/system/plant after levying liquidated damages as indicated hereunder. However, if the demonstrated guarantee(s) continue to be more than the stipulated Acceptable Shortfall Limit, the Employer may at his discretion reject the equipment/system and recover the payment already made or accept the equipment/system only after levying liquidated damages against the Contractor, at the rates listed herein, and such liquidated damages shall be deducted from the Contract Price:

S.N o.	GUARANTEE	RATE OF LIQUIDATION DAMAGE (LD)	ACCEPTABLE SHORTFALL LIMIT WITH LD

vii)	Auxiliary Power Consumption For increase in the auxiliary power consumption in KW guaranteed as per the requirements of clause 3.10 of this section at :	INR 5,84,000/- (INR Five Hundred eighty four Thousand only) or equivalent foreign currency for) per 1 KW increase in Auxiliary Power Consumption.	(+) 1% of the guaranteed auxiliary power consumption.
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NOTE:

- a) Each of the liquidated damages specified above shall be independent and these liquidated damages shall be levied concurrently as applicable.
- b) If the contract currency is other than INR, then the liquidated damages shall be in equivalent amount in contract currency based on Bill selling exchange rate of State Bank of India prevailing on the date of award of contract.
- c) All these liquidated damages for short fall in performance shall be deducted from the contract price as detailed in accompanying General Condition of Contract (GCC) / Special Conditions of Contract (SCC).
- d) Contractor's aggregate liability to pay Liquidated Damages (LD) for failure to attain the functional guarantee shall not exceed twenty five percent (25%) of the Contract Price.
- e) The LD values and acceptable shortfall limits are applicable for one single 660MW unit.



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3.10 AUXILIARY POWER CONSUMPTION

3.10.1 Unit Auxiliary Power Consumption

The unit auxiliary power consumption shall be calculated using the following relationship.

$P_{au} = P_u + TL$ (Unit)

P_{au} = Guaranteed Unit Auxiliary Power Consumption.

P_u = Power consumed by the auxiliaries of the unit under test.

TL = Losses of the transformers supplied by bidder based on works test reports for unit.

The power consumption (P_u) of entire unit auxiliaries fed from unit transformers shall be measured at the incomers of respective unit boards. Suitable correction for auxiliaries not in service at the time of this measured power consumption like MDBFP etc, shall be done on as per the technical specification.

While guaranteeing the auxiliary power consumption the bidder shall necessarily include all continuously operating unit auxiliaries. The auxiliaries to be considered shall include but not be limited to the following:



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- (xxxvi) Air Conditioning Plant for Main Plant Area, ESP Control Room, CHP Control Room, AHP Control Room, PT-DM Area and any other area.
- (xxxvii) Power consumption of fans, water pumps, exhausters of Air washer units for TG building and whole main plant area at its rated duty point.
- (xxxviii) Power consumption of UPS DC system
- (xxxix) Power consumption of any other continuously operating auxiliary for unit operation at 100% TMCR.

Note:

1. The bidder shall furnish a list of equipments to be covered under Unit auxiliary power consumption, which shall be subject to Employer's approval.
2. The bidder shall ensure that power supply to all such equipments to be covered under unit auxiliary power consumption is fed from unit board of the respective unit.
3. Number of coal mill and coal feeders shall be corresponding to the design coal.
4. Method of Computation of Auxiliary Power consumption for ESP:-

For guarantee purpose, total maximum continuous Auxiliary power consumption will be the power consumption of corona power (Excluding power consumption by hopper heaters, insulator heaters, rapping system, ventilation fans etc.) of all fields of all passes of ESPs for one unit. Corona power of TR sets will be computed at the input terminals of the TR sets when all ESP fields of all ESP passes are working and rapping system is in normal operation at the guarantee point condition as specified. The measurement for guaranteed auxiliary power consumption shall be carried out during ESP collection efficiency test. The method for computing the corona power shall be as described below:-

- a) Power consumption of TR sets will be measured pass wise and for one pass (Say ESP-A) at a time with the help of energy meter in ESP MCC.
- b) Energy meter reading will be taken before starting the collection efficiency test and after completion of collection efficiency test.

- c) Before starting collection efficiency test, switch off all the TR sets serving to one pass (ESP-A) temporally and note down energy meter readings for period t1 i.e. E1. Power consumed by hopper heaters, shaft and support insulator heaters and rapping systems shall be $W1 = E1/t1$. The time period t1 shall be minimum 4 hours.
- d) During the collection efficiency test the total energy fed in to ESP MCC of one pass (say ESP-A) will be measured during entire period of collection efficiency test i.e. E2. Total time period (t2) of test shall be noted. The power consumption shall be $W2=E2/t2$. During this period, no change in the status of hopper heaters, insulator heaters, rapping system, ventilation fans etc. will be allowed w.r.t. the condition at clause c) above. In case there is any change in the status of hopper heaters, insulator heaters, rapping system, ventilation fans etc., then auxiliary power consumption test will be repeated again.
- e) Measured corona power consumption for one pass (say ESP-A) = $(W2-W1)$
- f) Measured corona power of one unit= Corona power of (ESP-A + ESP-B + ESP-C + ESP-D + ESP-E + ESP-F).
- g) Number of fields shall be as per the PG test of ESP as detailed elsewhere.

3.10.2 Station Auxiliary Power Consumption

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

$$P_{Stn} = Pau_{Stn} + TL_{Stn}$$

$$Pau_{Stn} = \text{SUM } (Pi \times Di)$$

Where,

P_{Stn} = Power consumed by the station auxiliaries

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

Pi = Power consumed by each station auxiliary.

Di = Duty factor to be considered for each station auxiliary

TL_{Stn} = Transformer Losses of the station / standby / start-up transformers for meeting the station auxiliary power supply and that of any other transformer supplied by the bidder based on work test report.

NOTE: Transformer losses (TL) shall be considered as per following (as applicable)-

- GT - 100% no load loss, 54% of Copper losses & 100% Cooler Loss.



- ICT – 100% no load loss, 30% of Copper losses & 67% Cooler Loss.
- ST – 100% no load loss, 8% of Copper losses & 9% Cooler Loss.
- UT – 100% no load loss, 52% of Copper losses & 50% Cooler Loss.
- Aux/ LT Outdoor/ LT Indoor Transformer: 100% no load loss & 25% of Copper losses
- Reactor – losses at rated voltage

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

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

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

b) Air Conditioning System

Power consumption at motor input terminals of working units (i.e. excluding stand-by) at its rated duty point of Chilling machines, Chilled water Pumps, Condenser water Pumps, Air/water cooled condensing machines, precision air conditioners, Air handling units (AHU) fans, cooling towers, for the Air conditioning system.



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4.0 GUARANTEES UNDER CATEGORY-II**4.1 The Performance Guarantees, conformances to which are mandatory are as follows:****4.1.1 NOx emission**

Contractor shall guarantee that maximum total NOx emission from the unit shall not be more than 260 grams of NOx (from thermal as well as fuel) per giga joule of heat input (at 6% O2 level and as per equivalent NO2) to the boiler during the entire operating range of steam generator for the range of coals specified.

The emission shall be measured during steam generating capacity test. The bidder shall furnish the methodology of measurement and demonstration of variations w.r.t. load upto 50% of total load.

5.0 GUARANTEES UNDER CATEGORY-III

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

5.1 Noise

- 5.1.1 All the plant, equipment and systems covered under this specification shall perform continuously without exceeding the noise level over the entire range of output and operating frequency.
- 5.1.2 Noise level measurement shall be carried out using applicable and internationally acceptable standards. The measurement shall be carried out with a calibrated integrating sound level meter meeting the requirement of IEC 651 or BS 5969 or IS 9779.
- 5.1.3 Sound pressure shall be measured all around the equipment at a distance of 1.0 m horizontally from the nearest surface of any equipment/ machine and at a height of 1.5 m above the floor level in elevation.
- 5.1.4 A minimum of 6 points around each equipment shall be covered for measurement. Additional measurement points shall be considered based on the applicable standards and the size of the equipment. The measurement shall be done with slow response on the A – weighting scale. The average of A-weighted sound pressure level measurements expressed in decibels to a reference of 0.0002 micro bar, shall not exceed the guaranteed value. Corrections for background noise shall be considered in line with the applicable standards. All the necessary data for determining these corrections, in line with the applicable standards, shall be collected during the tests



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5.21 Air Conditioning & Ventilation System**A. Following shall be Demonstrated at Shop**

- 1) Capacity and discharge pressure of chilled water pumps, condenser water pumps and pumps of air washer and unitary air filtration units at its rated duty point of Air conditioning and Ventilation system.



- 2) Capacity and static pressure of air washer unit fans, Unitary air filtration unit fans, roof exhausters of TG building and AHU fans at its rated duty point of Air conditioning and Ventilation system.

B. Following shall be Demonstrated at Site

- 1) AC plant capacity of each area and guaranteed room conditions during summer for all the Air conditioned areas.
- 2) Parallel operation, Vibration & Noise level of all rotating equipments.



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7.0 TEST REPORTS

- 7.1 The Contractor shall prepare test reports in which the methods followed, instrument readings, graphs, observations, final results obtained, etc., shall be recorded.
- 7.2 Four (4) hard copies and 2 soft copies on CD –ROM of each test report shall be submitted to EMPLOYER for Approval.
- 7.3 Performance Guarantee/ Acceptance Tests on the equipments / systems not covered in this Sub-section shall be carried out as per the procedure/ test codes/ specified in respective detailed specifications/ Sub-sections in Volume – III to VI.



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factor over the recorded new capacity reading.



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APPENDIX – IV			
FORMAT FOR SUBMISSION OF GUARANTEE TEST PROCEDURE			
Clause No: as per LOA / Technical Specifications	Provision of LOA / Technical Specifications	Name and Methodology of Test proposed by Vendor	UPRVUNL comments on the tests proposed by Vendor



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APPENDIX-VI

GUARANTEE TEST PROFORMA
POWER MEASUREMENT

Project :

Package :

Date:

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

S. No.	Measurement Terminal Location	Time	Voltage (Volts)	Current (amps)	KW Reading M.F.		Total	Remarks
					W1	W2		

7. Energy-meter Readings

S.No.	Equipment	Time Duration		Energy-meter Readings Kw-Hr		Equipment Kw (R2- R1) / (t2-t1)	Remarks
		Initial T1	Final T2	Initial T1	Final T2		
*Reason and duration for system trip / stop may be recorded in remarks column.							
UPRVUNL Contractor							

APPENDIX-VII

GUARANTEE TEST PROFORMA
VIBRATION LEVEL MEASUREMENTS

Project :

Package:

Date:

Time:

Details of vibration Level Meter

1. Make
2. Model &Sl.No.
3. Date of calibration with name of Test House:

S.No	Equipment	Pick *Point	Vibration level Amplitude / Velocity		
			Horizontal Micron/mm/ sec.	Vertical Micron/mm/ sec.	Axial Micron/mm/ sec.
* Reading shall be taken at all the bearings of motor, gear box and driven equipment. In case of conveyor galleries, vibrations shall be measured at minimum three locations, at midpoint of stringer between two short supports.					
UPRVUNL			Contractor		

**GUARANTEE TEST PROFORMA
NOISE LEVEL MEASUREMENTS**

Project :

Package:

Date:

Time:

Details of vibration Level Meter

1. Make
2. Model &Sl.No.
3. Date of calibration with name of Test House:

S.No	Equipment with location	Equipment Load Capacity	Measurement * point no:	Sound Level dBA.	Remarks
UPRVUNL Contractor					
* For each equipment location, a Projected Plan Diagram shall be made and the location of measurement points shall be identified.					



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**PANKI STPP
AIR CONDITIONING SYSTEM
PAINTING SPECIFICATIONS**

SPECIFICATION No: PE-TS-426-553-A001

SECTION : I

SUB-SECTION : C 2C

REV. 00

SECTION: I

SUB-SECTION: C 2C

CUSTOMER SPECIFICATIONS

PAINTING SPECIFICATIONS

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