

**UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM
LIMITED**

1 X 660 MW PANKI TPS EXTENSION PROJECT

**TECHNICAL SPECIFICATION
FOR
CONDENSATE POLISHING UNIT**

SPECIFICATION NO: PE-TS-426-155-A001



**BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA, INDIA**



TITLE:
1 X 660 MW PANKI TPS EXTENSION PROJECT

SPECIFICATION NO. PE-TS-426-155-A001

TECHNICAL SPECIFICATION FOR CONDENSATE
POLISHING UNIT

REV. NO. 00

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PROJECT INFORMATION

1.0 PROJECT INFORMATION

1.1	Owner	:	UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LIMITED, LUCKNOW	
1.2	Project Title	:	Panki Thermal Power Station (1x660MW)	
1.3	Owner's Engineer	:	DEVELOPMENT CONSULTANTS PVT. LTD 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	$^{\circ}\text{C}$	>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	$^{\circ}\text{C}$	12
	b) Summer		21
5.0	Flash Point (min)		
	a) Abel	$^{\circ}\text{C}$	--
	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 $^{\circ}\text{C}$	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 $^{\circ}\text{C}$	Cst	370
2.0	Density at 15 $^{\circ}\text{C}$ (approx)	Kg/m ³	890 to 950
3.0	Flash Point (min)	$^{\circ}\text{C}$	66
4.0	Pour Point (max)	$^{\circ}\text{C}$	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.

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

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SECTION – I
SPECIFIC TECHNICAL REQUIREMENTS
SUB-SECTION IA - Specific Technical Requirements (Mech.)
SUB-SECTION IB - Specific Technical Requirements (Electrical)
SUB-SECTION IC - Specific Technical Requirements (C & I)



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SECTION : I

**TECHNICAL SPECIFICATION FOR
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SECTION – I
SUB-SECTION – IA-SPECIFIC TECHNICAL REQUIREMENTS (MECHANICAL)

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1.0 GENERAL

This specification is intended to cover design, engineering, manufacture, supply, fabrication, assembly, inspection / testing at vendor's & sub-vendor's works, painting, maintenance / special tools & tackles, mandatory spares alongwith spares for erection as required, startup and commissioning spares 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, preparation and submission of drawing /documents including "As Built" drawings and O & M manuals, layout drawings in 2D & 3D (As applicable) and carrying out performance guarantee /Functional / Demonstration tests at site (As applicable) & equipment /system guarantee/Aux. Guaranteed power consumption etc. inclusive of all prevailing taxes, duties and other levies and handover in flawless condition of the package specified above for above mentioned project to the end customer complete with all accessories for the total scope defined as per BHEL NIT & tender technical specification no. PE-TS-426-155-A001 for condensate polishing unit package of **1 X 660 MW PANKI TPS EXTENSION PROJECT**.

The Condensate Polishing Units with a common external regeneration system and associated accessories shall conform to the technical specification (PE-TS-426-155-A001) for **CONDENSATE POLISHING UNIT of 1 X 660 MW PANKI TPS EXTENSION PROJECT**.

2.0 DESIGN CONDITIONS FOR CONDENSATE POLISHING UNIT

There shall be three service vessels (3X50%) for 660 MW unit, each polishing 50% of the condensate flow corresponding to the maximum mass flow rate established with VWO (valve wide open) condition at 1% make up (Flow through each service vessel indicated in the data sheet).

3.0 BRIEF DESCRIPTION OF THE SYSTEM

The purpose of the system is to reduce the total dissolved solids in Condensate of 1X660 MW PANKI THERMAL POWER STATION.

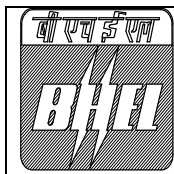
For maintaining the feed water purity condensate polishing plant will be provided in the feed water cycle at the downstream of condensate extraction pumps. The function of the CPU will be to purify the condensate effluent from the condenser by removing solids and dissolved salts with the intent of reducing corrosion and depositions in the steam water cycle. The condensate polishing units shall be of deep mixed bed type. Condensate Polishing Plant including mixed bed unit, regeneration unit, piping, valves, instrumentation etc. The CPU shall be provided with associated chemical feed system for preparing, measuring and dosing the required chemicals and with its external regeneration system located near DM plant building.

On line Condensate Polishing System (CP System) is envisaged to achieve high order of availability of various power cycle equipments as well as to ensure quick start up of the unit & continue the unit operation without any restriction by maintaining desired quality of condensate water. The CP System should also be capable of maintaining specified condensate quality with condenser tube leakage condition.

CP System shall comprise 3 X 50% Condensate Polisher Mixed Beds and One (1) External Regeneration System.

The Condensate Polisher Mixed Beds and associated pipe works, valves, instruments, control panels etc. shall be located at ground floor of Power House.

The regeneration facilities comprising of Regeneration Vessels, Measuring Tanks and Pumps shall be located in a separate place near DM plant building and outside TG building. The resins will be transferred to the Regeneration Area from the Condensate Polisher Mixed Beds and vice versa through a pipeline.



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The proposed condensate plant shall treat the entire condensate of the turbine generator of power station. The proposed schematic arrangement of the condensate polishing plant and its regeneration facility shall be as per the enclosed P&I Diagram. Arrangement of piping, valves and instruments shown in the P&ID are bare minimum. The bidder shall include the complete system including regeneration facility as elaborated in this specification meeting the contractual requirements.

The condensate polisher service vessels shall be located in the TG hall. The resins shall be transferred to and from the common regeneration facility by sluicing through a pipeline hydro pneumatically/hydraulically. The regeneration system shall be external. The CPU regeneration system will be located as per plot plan near to DM plant (BHEL DRG. No. PE-DG-426-100-M001).

The regeneration process shall be of proven design and shall give resin– separation compatible with the desired effluent quality.

4.0 SCOPE OF SUPPLY (MECHANICAL)

Broad scope of supply (mechanical) for this package is detailed below and as indicated in relevant portion of this specification. The same shall be in bidder's scope of supply.

The CP System shall consist of but not limited to the equipment and accessories as follows:

A. SERVICE VESSEL FACILITY

- 1) There shall be three service vessels (3X50%) for 800 MW unit, each polishing 50 % of the condensate flow.
- 2) Each Condensate polisher vessels shall be complete with condensate inlet and outlet connections, connections for resin transfer to and from the vessels, bed support-cum-under drain system, inlet water distributors, air distribution arrangement for resin mixing, all fittings and appurtenances etc. as specified and as required.
- 3) One no External resin traps at the condensate & rinse outlet of each of the condensate polisher mixed beds each designed for in-place manual back flushing facility.
- 4) Condensate inlet and outlet headers for each installation with pipe connections to the condensate polisher vessels.
- 5) Resin transfer headers and pipe lines connecting the common external regeneration facilities to the condensate polisher vessels of each installation. The resin transfer pipe lines shall be of SS-304 and sized for a flow velocity of between 2 and 3 m/s.
- 6) Rinse water outlet headers from condensate polisher vessels of each installation up to the condenser hot well. Rinse water outlet headers from condensate-polisher vessels shall be provided with a pressure reducing valve and orifice plate, suitably designed to enable the water entry to the condenser hot well under all operating condition of condenser.
- 7) All necessary valves, and fittings for the installations with actuators necessary for their remote operation. These shall include suitable fool proof arrangement to prevent accidental over pressurization of the resin transfer pipeline and regeneration facilities connected to it, which are designed for pressure much lower than that of the Condensate Polisher Service vessels.
- 8) A drain header for the condensate polisher service vessels. All necessary drains, vents and sampling points, with valves as required.
- 9) Gland sealing water piping for the Gland sealing valves in the rinse water line & other lines (as applicable).
- 10) Sample cooling line piping for sample cooling for all analysers.
- 11) Two nos. (1W + 1S) per unit oil free type air blowers with electric motor drives for each unit for

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supplying air required for mixing the resins in the service vessels. Each blower shall be complete with motor, V-belt drive with belt guard, inlet filter, silencer, flexible couplings and discharge snubber, acoustic hood, relief valve etc. all mounted on a single base.

- 12) Complete Instrumentation and Control for automatic operation of the CP system.
- 13) Emergency bypass between the condensate influent and effluent headers. Each Condensate polisher service unit shall be provided with an automatic bypass for the condensate polisher on the condensate inlet and outlet headers of the unit with a double flanged butterfly type control valve and double flanged butterfly type isolation valves on the upstream and downstream sides of the control valve. 1X100% capacity control valve shall be provided to achieve proper control under all operating conditions. Isolation valve shall be provided with geared operators for manual operation and shall be located at a height which can be easily operatable. Complete instrumentation and controls for this emergency by-pass system. Further all tubing, wiring air sets and other fittings required to complete the system shall be provided.
- 14) Total resin charges shall be supplied for the project is six (6) numbers. One resin charge shall be considered as resin required for one service vessel i.e. cation resin, anion resin and inert resin (if any) used for the project. Further one Year's topping requirements or 10 % of first fill quantity, whichever is more shall be supplied by bidder.
- 15) One no. Specific Conductivity analyser at condensate inlet header & One no. specific Conductivity Analyzer at outlet of each Condensate polishing Mixed Beds / Condensate Polisher Service vessels. Hence total 4 nos. of Specific Conductivity analyser shall be supplied for TG unit service vessel area.
- 16) One no. Cation Conductivity analyser at condensate inlet header & two nos. cation Conductivity Analyzer at outlet of each Condensate polishing Mixed Beds / Condensate Polisher Service vessels. Hence total 7 nos. of Cation Conductivity analyser shall be supplied for TG unit service vessel area.
- 17) One no. pH analyser at condensate inlet header & one no. pH analyser at outlet of each Condensate polishing Mixed Beds / Condensate Polisher Service vessels. Hence total 4 nos. of pH analysers shall be supplied for TG unit service vessel area.
- 18) One no. multi stream (four channel) sodium analyzer to measure process value of each service vessel outlet and process value of common inlet header of TG unit. Sodium analyzer shall be limited to a maximum of four (4) streams only.
- 19) One no. multi stream (four channel) silica analyzer to measure process value of each service vessel outlet and process value of common inlet header of TG unit. Silica analyzer shall be limited to a maximum of four (4) streams only.
- 20) One no. multi stream (four channel) chloride analyzer to measure process value of each service vessel outlet and process value of common inlet header of TG unit. chloride analyzer shall be limited to a maximum of four (4) streams only.
- 21) Complete instrumentation and controls for this system, including the differential pressure transmitters, panel mounted indicating type controller with provision for remote manual operation, actuator for the control valve with positioner etc. All tubing, wiring, airsets, and other fittings, required to complete the system.
- 22) All the piping, valves, fitting, accessories etc. used in service vessel area shall be 300# class minimum and this area shall be considered as high pressure side.
- 23) Minimum instrumentation required as per P & ID included in this tender specification. In addition to that bidder to follow sub-section I-C & sub-section II-C for redundancy criterion of instruments and analyzers and consider the same in their scope.
- 24) All butterfly valves MOC used in service vessel area in condensate inlet line shall be (Body & Disc both:CF8M/SS316) and condensate outlet line will be (Body & Disc both: CF8M/SS316).
- 25) All nuts & bolts used for CPU service vessel area in piping and valves shall be of MOC –SS316.

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B. REGENERATION SYSTEM

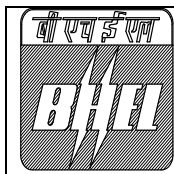
The regeneration system shall be common for all mixed bed polishers of TG unit and shall be external. The external CPU regeneration system will be located as per plot plan near to DM plant (BHEL DRG. No. PE-DG-426-100-M001). Regeneration area shall be considered as low pressure area. Complete regeneration facility as mentioned below shall be in Bidder's scope:

I. One external regeneration facility for regeneration of the resins from the condensate polisher vessels for TG unit shall be provided by the bidder and consists of following:

- 1) One (1) Resin Separation & Cation Regeneration Vessel complete with all accessories.
- 2) One (1) Anion Resin Regeneration Vessel complete with all accessories.
- 3) One (1) Mixed Resin Storage Vessel complete with all accessories.
- 4) All internals, fittings and appurtenances for these vessels.
- 5) Common waste effluent header with one resin trap designed for in place manual backwashing.
- 6) The vessels indicated against sr. no. 1 to 3 is tentative and for reference only. The same shall depend on the supplier recommendations based on specific regeneration technology to make the system suitable in all respects for satisfactory operation and performance of condensate polisher mixed beds.
- 7) Resin Make up/injection hopper complete with water ejector system for resin make up. Resin make Up /injection hopper shall be sized to handle up to minimum 150 liters of as received new resins.
- 8) Two nos. (2X100%) (1W+1S) oil free type air blowers with electric motor drives, for supplying all the process air required for cleaning of resins and their regeneration processes. Each blower shall be complete with motor, V-belt drive with belt guard, inlet filter, silencer, flexible couplings and discharge snubber, acoustic hood, relief valve etc.as required and shall be mounted on a single base.
- 9) Two nos. (2X100%) (1W+1S) CPU Regeneration cum resin transfer Pumps each with electric drive motor drives, one normally operating and the other standby, for water supply for chemical preparation / dosing and transfer of resin from service vessel to regeneration vessels & vice-versa, backwash & rinse activities shall be provided. These CPU Regeneration cum Resin Transfer Pumps will take suction from DM water storage tanks (DM water storage tanks not in bidder's scope) of DM plant. A terminal point of DM water line shall be provided by BHEL at 5 m distance from CPU regeneration Building.
- 10) All integral pipe works, valves, internals, fittings for this installation with the actuators necessary for their remote automatic operation along with hangers, supports and appurtenances etc. for these equipments. These shall include all drains, vents and sampling points with valves as specified and as required.
- 11) One (1) set of safety equipment comprising PVC protection suits with hoods, rubber boots, face visors and thick PVC gauntlets shall also be provided by bidder. One numbers personnel water drench shower/safety shower and eye bath in regeneration area shall be provided by the bidder.
- 12) Minimum one No. chain pulley block with tri-pod arrangement shall be provided by bidder for handling of rotary equipments of CPU regeneration area in addition to the requirement of ELECTRIC HOIST AND MANUAL HOIST specified here under clause no. 5.0 in this specification.

II. BULK ACID AND ALKALI STORAGE & ACID & ACID AND ALKALI DOSING FACILITY

All equipment for dosing of acid and alkali solutions shall be rated to provide a maximum dosing rate at least 20% in excess of that required from process calculation. The Acid and alkali dosing equipment for regeneration of condensate polishing resins shall preferably be mounted on skid. All the equipment, piping etc. shall be assembled on two structural steel skids one for acid and one alkali dosing equipment.



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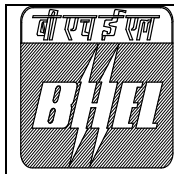
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In order to facilitate erection at site chemical dosing preparation equipment shall be mounted on structural steel skids and assembled (including piping) at the manufacturer's shop, to the maximum extent possible, prior to shipping. The number of mechanical connections shall be minimised by the use of pipe headers wherever possible.

The following below mentioned items shall be in bidder's scope of supply:

- 1) Two nos. (2X100%) (1W+1S), acid measuring tanks for cation resin regeneration complete with fume absorbers, overflow seal pot, integral pipe works, valves, instrumentation and all other accessories required. Each acid measuring tank capacity shall adequate to hold 120% of acid required for one regeneration.
- 2) Two nos. (2X100%) (1W+1S) simplex hydraulically operated diaphragm type metering pumps for acid dosing for regeneration with electric motor drive, pulsation dampener & safety relief valve at the outlet header of each pump along with all other required accessories.
- 3) Two nos. (2X100%) (1W+1S), alkali preparation cum measuring tank for anion resin regeneration. The tank shall consist of slow speed agitator driven by motor, carbon dioxide absorber, overflow seal pot, dissolving basket, integral pipe works, valves, instrumentation and all other required accessories. Each alkali preparation cum measuring tank capacity shall adequate to hold 120% of alkali required for one regeneration.
- 4) Two nos. (2X100%) (1W+1S) simplex hydraulically operated diaphragm type metering pumps for alkali dosing for regeneration with electric motor drive, pulsation dampener & safety relief valve at the outlet header of each pump along with all other required accessories.
- 5) One (1) no. hot water tank for heating of alkali diluent water with (2X50%) electric heating coil, adequately insulated of stainless steel construction (MOC-SS304) shall be provided complete with integral pipe works, valves, instrumentation and all other accessories required. The capacity of tank shall be minimum 20% higher than the maximum water demand. This tank shall be provided with burn out protection, pressure relief valve, level transmitter, temperature indicator, temperature transmitter etc. The temperature transmitter provided on the tank shall control the heater. The heaters shall be sized for heating the water from a temperature of 15 to 50 deg. C in 5 hours at the outlet of ejector.
- 6) Two nos. (2X100%) (1W+1S), alkali transfer cum recirculation pumps. These pumps shall be provided with a pulsation dampener at the outlet header of each pump along with necessary valves, instrumentation, piping & accessories as required.
- 7) One (1) no. Activated carbon filter for alkali complete with internals, integral pipe works, valves and all other accessories as required. Activated Carbon Filter for alkali rated flow of the filter shall not be less than the design capacity of the alkali transfer cum recirculation pumps, and the maximum velocity through the filter for this flow shall not exceed 15 meters/hour. Depth of the filter materials shall not be less than 1 meter.
- 8) Two number Carbon trap shall be provided, one at the outlet line of Activated carbon filter & one at rinse outlet. This carbon trap shall have screen opening of 60 mesh and MOC –SS316.
- 9) Diluent water supply separately, for acid and alkali, each provided with an automatic on-off valve, a throttling valve for setting of flow, a local flow indicator with flow transmitter and a mixing tee where the chemicals get injected into the water stream.
- 10) DM Plant Bulk acid & alkali storage tanks (not in bidder' scope) shall be used drawing chemicals for regeneration of CPU Resins. These Bulk acid & alkali storage tanks shall be located in DM plant area which is adjacent to CPU regeneration building. The terminal point for acid (30-33% HCL) shall be both bulk acid storage tanks (2 nos.) outlet nozzle. The terminal point for alkali (48% NaOH) shall be both bulk alkali storage tanks (2 nos.) outlet nozzle Further Acid & Alkali pipe lines of size 80 NB each along with isolation valve to meet the CPU regeneration chemical requirement shall be tapped of from the 2 nos. Bulk acid & 2 nos. alkali storage tanks outlet nozzles provided in DM plant area. Further counter flanges, piping, valve, instrumentation and required fitting & accessories required for the same shall be in bidder' scope.
- 11) To meet the regeneration and resin transfer water requirements of DM Water, BHEL will provide a



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150 NB size DM water line terminal point along with isolation valve at 5 m distance from CPU regeneration Building. Further counter flanges, piping, valve, instrumentation and required fitting & accessories after BHEL terminal point shall be in bidder' scope. Further recirculation line of CPU Regeneration cum resin transfer Pumps shall be connected by bidder to common recirculation line provided by BHEL along with pressure reducing valve and NRV. Necessary Valves, piping, instruments, flanges & fittings along with accessories for CPU Regeneration cum resin transfer Pumps recirculation line shall be in bidder's scope of supply.

- 12) All necessary suction and discharge piping for these pumps including all strainers, valves and fittings as required, upto the mixing tee with the diluent water.
- 13) All the equipment, piping etc. shall be assembled on two structural steel skids one for acid and one for alkali dosing equipment. The bidder shall supply all anchor bolts, foundation plates, sleeves, nuts, inserts etc. to be embedded in concrete for these equipment skids. The length of the foundation bolts shall be liberally sized to reach below the reinforcement level. Each equipment skid shall be provided with suitable lighting lugs, eye bolts etc. to facilitate erection and maintenance.
- 14) All integral pipe works, valves, internals, fittings for this installation with the actuators necessary for their remote automatic operation along with hangers, supports and appurtenances etc. for these equipments. These shall include all drains, vents and sampling points with valves as specified and as required.
- 15) All interconnecting piping, valves and fittings & instrumentation as required to complete the CPU regeneration system shall be in bidder's scope.

All piping, valves & fittings handling acid & alkali in CPU regeneration area shall be of CPVC schedule 80 rating only.

- 26) All nuts & bolts used for CPU regeneration area in piping and valves shall be of MOC –SS316.

C. NPIT AND NPIT DISPOSAL SYSTEM

- 1) Effluent generated during the regeneration and resin transfer operation from CPU regeneration area shall be transferred through a drain trench to DM plant Neutralization Pit (RCC construction). There will no dedicated Neutralization pit for CPU regeneration area.

The details of N-pit will be as mentioned below. One (1) no. Neutralization Pit of RCC construction with two (2) compartments with acid and alkali resistant lining/tiling along with isolation gates for each compartment shall be provided in DM plant. Each section/ compartment shall have capacity to hold (waste generated from single regeneration of one stream of DM Plant + waste generated from single regeneration of one CP Service Vessel + 20% Margin).

Effluent generated during the regeneration and resin transfer operation from CPU regeneration area shall be transferred through a drain trench to DM plant Neutralization Pit (RCC construction).

Bidder to note that if invert level of DM plant trench is higher than CPU regeneration area trench then suitable arrangement (i.e. mechanical items (Spool pipe, valve, piping & fittings etc.)) required for terminating the drain trench of CPU regeneration area in DM plant drain trench shall be in bidder's scope and shall be provided by bidder without any price and delivery implication to BHEL & Customer.

- 2) All interconnecting piping, valves, instrumentation and fittings as required for the N-pit system as applicable and as required.

Further all interconnecting piping, valves, instrumentation and fittings as required for the complete CPU regeneration system shall be in bidder's scope. All piping, valves & fittings handling acid & alkali in CPU regeneration area shall be of CPVC schedule 80 rating only.

D. PIPING

All the piping as listed below shall be in bidder's scope. The below indicated pipes shall be designed,



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supplied, erected, laid and tested by the bidder. Elbows, tees, flanges, counter flanges, Hangers and supports, embedment plates with lugs etc. required for the below given piping shall also be provided by the bidder.

- 1) Service vessel inlet header shall be ASTM A 106 Gr. C (OD 457.2 X 12.7 mm thick)
- 2) Service vessel outlet header shall be ASTM A 106 Gr. C (OD 457.2 X 12.7 mm thick)
- 3) By pass line between Service vessel inlet & outlet header shall be ASTM A 106 Gr. C (OD 457.2 X 12.7 mm thick)
- 4) Rinse water outlet piping shall be ASTM A 106 Gr. C (OD 168.3 x 7.11 mm). The distance between CPU service vessel (farthest vessel) to condenser hot well shall be considered as 110 meter and this piping along with necessary valves, instrument, fitting and flanges shall be in bidder's scope.
- 5) Resin transfer piping shall be minimum 80 NB and of ASTM A 312 Gr. TP 304(SS 304) Sch 40 (minimum). One-way distance for resin Transfer Piping between farthest service vessel and regeneration area shall be 425 m. In addition to that complete resin transfer piping shall be in bidder's scope which shall include the piping inside CPU regeneration area & CPU service vessel area equipments also.
- 6) Piping handling DM water shall be ASTM A 312 Gr. TP 304 (SS 304) Sch 40 (minimum). One-way distance for DM water piping between farthest service vessel and regeneration area shall be 425m. Further piping from terminal point of DM water to CPU regeneration cum resin transfer shall be considered as 55 m and shall be in bidder's scope. In addition to that complete DM Water piping shall be in bidder's scope which shall include the piping inside regeneration area equipments & CPU regeneration cum resin transfer pump recirculation line from pumps outlet to recirculation line/ recirculation nozzles provided in DM water storage tanks.
- 7) Piping used for handling alkali (all concentration) and alkali solution shall be CPVC Sch. 80 minimum for complete CPU regeneration area. The terminal point for 48% NaOH shall be from two numbers Bulk alkali storage tanks individual nozzles located in DM plant. Further Piping from these Bulk alkali storage tanks nozzle to CPU regeneration building shall be also in bidder's scope.
- 8) Piping handling acid (all concentration) and acid solution shall be CPVC Sch. 80 minimum for complete CPU regeneration area. The terminal point for 30-33% HCL shall be from two numbers Bulk acid storage tanks individual nozzles located in DM plant. Further Piping from these Bulk acid storage tanks nozzle to CPU regeneration building shall be also in bidder's scope.
- 9) Piping for air service (Instrument & service) shall be hot dip galvanized (heavy grade) steel as per IS 1239.
- 10) All piping within each of the above skids/equipment for CPU regeneration area & CPU service vessel area shall be in bidder's scope.
- 11) Similarly, DM water piping from BHEL terminal point to CPU REGENERATION CUM RESIN TRANSFER PUMPS suction lines along with their isolation valves, Instruments, piping, flanges & fittings shall be in bidder's scope.
- 12) Further DM water piping from each CPU REGENERATION CUM RESIN TRANSFER PUMPS to service vessel area and regeneration area all equipments shall be in bidder's scope.
- 13) Service water piping (used for cooling of condensate sample & other activities in CPU service vessel area), piping for gland sealed valve cooling, instrument air piping, potable water piping for eye wash, service water piping for pump flushing & piping for other applications of CPU service vessel area & regeneration area shall also be in bidder's scope.
- 14) Similarly, all piping between the external regeneration facility and the skids for chemical (acid or alkali) dosing and preparation shall also be designed, supplied, erected and tested by the bidder. These shall include demineralized water piping to the chemical dosing/preparation system, acid /alkali piping from BHEL terminal point to respective preparation/ dosing skids, the alkali preparation/ dosing skids from the external regeneration facility, alkali solution from its preparation facility to the alkali dosing skid, dilute chemical solution piping for acid and alkali from the dosing skids to the external regeneration facility, piping to the preparation/dosing facilities. Instrument air piping and power supply for immersion heaters of the diluent water tank from the regeneration facility, and all instrumentation and control wiring between these

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skids, etc.

- 15) In addition, any additional piping and associated accessories required to complete the system shall be in bidder's scope.

NOTE: Pipe routing shall be finalized during detailed engineering. However, system shall be designed to take care $\pm 10\%$ of increase in length of piping. There will be no price implication to BHEL/Customer on account of the same by bidder.

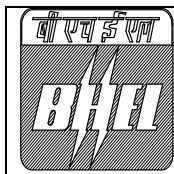
E. ADDITIONAL REQUIREMENT

- 1) Operating platforms, ladders, supports and other structural works for each vessel to facilitate accessibility for operation and maintenance for all the condensate polisher mixed beds, regeneration vessels, storage tanks, alkali and acid measuring tanks & preparation tanks and other equipment's etc. is also in bidder's scope.
- 2) Initial charge of all lubricants & grease.
- 3) All special tools necessary for proper maintenance or adjustment of the equipment packaged in permanent box. Finish paints for touch-up painting of equipment after erection at site in sealed container.
- 4) Start-up and commissioning spares as required.
- 5) All required elbow, tee, pipe fittings etc. required for erection of the complete system including piping shall be in bidder's scope. Bidder to provide the detailed BOQ shall be derived during detail engineering. Bidder to consider 10% margin over and above the BOQ requirement of all the fittings.
- 6) Wherever pipe racks are not available, pipes shall run on pedestals or below ground. All fixing items such as U clamps, nuts, bolts etc. required to lay the pipes on pedestals shall be in bidder's scope of work. Coating, wrapping and protection required for buried pipes shall be in bidder's scope of work.
- 7) Bidder shall consider 12 m static head + 10% margin in addition to the losses in straight pipes and bend in pipes, tees, reducer, expander and valves etc. (in yard piping) while selection of pump head during detailed engineering.
- 8) 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 or PG test of bidder's supplied equipment (whichever is later) and final filling after the initial operation OR PG test of bidder's supplied equipment (whichever is later) 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. 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.
- 9) 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.
- 10) MCC, DCS control room & battery room shall be located in CPU regeneration area building. All regeneration vessels and chemical dosing facilities shall be located in CPU regeneration building. Further N-pit shall be located in open area near DM plant building. CPU regeneration cum resin transfer pumps shall be located inside CPU regeneration Building. Further Bidder to also provide the localized CANOPY arrangement on all pumps, blower & motors which are open to sky. CPU regeneration area equipment layout drawing has been enclosed herewith this technical specification for bidder's compliance. Successful bidder has to use the same layout during detail engineering and arrange CPU regeneration area equipment in the same layout.
- 11) Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written

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approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.

- 12) In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion.
- 13) Bidders shall make Site visit in order to familiarize themselves with existing condition of site before submitting the bid in order to make their offer complete. During detail engineering also, the successful bidder shall be responsible for the correctness of details w.r.t. existing facility at site. Customer approval on any drawing having details of existing facility shall not be cited by the successful bidder a valid reason for any shortcoming in the work by them. BHEL shall also not entertain any cost implication for any lack of input data with regard to site during detail engineering.
- 14) Successful bidder shall furnish detailed erection manual for each of the equipment as well as complete system supplied under this contract at least 3 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier.
- 15) Final Electrical Load list will be submitted by the successful bidder as per agreed drawing/ doc submission schedule. Thereafter any change in the electrical load list shall be entertained only subject to its feasibility, and BHEL reserves the right to debit the vendor cost of any changes necessitated in the switch gear /MCC on account of changed loads.
- 16) Wherever CIVIL works is excluded from the bidder's scope, successful bidder shall furnish civil assignment / scope drawings. The corresponding CIVIL drawing prepared by BHEL / CIVIL agency, based on civil assignment drawing of bidder will be furnished to the successful bidder for concurrence. In case any modification is required in the civil work already carried out based on final civil inputs given by vendor, BHEL reserves the right to debit cost of such rework to vendor".
- 17) Ladder & platforms shall be provided for each tank for easy accessibility & maintenance purpose by bidder and the same shall be in bidder's scope.
- 18) All necessary valves and fittings for the installations with the actuators necessary for their remote operation and the same shall be in bidder's scope.
- 19) Embedment plates with lugs shall also be provided by bidder as per system requirement and the same shall be in bidder's scope.
- 20) All channels & brackets, mounting plates as required for mounting of motors, pumps, stirrers, tank etc. shall be in bidder's scope.
- 21) Start-up and commissioning spares as required shall be in bidder's scope.
- 22) Mandatory spares as per attached Annexure-VI of Section IA to this technical specification and the same shall be in bidder's scope.
- 23) All necessary structural steel for pipe supporting structure, platforms, walkways / pathways and access stairs, mechanical plant and equipment, mechanical services and pipe work associated with CPU Plant shall be in bidder's scope.
- 24) All Motorized valves shall be provided with integral starter as per requirement and as indicated in the P&ID and shall be in bidder's scope.
- 25) All handrails shall be of 32 mm nominal bore MS pipes (medium class) as per IS: 1161 galvanized using 750 gm/sq. m of zinc. Hand railing shall be a two-rail system with the top rail 1000 mm above the walkway surface and the intermediate rail 450 mm below the top rail. Handrail post spacing shall be limited to 1500 mm as far as possible but can be proportioned to the length of the opening. In such a case spacing shall not exceed 1850 mm centre to centre of posts. Hand railing shall be shop fabricated for specific locations



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and field welded or bolted to the erected structural steel. Railings shall be provided with 100 mm wide and 8 mm thick MS strip at bottom as toe guard all along the length of railing in horizontal plane. For RCC stairs, hand railing with 20 mm square MS bar balustrade with suitable MS flat and Aluminium / Teakwood handrail shall be provided, unless specifically mentioned otherwise.

- 26) Instrument hook up material shall be in bidder's scope.
- 27) Permanent ladder (not rungs) for approaching the top of tanks, valves for All steel inserts with lugs, plates, bolts, nuts, sleeves, edge angles and all other embedding components etc. as required to grout in civil works and to support/hold the equipments being supplied under this specification for opening/maintenance purpose.
- 28) If service air required by the bidder in the service vessel area (for hydro-pneumatic resin transfer operation etc.) then bidder to provide necessary compressors, valves, piping, fittings, flanges, instruments etc. to meet the system requirement.
- 29) If service air required by the bidder in the CPU regeneration area (for hydro-pneumatic resin transfer operation etc.) then bidder to provide necessary compressors, valves, piping, fittings, flanges, instruments etc. to meet the system requirement.
- 30) Wrapping, coating and protection of the entire buried pipe shall be as per IS 10221 or AWWA C 203-93.
- 31) Any item/work either supply of equipment or erection material which have not been specifically mentioned in but are necessary to complete the works for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification and shall be in bidder's scope without any commercial, technical and delivery implication to BHEL.
- 32) All other items are also included in scope of supply as specified in other part of the specification.
- 33) Bidder to use analysis given in Section –IA ANNEXURE –VIII of this technical specification for arriving Circulating water analysis (considering COC 5.0) for design of condensate polishing plant for CONDENSER TUBE LEAK CONDITION.
- 34) Bidder shall perform the guarantee parameters as per specification requirement to the satisfaction of owner. The exact modalities of verifying guarantee for the parameters indicated in the specification shall be finally as agreed with the owner during detailed engineering & mutually agreed.

5.0 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.

Bidder to note that 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).

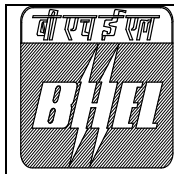
The stipulations of all statutory codes like Indian Electricity Act, Indian Electricity Rules, Factory Acts, Local Municipality act etc. shall however prevail over the specification requirements, in case any conflict arises between this specification and the statutory codes.

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

5.1 DESIGN CRITERION FOR ELECTRIC HOIST AND MANUAL HOIST (CHAIN PULLEY BLOCK)

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.

Chain pulley block (Manual hoist) - 300kg to <1T, wherever feasible, considering layout constraints. Capacity of cranes & hoists shall be selected considering a minimum margin of 25% over the maximum weight of the heaviest equipment / component to be handled.



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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.

5.2 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 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.

5.2.1 Electric hoist shall include but not be limited to the following: -

- Equipment offered shall be suitable for indoor duty conforming to Class II of IS: 3938.
- Equipment shall be designed to operate in non- hazardous area.
- Electric hoists shall be pendent operated.
- Both hoisting and trolley movement shall be motor driven.
- Hoisting motion shall be thru' VVVF drives to achieve creep speed of 10% of main speed.
- Wheels shall be single flanged type.
- Hook shall be swiveling type and fitted with a safety latch.
- Control panel shall be hoist mounted.
- Power feeding to the electric hoists shall be thru' PVC shrouded DSL.
- Brakes shall be fail to safety.
- Load/overload testing of the hoists shall be carried out as per IS: 3938.
- All material, castings and forgings will be of tested quality & certificates shall be made available for review as per approved QAP

5.2.2 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.

5.2.3 Services to be provided by the bidder

Packing, forwarding and transportation to site, storage and handling at site.

5.2.4 Erection and Commissioning

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

5.2.6 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 bidder.

5.3 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.

5.4 TESTING AT VENDOR'S WORKS



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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.

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.

5.5 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-II)

5.6 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:

- 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 unfavourable conditions.
- The correctness of all circuits and interlocks and sequence of operation.
- 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:

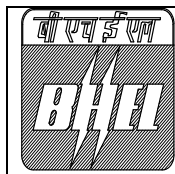
As required for statutory clearance for operating at site with following minimum test i.e. Overload and load test.

5.7 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 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.



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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.

5.8 ELECTRICAL REQUIREMENTS

For Electrical requirement bidder to refer sub section I-B & II B of this technical specification.

6.0 SCOPE OF SUPPLY (ELECTRICAL)

Complete electrical scope as per specification / details indicated in Sub-Section IB (Specific Technical Requirement Electrical) and IIB (General Technical Requirement Electrical).

7.0 SCOPE OF SUPPLY (C&I)

Complete C&I scope as per specification / details indicated in Sub-Section IC (Specific Technical Requirement C&I) and IIC (General Technical Requirement C&I).

8.0 SCOPE OF SUPPLY (CIVIL)

Total Civil is in BHEL's Scope of work, however complete grouting for equipments, fixing and any concreting inside the vessels, puddle pipe inside civil structure, nozzles, supporting plate/ structures & lining shall be in bidder's scope.

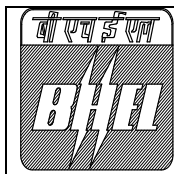
CPU regeneration area equipment layout drawing has been enclosed herewith this technical specification for bidder's compliance. Successful bidder has to use the same layout during detail engineering and arrange CPU regeneration area equipment in the same layout.

Also detailed Civil Input drawing shall be provided by bidder. Successful bidder shall furnish civil assignment drawings. The corresponding CIVIL drawing prepared by BHEL / CIVIL agency, based on civil assignment drawing of bidder.

9.0 SCOPE OF SERVICES

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

- (i) Erection and commissioning, unloading, storage and handling at site.
- (ii) Minor civil work like chipping of foundation, grouting below base plate for all structures, equipment, grouting of anchor bolts wherever these are not placed in the foundation during casting of foundation itself, excavation & filling of earth for buried pipes if and as required. Grouting material shall be in bidder's scope of supply. To the extent possible, vendor shall ensure to supply all foundation bolts timely so as to facilitate placement of these bolts while casting the foundation. Wrapping, coating and protection of all the buried pipe shall be as per IS10221.
- (iii) Pre-commissioning work such as flushing, hydraulic testing etc. Necessary consumables and instrumentation as required for inspection and testing at works as well as at site including pre-commissioning activities shall be arranged by the successful bidder at their own cost.
- (iv) Arrangement of all instruments, equipments, lab facilities, reagents, monitoring gadgets for monitoring, pre-commissioning, carrying out trial run, commissioning, PG test & till plant hand over.
- (v) Monitoring gadgets, instruments and equipments required for maintenance.
- (vi) Bidder to arrange his personnel at BHEL-PEM office for preparation of control scheme of the CPU package. Further bidder to also depute his personnel during FAT of CPU-DDCMIS for certifying correctness & completeness of implementation of Control logic at BHEL –EDN office. Bidder to also arrange his personnel at site during commissioning of DDCMIS of CPU package as and when required by customer / BHEL without any delay.



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- (vii) Complete grouting for equipment, fixing and any concreting inside the vessels and lining.
- (viii) All personnel required during maintenance, Commissioning, trial run and PG test.
- (ix) Trial run for requisite period.
- (x) Performance Guarantee testing.
- (xi) Training of plant Owner's personnel, O&M operator's personnel on plant operation and maintenance for desired period shall be in bidder's scope.
- (xii) All other facilities/ services as described in section on site services in specification and related to CPU Plant scope of work.
- (xiii) Relevant requirements as per GTR, GCC, ECC & SCC.
- (xiv) All the Piping, Valves and Equipment's of this system shall be protected against external corrosion by providing suitable painting. The surfaces of stainless steel, Gunmetal, brass, bronze and non-metallic components shall not be applied with any painting. The condensate pipelines and valves near the condensate polisher vessels shall be painted as per Sub-Section IA ANNEXURE V of this Technical Specification.
- (xv) Painting shall be as specified Sub-Section IA ANNEXURE V of this technical specification. However, any variation in the painting schedule as finally approved by BHEL / Customer shall be taken care by the bidder without any commercial and delivery implication to BHEL / Customer. Colour coding scheme shall be intimated to vendor during detail engineering.
- (xvi) Final touch up paint at site.

10.0 TERMINAL POINTS

10.1 CONDENSATE POLISHING PLANT - SERVICE VESSEL AREA

- (i) Service vessel inlet – (OD 457.2 X 12.7 mm thick, ASTM A 106 Gr. C) - Single piping connection near service vessel area in BC bay for TG unit.
- (ii) Service vessel outlet – (OD 457.2 X 12.7 mm thick, ASTM A 106 Gr. C) - Single piping connection near service vessel area in BC bay for TG unit.
- (iii) Rinse water outlet- Rinse water outlet piping (OD 168.3 x 7.11 mm, ASTM A 106 Gr. C) from the service vessel outlet till condenser hot well is in scope of bidder.
- (iv) The DM water used for resin transfer operations from the Regeneration building to the Condensate Polisher vessels shall be terminated by the bidder to the nearest drain trench through drain channel.
- (v) 25 NB connection of Instrument air supply at 5 to 7 kg/cm² (g) – at 5-meter distance from service vessel area. However, instrumentation pipe line distribution and piping inside CPU service vessel area from the terminal point shall be in bidder's scope.
- (vi) Gland sealing valves cooling water supply & analysers rack cooling water supply piping – Service water connection (50 NB) at 5-meter distance from service vessel area for TG unit. Piping inside service vessel area for TG unit for mentioned services will be in bidder's scope.

10.2 EXTERNAL REGENERATION AREA

- (i) DM Water Supply – CPU Regeneration cum Resin Transfer Pumps will take suction from DM water storage tanks (DM water storage tanks not in bidder's scope) of DM plant. A terminal point of DM

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water line shall be provided by customer at 5 m distance from CPU regeneration Building. Complete DM water piping from this terminal shall be in the scope of bidder.

- (ii) Alkali (48% NaOH)- DM Plant Bulk alkali storage tanks (not in bidder' scope) shall be used for regeneration of CPU Reins. The terminal point for 48 % NaOH shall be from two numbers Bulk alkali storage tanks individual nozzles and location of the same shall be in DM plant. Further Alkali pipe line of 80 NB size minimum shall be considered by bidder to meet the CPU regeneration chemical requirement and same shall be in bidder's scope. Complete alkali Piping from this terminal point shall be in the scope of bidder.
- (iii) Acid (30-33% HCL)- DM Plant Bulk acid storage tanks (not in bidder' scope) shall be used for regeneration of CPU Reins. The terminal point for 30-33% HCL shall be from two numbers Bulk acid storage tanks individual nozzles and location of the same shall be in DM plant. Further acid pipe line of 80 NB size minimum shall be considered by bidder to meet the CPU regeneration chemical requirement and same shall be in bidder's scope. Complete acid Piping from this terminal point shall be in the scope of bidder.
- (iv) 25 NB Instrument air supply at 5 to 7 kg/cm² (g) – At 5-meter distance from the regeneration building. However, instrumentation pipe line distribution and piping inside Complete CPU regeneration area from the terminal point shall be in bidder's scope.
- (v) Service water (50 NB) - At 5-meter distance from the CPU regeneration building. However, distribution and piping inside Complete CPU regeneration area will be in bidder's scope.
- (vi) Drinking/Potable water (40 NB) - At 5-meter distance from the CPU regeneration building. However, distribution and piping inside Complete CPU regeneration area will be in bidder's scope.
- (vii) In addition to that detailed terminal points shall be as per the P&ID for CPU plant (BHEL Drg. No.: PE-DG-426-155-A001) enclosed with the technical specification.

11.0 EXCLUSIONS

- 11.1 All civil works including foundation of equipment. However complete grouting for equipment, fixing and any concreting inside vessels and lining shall be in the scope of the bidder. Grouting material shall be in bidder's scope of supply. But civil works including operating / maintenance platforms and interconnection platforms (if any) with ladders / stairs & handrails, structural supports and hangers for pipes / cables / ducts, crane rails, all embeddings and inserts with lugs including anchor fasteners, bolts etc., dressing of foundations, grouting of pockets and underpinning of base plates for equipment / structures and fixing supports, filling and finishing of openings in walls, floors, cladding, roof and trenches shall be in Bidder's scope.
- 11.2 Main pipe trestles interconnecting CPU regeneration building and Service vessel Pipe trestle. However, auxiliary structure, hanger/support components for all the piping (CPU regeneration area, in acid/alkali handling area, interconnecting acid/alkali storage area, CPU service vessels, DM water piping, resin transfer piping, instrument air piping, service air piping, service water piping, potable water piping and blower piping etc.) are in bidder's scope.
- 11.3 Instrument air up to terminal points.
- 11.4 All chemicals except reagents, monitoring gadgets required for pre- commissioning, commissioning, trial run and PG test.
- 11.5 Air conditioning, ventilation & firefighting facilities.
- 11.6 Other exclusions are mentioned in the electrical & C&I parts of this specification.
- 11.7 Service water, Drinking/ potable water & DM water up to terminal points.
- 11.8 Acid (30-33% HCL) & alkali (48% NaOH) up to terminal point. The terminal point for 48 % NaOH shall



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be from two numbers Bulk alkali storage tanks individual nozzles and location of the same shall be in DM plant. The terminal point for 30-33% HCL shall be from two numbers Bulk acid storage tanks individual nozzles and location of the same shall be in DM plant.

11.9 Supply of ISMB monorail.

11.10 Chemicals.

12.0 QP AND SUB VENDOR APPROVAL

12.1 Minimum QP requirements are specified as Sub-Section IA ANNEXURE I. BHEL & customer reserves the right for inspection of imported items by BHEL/customer officials (if felt necessary). The same shall be decided during detail engineering during approval of QP's.

12.2 However any additional comments as given by BHEL/Customer on quality plan shall be adhered by the bidder without any commercial & delivery implication to BHEL.

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

12.4 List of make sub vendor items is enclosed as Sub-Section IA ANNEXURE-II is indicative only and is subject to BHEL and Customer approval during detailed engineering stage without any commercial & delivery implication to BHEL. Any additional sub vendor shall be subject to BHEL and Customer approval during detailed engineering stage without any commercial & delivery implication to BHEL.

12.5 Bidder to propose sub vendor list with following back up documents within 4 weeks of placement of LOI/LOA. Thereafter no request for additional sub-vendor shall be entertained. The sub vendor list shall subject to BHEL and Customer approval during detailed engineering stage without any commercial & delivery implication to BHEL.

12.6 Dealers are not acceptable for any item of the package. Bidder shall procure all items including plates, structural, flanges; counter flanges etc. from approved sub vendor only.

13.0 FUNCTIONAL GUARANTEES AND LIQUIDATED DAMAGES

Functional Guarantees and liquidated damages shall be as per enclosed Sub-Section IA ANNEXURE III.

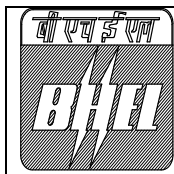
14.0 DESIGN/ CONSTRUCTION

In addition to the requirements of Sub-Section IA & IIA, Sub-Section IB & IIB & Sub –Section IC& IIC the following shall also be complied under scope of this specification.

The P&I diagram is enclosed herein in this section for bidder's compliance.

The material of construction specified in Datasheet-A are minimum requirements and material of construction for other components not specified shall be similarly selected by the bidder for intended duty which shall be subject to BHEL / Customer approval during detail engineering without any commercial & delivery implication to BHEL.

15.0 BIDDER TO FURNISH 4 SETS OF TECHNO-COMMERCIAL BID INCLUDING FOLLOWING DOCUMENTS/INFORMATION (FOR ELECTRICAL AND C&I PLEASE REFER THE RESPECTIVE SECTION OF THE SPECIFICATION).



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- Deviation if any in the enclosed Schedule of deviation with cost of withdrawal only with mention of specification clause for which deviation is being asked. (Stamped & Signed)
- Compliance certificate. (Stamped & Signed)
- Schedule of Declaration. (Stamped & Signed)
- Unpriced Price Schedule duly filled as "Quoted". (Stamped & Signed).
- Equipment layout of CPU regeneration area (Stamped & Signed).

Any other documents submitted by bidder except as asked in the bid's specification shall not be evaluated & considered as null & void.

16.0 DRAWING/DOCUMENTS REQUIREMENT

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

The number of drawing/documents to be submitted by the bidder shall be as per enclosed Sub - Section IA ANNEXURE IV. The submission of soft copy or hard copy of the document whichever is later will be considered as final date of submission of the document. The bidder has to submit the revised drawing /document along with the compliance sheet indicating enumerate reply to all BHEL and customer comments or observations. Without compliance sheet the submission of the drawings/documents will not be considered and the delay on this account will be solely on bidder's side only. Bidder to comply with the observations of the BHEL and CUSTOMER without price & delivery implication.

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

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

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

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

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17.0 SPARES

The Bidder shall include in his scope of supply all the necessary Mandatory spares, start up and commissioning spares as indicated in the relevant sections of specifications. The general requirements pertaining to the supply of these spares is given below: -

17.1 RECOMMENDED SPARES:

The bidder shall also furnish list of recommended spares parts for three (3) years normal operation with unit prices. These recommended spares shall be those considered necessary by the bidder on a stand-alone basis. The BHEL reserves the right to buy any or all of the recommended spare parts as considered necessary by him.

The recommended spares shall be delivered at project site at least two months before the scheduled date of initial operation of first unit. However, the spares shall not be dispatched before the dispatch of the main equipment.

Price of recommended spares will not be used for evaluation of the bids. The price of these spars will remain valid upto 6 months after placement of Notification of Award for the main equipment. However, the Bidder shall be liable to provide necessary justification for the quoted prices for these spares as desired by the BHEL/Customer.

17.2 MANDATORY SPARES:

All Mandatory spares listed in Sub -Section IA Annexure VI of this specification are in bidder's scope of supply.

All the Mandatory spares for the equipment under the contract provided by the vendor will strictly conform to the specifications and documents and will be identical to the corresponding main Equipment/components supplied under the contract.

Whenever the quantity is mentioned in "sets" the bidder has to give the item details and prices of each item.

The Employer reserves the right to buy any or all the mandatory spares parts.

All mandatory spares shall be delivered at site at least two months before scheduled date of initial Operation of the first unit. However, spares shall not be dispatched before dispatch of corresponding main equipments.

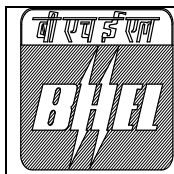
Wherever quantity is specified both as a percentage and a value, the Bidder has to supply the higher quantity until and unless specified otherwise.

Inspection of mandatory spares shall be in line with the approved quality plans for the respective Items/equipments. The inspection categorisation of mandatory spares shall also be in line with the approved categorisation plan for the respective items/equipment.

17.3 START-UP & COMMISSIONING SPARES

Start-up and commissioning spares are those spares which are required during the start-up and commissioning of the equipment/system. All spares used till the plant is handed over to the BHEL/Customer shall come under this category. The Bidder shall provide for an adequate stock of such start up and commissioning spares to be brought by him to the site for the plant erection and commissioning. They must be available at site before the equipments are energized. The unused spares, if any, should be removed from there only after the issue of Taking Over certificate. All start up spares which remain unused at the time shall remain the property of the Bidder.

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- 1) The Bidder shall indicate the service expectancy period for the spares parts (both mandatory and recommended) under normal operating conditions before replacement is necessary.
- 2) All spares supplied under this contract shall be strictly interchangeable with the parts for which they are intended for replacements. The spares shall be treated and packed for long storage under the climatic conditions prevailing at the site e.g. small items shall be packed in sealed transparent plastic with desecrator packs as necessary.
- 3) All the spares (both recommended and mandatory) shall be manufactured along with the main equipment components as a continuous operation as per same specification and quality plan.
- 4) Each spares part shall be clearly marked or labelled on the outside of the packing with its description. When more than one spares part is packed in a single case, a general description of the content shall be shown on the outside of such case and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purposes of identification.
- 5) All cases, containers or other packages are to be opened for such examination as may be considered necessary by BHEL / Customer.
- 6) The Bidder will provide the BHEL/Customer with all the addresses and particulars of his sub suppliers while placing the order on vendors for items/components/equipments covered under the contract and will further ensure with his vendors that the BHEL/Customer, if so desires, will have the right to place order for spares directly on them on mutually agreed terms based on offers of such vendors.
- 7) The Bidder shall warrant that all spares supplied will be new and in accordance with the contract Documents and will be free from defects in design, material and workmanship.
- 8) The bidder to provide datasheets/assembly drawings, cross-sectional drawings, catalogues of the manufacturer/ any other relevant document showing Bill of Material(s), Make, Model Number, Part Number etc. through which the mandatory spares to be supplied can be uniquely identified.
- 9) The bidder shall guarantee the long term availability of spares to the BHEL/Customer for the full life of the equipment covered under the contract. The Bidder shall guarantee that before going out of production of spares parts of the equipment covered under the Contract, He shall give the BHEL/Customer at least 2 years advance notice so that the latter may order his bulk requirement of spares, if he so desires. The same provision will also be applicable to sub-vendors. Further, in case of discontinuance of manufacture of any spares by the Bidder and/or his sub-vendors, bidder will provide the BHEL/Customer, two years in advance, with full manufacturing drawings, material specifications and technical information including information on alternative equivalent makes required by BHEL /Customer for the purpose of procurement of such items.
- 10) Wherever quantity has been specified as percentage (%), it shall mean percentage (%) of the total population of the item in the station (project), unless specified otherwise and the fraction will be rounded off to the next higher whole number.
- 11) Wherever the quantities have been indicated for each type, size, thickness, material, radius, range etc. these shall cover all the items supplied and installed and the break up for these shall be furnished.
- 12) In case spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to offered design with quantities.
- 13) Each spare shall be clearly marked and labelled on the outside of the packing with its description. When more than one spare part is packed in single case, a general description of the contents shall be shown on the outside of such case and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purpose of identification.

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18.0 MISCELLENEOUS REQUIREMENT

- I. Bidders is advised to visit the site in order to familiarize themselves with existing condition of site before submitting the bid in order to make their offer complete. During detail engineering also, the successful bidder shall be responsible for the correctness of details wrt existing facility at site. Customer approval on any drawing having details of existing facility shall not be cited by the successful bidder a valid reason for any shortcoming in the work by them. BHEL shall also not entertain any cost implication for any lack of input data with regard to site during detail engineering.
- II. The complete system shall be proven and necessary design documentation in support of proveness shall be submitted by the successful bidder in support of the systems, if asked by the customer without any price and delivery implication to BHEL and customer.
- III. System to be designed to meet all the statutory requirements. Preparation of all necessary drawings/data/ documents for obtaining necessary Approval of statutory authorities like CCOE, IBR, Weight & Measures Department and any other agency/ competent authority, on behalf of the customer, related to installation of CPU plant (if required) is included in bidder's scope. All expenses required to obtain the approval shall also be borne by the successful bidder. Successful bidder shall inform customer well in advance requirement of authority letter along with format for the same. After issuance of authority letter by customer, it will be vendor's responsibility to regularly follow up with the concerned authorities to obtain timely approval from these authorities. Any delay on account of the same, unless any specific information related to above approval to be furnished by customer is delayed by customer, shall be to vendor's account and shall not be used as a reason for extension in contract completion.
- IV. Vendor to attend regular engineering meeting with BHEL and customer fortnightly in BHEL or customer office as decided during detail engineering. Vendor will depute all his concerned engineering representative along with the project manager for discussion and approval. Meeting can be held at site also.
- V. In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.
- VI. Latest version of all codes and standards to be followed.
- VII. CPU regeneration facilities (Neutralisation pit which is kept in DM plant not in bidder's scope) shall be housed in RCC Building. Control room, battery room & MCC room for CPU plant shall be housed shall be located in RCC building. RCC building shall have toilet blocks for ladies and gents.
- VIII. Any statutory requirement / clearance required for the package from government / local body shall be in bidder's scope.
- IX. All interconnecting piping, valves, fittings including dosing piping, drain piping from tanks to nearby drain, flushing lines from nearest available water source, valves, fittings and accessories is also in bidder's scope.
- X. All the vertical pumps shall be self-lubricating type.
- XI. Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval shall be taken from BHEL. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.



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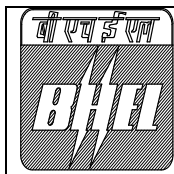
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- XII. KKS numbering if required, as per BHEL/Customer requirement shall be provided by the Bidder during detailed engineering stage without any commercial/delivery implication to BHEL.
- XIII. Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the works for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The bidder without any extra charge shall provide the same.
- XIV. Buried piping shall be protected as under (as per IS-10221).
Surface cleaning by wire brush, power tool cleaning etc.
Apply one coat of coaltar/primer/enamel.
Apply one layer of tape comprising of coaltar. Application of tape shall conform to AWWA C-203/IS 10221 (Appendix-B) with Minimum thickness of tape as 4MM +10%
- XV. All drawings/documents shall be approved by BHEL/Customer during detailed engineering stage. Successful Bidder shall comply with the comment of the customer/BHEL without price & delivery implication.
- XVI. Successful bidder shall furnish detailed erection manual for each of the equipment as well as complete system supplied under this contract at least 3 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier.
- XVII. Final Electrical Load list will be submitted by the successful bidder as per agreed drawing/ doc submission schedule. Thereafter any change in the electrical load list shall be entertained only subject to its feasibility, and BHEL reserves the right to debit the vendor cost of any changes necessitated in the switch gear /MCC on account of changed loads.
- XVIII. Wherever CIVIL works is excluded from the bidder's scope, successful bidder shall furnish civil assignment / scope drawings. The corresponding CIVIL drawing prepared by BHEL / CIVIL agency, based on civil assignment drawing of bidder will be furnished to the successful bidder for concurrence. In case any modification is required in the civil work already carried out based on final civil inputs given by bidder, BHEL reserves the right to debit cost of such rework to bidder.
- XIX. In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion.
- XX. 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/Sub-section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under SECTION -III of the specification. In absence of any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of Purchaser / Customer shall prevail and shall be complied by the bidder without any commercial implication on account of the same. Further in case of any missing information in the specification not brought out by the prospective bidders as part of pre-bid clarification, the same shall be furnished by Purchaser/ Customer as and when brought to their notice either by the bidder or by purchaser/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication to BHEL / Customer.
- XXI. The bidder 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. Items though not specifically mentioned but needed to make the system



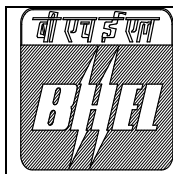
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complete as stipulated under these specifications are also to be furnished unless otherwise specifically excluded. Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve the vendor from the responsibility of providing such facilities to complete the supply and erection & commissioning of condensate polishing unit.

- XXII. It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to high standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgment is not in full accordance herewith.
- XXIII. 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.
- XXIV. The general term and conditions, instructions to tenderer and other attachment referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification are subject to compliance to all attachments referred in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.
- XXV. Deviations along with cost of withdrawal (positive or negative), if any, should be very clearly brought out clause by clause in the enclosed schedule; otherwise, it will be presumed that the vendor's offer is strictly in line with tender specification & there is no deviation. (Price to be given in sealed envelope only.)
- XXVI. In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.
- XXVII. Unless specified otherwise, all through the specification, the word contractor shall have same meaning as successful bidder / vendor and Customer / Purchaser / Employer will mean BHEL and /or UTTAR PRADESH RAJYA VIDYUT UTPADAN NIGAM LIMITED (UPRVUNL), and /or DEVELOPMENT CONSULTANTS PRIVATE LIMITED AND NTPC (customer's assigned consultant).
- XXVIII. The equipment covered under this specification shall not dispatch unless the same have been finally inspected, accepted and shipping release issue by BHEL/Customer.
- XXIX. BHEL's/Customer's representative shall be given full access to the shop in which the equipments are being manufactured or tested and all test records shall be made available to him.

19.0 MINIMUM IMPORTED ITEMS

- i) Resins.



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TECHNICAL DETAILS OF CONDENSATE POLISHING PLANT

1.00.00 INTRODUCTION

For maintaining the feed water purity condensate polishing plant will be provided in the feed water cycle at the downstream of condensate extraction pumps. The function of the CPU will be to purify the condensate effluent from the condenser by removing solids and dissolved salts with the intent of reducing corrosion and depositions in the steam-water cycle. The proposed Condensate Polishing Unit (CPU) shall treat the condensate of the Turbine-Generator (TG) Unit of the power station, using deep Mixed Bed Ion exchanger Polisher vessels and an external regeneration system. One (1) number of Condensate Polishing Plants (CPP), for TG (Turbine-Generator) unit, along with one complete common external regeneration system shall be provided alongwith instrumentations, valves and pipings, controls etc.

2.00.00 SYSTEM DESCRIPTION (GENERAL)

- 2.01.00 The proposed Condensate Polishing Plant (CPP) shall treat the condensate of the respective Turbine-Generator (TG) Units of the power station. The system shall be as per tender drawing titled P&ID of Condensate polishing Plant.
- 2.02.00 The proposed schematic arrangement of the Condensate Polishing Plant has been shown in the relevant Tender Drawing (P&ID). Arrangement of piping and valves shown in them are bare minimum only. The Contractor shall propose the complete system including regeneration facilities as per their standard design and as elaborated in this specifications meeting the basic functional requirements.
- 2.03.00 The Condensate polishing Plant shall consist of one set of Condensate polishing Units (CPU) for each TG unit inside TG Building and a common regeneration system. There shall be three service vessels (3X50%) for 800 MW unit each polishing 50% of the condensate flow corresponding to VWO (valve wide open) condition at 1% make up. The design flow shall be the corresponding to maximum condensate flow occurring in this condition mentioned above (Flow through each service vessel indicated in the data sheet).
- 2.04.00 The regeneration system shall be external and common to the CPU TG unit. For regeneration, resin from the exhausted exchanger vessel will be transferred hydraulically/hydro-pneumatically to this facility. The exhausted resin charge will be cleaned, separated, regenerated, mixed and rinsed before being stored for the next use. The regeneration process shall be of proven design and shall give resin– separation compatible with the desired effluent quality.
- 2.05.00 The common influent and effluent headers of each CPU, will be connected to an automatic bypass line (s) to be provided by Bidder. On high pressure signal across the service vessel, the automatic control valve(s) in the bypass line(s) shall open, bypassing the service vessel(s).
- 2.06.00 In the event of a tube failure in the condenser, circulating water will enter the condensate system and will contaminate it. Typical composition for the “CONDENSER TUBE LEAK CONDITION” is exhibited elsewhere in the technical specification and the condensate polishing plant shall be designed for such tube leakage condition as mentioned.
- 2.07.00 For arriving water analysis under condenser tube leakage condition. The analysis of clarified water is exhibited in the Sub-section IA Annexure VIII of tender specification shall be used with 5.0 COC.
- 2.08.00 Polisher mixed bed / service vessels of 800 MW Unit shall be located in TG hall unit. However, the regeneration system shall be common for all mixed bed polishers and shall be external and in building (except bulk acid & alkali storage facility & N-pit which is in open area and will be located in DM plant area).



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- 2.09.00 The equipments kept in open area (Pumps, blowers, motors, tanks, instruments, analysers etc.) have localized shade provisions which is in bidder's scope. All the instruments associated with condensate polishing plant shall be provided with proper enclosures by Bidder. All vessels, pumps & blowers and their drives and other electrical and C&I equipments/accessories of regeneration system shall be suitable for outdoor duty and enclosures class of all the equipments shall be as per tender specification and shall be suitably selected by bidder.

3.00.00 SALIENT DESIGN DATA

- 3.01.00 There shall be three service vessels (3X50%) for 660 MW unit, each polishing 50% of the condensate flow corresponding to the maximum mass flow rate established with VWO (valve wide open) condition at 1% make up (Flow through each service vessel indicated in the data sheet).

GENERAL DESIGN DATA TABLE		
Sr.No.	Description	Parameter
1.	Total Number of Vessels	Three (3x50%)
2.	CEP Discharge Pressure (Operating).	33 kg/cm2 (g)
3.	CEP Shut off head	43 kg/cm2 (g)
4.	Design Pressure of CPU,	50 kg/cm2(g)
5.	Condensate Flow (flow at VWO condition at 1% make up)	1285 t/hr
6.	Condensate Flow (660 MW , 1% MU)	1210 t/hr
7.	Flow through each polisher vessel.(Design)	642.5 t/hr.
8.	Condensate Temperature (Operating)	41.5 Deg. C
9.	Condensate Temperature (Process Design)	50 Deg. C
10.	Condensate Temperature (Mechanical Design)	60 Deg. C
11.	Service Run Cycle-Normal Run (Hrs)	240 hrs
12.	Service Run Cycle-Start up condition (Hrs)	50 hrs
13.	Service Run Cycle-Condenser Tube Leakage condition (Hrs)	50 hrs

- 3.02.00 The following dissolved solids concentration and conditions shall be used as a basis of design for the condensate polishing system.

The inlet and outlet quality ionic concentrations for design of CPU exchanger shall be as mentioned below. The ionic concentrations indicated below are as such.

(a) NORMAL RUN:

CONTAMINANT	UNIT	INFLUENT	EFFLUENT
Ammonia	ppb	250	Below detectable limit.
Total dissolved solids (TDS, ammonia excluded)	ppb	---	< 25
Electric Conductivity after hydrogen column (at 25°C)	Micro S/cm	--	< 0.1
Reactive Silica (as SiO ₂)	ppb	30	< 5 (Refer note # 1)
Total Ferrous Iron	ppb	50	< 2
Sodium (as Na)	ppb	10	< 2
Chloride (as Cl)	ppb	20	< 2
pH (polisher runs at 25°C with H/OH mode)		8.5-9.0	6.5-7.5
Crud (mostly black oxide of iron)	ppb	50	< 5



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Note-1: For temperature 50°C and above the silica value in the effluent shall be based on the resin supplier's recommendations.

Under the Normal Condition, each Condensate Polisher Mixed Bed shall be designed to operate in hydrogen cycle for not less than 240 hours of continuous operation, while maintaining the above treated condensate quality.

In addition to the dissolved solids, the influent condensate shall also contain some quantities of suspended solids (crud) derived from the corrosion of water and steam carrying pipelines, turbine condenser and steam side of the feed water heater. Normally this concentration will not exceed about 50 ppb and the polisher beds shall be providing sufficient filtering action to restrict the effluent crud content to less than 5 ppb.

(b) START-UP CONDITION:

The inlet and outlet quality ionic concentrations for design of CPU exchanger for startup condition shall be as mentioned below. During startup conditions, quality of the influent may deteriorate to:

CONTAMINANT	UNIT	INFLUENT	EFFLUENT
Ammonia	ppb	1500	Below detectable limit.
Total dissolved solids (TDS, ammonia excluded)	ppb	--	< 50
Electric Conductivity after hydrogen column (at 25°C)	Micro S/cm	--	< 0.2
Reactive Silica (as SiO ₂)	ppb	500	< 20 (Refer note # 1)
Crud (mostly black oxide of iron)	ppb	1000	< 100
pH (polisher runs at 25°C with H/OH mode)		9.0-9.6	6.5-7.5
Total Ferrous Iron	ppb	1000	< 10
Sodium (as Na)	ppb	20	< 5
Chloride (as Cl)	ppb	100	< 10

Note-1: For temperature 50°C and above the silica value in the effluent shall be based on the resin supplier's recommendations.

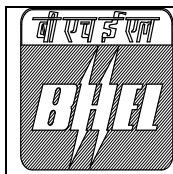
Useful service run under this condition shall be 50 hours before regeneration.

(c) CONDENSER TUBE LEAKAGE CONDITION:

The inlet and outlet quality ionic concentrations for design of CPU exchanger for condenser tube leakage conditions shall be as mentioned below. During condenser tube conditions, quality of the influent may deteriorate to:

Under condenser tube-leakage condition, the CP system shall be designed for ingress of 2000 ppb TDS in addition to the normal influent contaminants stated in as specified under table of sr. no. 3.02.00 (a) above. The cation and anion load in 2000 ppb TDS shall be based on the circulating water analysis. Under such condition, both sodium content and silica content of the effluent shall be limited to less than 20 ppb. For deriving circulating water analysis, clarified water analysis with COC of 5.0 shall be used.

CONTAMINANT	UNIT	INFLUENT	EFFLUENT
Total dissolved solids (TDS, ammonia excluded) (In addition to normal influent contaminants stated in clause 3.02.00 (a) above	ppb	2000	---
Reactive Silica (as SiO ₂)	ppb	---	< 20 (Refer



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			note # 1)
Sodium (as Na)	ppb	---	< 20

Note-1: For temperature 50°C and above the silica value in the effluent shall be based on the resin supplier's recommendations.

Useful service run under condenser tube leak condition shall be 50 hours before regeneration.

- 3.03.00 Influent water quality as indicated in the above clauses is minimum only. Bidder to check the same and higher values, if felt by them, shall be considered in the design so as to meet the specified effluent quality.
- 3.04.00 The bed cross section in the service vessels shall be such that the average velocity of condensate through it shall not exceed 2 meters/min (120 M3/hr/M2) at the design flow rate. Internal diameter of the service vessels (excluding the rubber lining) of spherical type shall be selected meeting the above mentioned velocity criteria. The effective depth of mixed bed in condensate polisher service vessel shall be not less than 1100 mm.
- 3.05.00 At the design flow rate, the pressure drop between inlet and outlet flanges of the polisher Condensate Polisher Mixed Beds with clean resin bed shall not exceed 2.0 bar (g). This pressure drop shall include losses due to entrance and exit nozzles, distributors, under drains, resins and the effluent resin traps. Maximum pressure drop under dirty conditions shall be restricted to about 3.5 bar (g) including the pressure drop across effluent resin traps. The total pressure drop across condenser polisher units under dirty conditions shall be restricted to 3.5 bar (g).
- 3.06.00 Cation resins shall be regenerated by technical grade hydrochloric acid to IS: 265 (concentration 30-33% by volume) and anion resins by sodium hydroxide, rayon grade to IS: 252 available as 48% lye. For calculations regeneration temperature should be taken as 25°C. In no case, the regeneration levels cannot be lower than the values indicated below:
- Cation resin: 125 kg of 100% HCl per cubic meter of resin
 - Anion resin: 160 kg of 100% NaOH per cubic meter of resin.
- 3.07.00 Rinse water outlet headers from condensate-polisher vessels shall be provided with a pressure reducing valve and orifice plate, suitably designed to enable the water entry to the condenser hot well under all operating condition of condenser. The pressure reducing station shall consist of both a pressure reducing valve from design pressure of service vessel to condenser vacuum or a combination of orifice plates to reduce pressure from design pressure of service vessel to 2 kg/cm2 and a pressure reducing valve from 2 kg/cm2 to condenser vacuum.
- 3.08.00 While calculating pump head, 10% margin (minimum) shall be considered of the value of friction losses. Pipe friction loss shall be calculated as per Willam-Hazen formula and "C" value to be adopted shall be as below: -
- Carbon Steel pipe : 100
 - CI pipe/ductile Iron : 100
 - Rubber lined steel pipe : 120
 - Stainless steel pipe : 100

For pumps whose discharge pipes shall be running on pipe trestle/ pipe rack and traveling from one area to another area bidder to select 12 m static head while selecting the pump head. Pump recirculation with a regulating valve shall be provided for all the pumping system.

4.00.00 GUARANTEES

All the design parameters at clause no 3.02.00 of this chapter, i.e. the effluent quality, the



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design flow, design service length and Pressure drop across the resin bed in clean and dirty condition at rated design flow shall be guaranteed by the Bidder. In addition to that Bidder to refer detail chapter of guarantees as specified in Sub-Section-IA, Annexure -III of this specification for the same.

5.00.00 SYSTEM REQUIREMENT

5.01.00 The regeneration process offered by the bidder, shall be of proven design and shall essentially be the same process by virtue of which the bidder is qualified and shall give resin-separation compatible with the desired effluent quality. Documentary evidence shall be submitted by the bidder to the Customer/BHEL to establish this requirement during detailed engineering stage if required.

Any other proven alternative scheme of external regeneration as per the standard practice of Supplier of CP System may also be adopted subject to suitability of the same in all respects for satisfactory operation and performance of Condensate Polisher Mixed Beds.

5.02.00 The bidder shall include inert resin in the system if they feel that it helps in better resin separation.

5.03.00 In case, after separation of resins, there are undesired contaminant resins, the bidder shall provide a system either to eliminate this cross contamination of resins or to nullify the detrimental effect of entrapped resins to the effluent quality.

5.04.00 EXCHANGE RESINS

5.04.01 Bidder has to supply total six (6) nos. resin charges for the project. One resin charge shall be considered as resin required for one service vessel i.e. cation resin, anion resin and inert resin (if any) used for the project. Further one Year's topping requirements or 10 % of first fill quantity, whichever is more shall be supplied by bidder.

5.04.02 The resins used for the Condensate Polishing Unit are of the spherical form. Resins used for the project shall be of macroporous (type -I) for anion and gel or macroporous type cation. Other details are as follows:

Cation : Strong acid, with sulfonic acid functional group.
Anion : Strong base, with quaternary ammonium (Type-I) functional group.
Inert (if required) : Non-ionic, compatible with the above resin types.

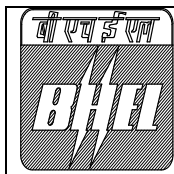
Cation resins shall be supplied in hydrogen form and Anion resins shall be supplied in hydroxide form.

5.04.03 PHYSICAL PROPERTIES:

Particle size: The resins shall be in the form of spherical beads. All resins, when wet screened with U.S. standard sieves, shall pass through a No.14 sieve no more than 2 percent shall be retained on a no. 16 sieve, and more than 2 percent shall pass through a no. 40 sieve. The particle sizes and densities shall be carefully controlled to facilitate clear separation between the resins during regeneration process.

Bead Strength: The average force required to fracture individual beads of cation resins in hydrogen form, anion resins in hydroxide form, and the inert resins, shall exceed 350 grams. Not more than 5 percent of the beads tested in each batch shall get fractured by forces less than 200 grams.

5.04.04 CHEMICAL PROPERTIES:



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Total wet volume ion-exchange capacities in equivalents/liter shall not be less than the following:

Cation in hydrogen form: 1.7
Anion in hydroxide form: 0.8

The resins shall contain a minimum of metallic and organic impurities consistent with good processing. The processing procedure will include rinsing the resins with demineralized water before packing, so that further rinsing will not be required before use. Foreign objects in the resins shall constitute a basis for its rejection.

Cation-Anion resin ratio shall be 2.0 parts cation to 1.0 part anion by volume. In case the bidder's process requires any non-ionic resin the same shall represent at least 10 percent of the bed volume, but not less than 15 cm of the bed depth in the resin separation / cation regeneration vessel of the external regeneration facility.

In case, after separation of resins, if there are undesired contaminant resins, the Bidder shall provide a system either to eliminate this cross contamination of resins or to nullify the detrimental effect of entrapped resins to the effluent quality.

The CPU Grade resin shall be of uniform particle size quality with uniformity co-efficient of 1.2 and suitable for short term excursion of temperature up to 60 °C.

The resin charge shall consist of material properly selected, washed, processed and graded to provide the guaranteed capacity and life. The resin shall have adequate abrasion resistance during its guaranteed life.

The resins shall be of reputed manufacturer with adequate past record of successful service for not less than 3 years in similar application. Some of these possible resin makes shall be as follows:

- 1.0 Duolite.
- 2.0 Rohm and Hass
- 3.0 Dowex
- 4.0 Purolite.
- 5.0 Lanxess.

Above listing is by no means exhaustive, and shall not be construed to be a recommendation for their selection for this plant. Bidder shall fully satisfy himself as to the suitability of the resin system selected by him before offering it in his proposal.

The resin shall be suitable for the condensate temperature that may be achieved in all operating regimes of TG cycle. However, the anion resin shall be suitable for a minimum temperature of 60 deg.C.

5.05.00 CONDENSATE POLISHING UNITS

5.05.01 Operating pressure for service vessels shall be normal operating pressure of condensate extraction pump. Service vessel design pressure shall be equal to shut off pressure of condensate extractions pump plus 5% margin or as specified in data sheet (A) of this technical specification, whichever is higher.

5.05.02 Design temperature of the service vessel shall take care of all operating regimes including HP-LP bypass operation of TG cycle.

5.05.03 EMERGENCY BYPASS SYSTEM:

1) Each Condensate polisher service unit shall be provided with an automatic bypass for the



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condensate polisher on the condensate inlet and outlet headers of the unit with a double flanged butterfly type control valve and double flanged butterfly type isolation valves (resilient material seated, to ensure bubble-tight shut off) on the upstream and downstream sides of the control valve.

2) In the event of excessive pressure differential (0.35 MPa) between the condensate inlet and outlet headers, this control valve will open automatically to bypass requisite quantity of condensate to prevent this pressure differential from exceeding a preset limit when two vessel/one vessel / no vessel is in operation.

3) When condensate temperature exceeds 55 Degree C, the bypass valve shall be 100 % opened automatically and the inlet/outlet of the Condensate Polisher Mixed Beds shall be closed to protect elements and resins inside the polisher.

4) Bidder to provide 1x100% control valve to achieve proper control under all operating conditions.

5) The control system shall be so designed that the control valve is able to bypass 50 % of rated flow when any of the service vessel is out of service & 100% when both the service vessels are out of service.

6) The isolation valves shall be provided with geared operators for manual operation and shall be located at a height which can be easily operatable. The entire system shall be designed for an internal pressure of at least the design pressure of service vessels and for a maximum condensate flow of not less than total design flow of all the working service vessels.

7) Complete instrumentation and controls for this emergency by-pass system, including the differential pressure transmitters, panel mounted indicating type controller with provision for remote manual operation, actuator for the control valve with position indicator shall be furnished by the bidder as part of this package. Further All tubing, wiring, air sets, and other fittings, required to complete the system, shall also be installed by bidder.

5.05.04 EXTERNAL REGENERATION FACILITY (REGENERATION PLANT)

The pressure vessels in the common external regeneration facility shall be provided with adequate freeboards over the top of the settled resins, to minimize resin loss during their use. Minimum permissible freeboards are to be as follows:

- | | | |
|-------|---|----------------------|
| (i) | Mixed resin Storage vessel | : Not less than 100% |
| (ii) | Resin separation vessel & cation regeneration vessel: | Not less than 100% |
| (iii) | Anion regeneration vessel | : Not less than 100% |
| (iv) | Activated carbon filter | : Not less than 75% |

However, if a vessel is used for more than one service, then the vessel design shall be based on the service which gives maximum freeboard.

- 5.05.05 Design pressure of the condensate Polisher Service Vessels is indicated elsewhere. For all other Pressure vessels the design pressure shall be at least 10 kg/sq. cm (g) or as per system requirement whichever is higher.
- 5.05.06 All equipment for dosing of acid and alkali solutions shall be rated to provide a maximum dosing rate at least 20% in excess of that required from process calculation.
- 5.05.07 Mill tolerances 0.3 mm shall be considered for determining the thickness of the shells and dished ends. A minimum thinning allowance of 2 mm shall be considered for the dished ends.
- 5.05.08 All pressure vessels shall be designed and constructed in strict accordance with the ASME



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code Section VIII/IS 2825 or acceptable equivalent international standard.

- 5.05.09 All pressure vessels shall be fabricated from carbon steel plates as per SA-515/516 Gr. 60/ 70 and lined internally.
- 5.05.10 Lining used shall be natural rubber having a shore durometer reading of 65 ± 5 Shore 'A' as per IS 4682 Part I.
- 5.05.11 The lining shall be applied in three layers, resulting in a total thickness of not less than 4.5 mm anywhere on the internal surfaces of the vessels. The lining shall extend over the full face of all flanged connections and shall have a minimum thickness of 3 mm in all such external areas.

5.05.12 HOT WATER TANK (FOR ALKALI)

One (1) no. hot water tank for heating of alkali diluent water with (2X50%) electric heating coil, adequately insulated of stainless steel construction shall be provided complete with integral pipe works, valves, instrumentation and all other accessories required shall be provided. The capacity of tank shall be minimum 20% higher than the maximum water demand. This tank shall be provided with burn out protection, pressure relief valve, level transmitter, temperature indicator etc. The temperature transmitters provided on the tank shall control the heater. The heaters shall be sized for heating the water from a temperature of 15 to 50 deg. C in 5 hours at the outlet of ejector.

5.05.13 ACTIVATED CARBON FILTER (FOR ALKALI):

Rated flow of the filter shall not be less than the design capacity of the alkali transfer-cum recirculation pump, and the maximum velocity through the filter for this flow shall not exceed 15 meters/hour. Depth of the filter material shall be as specified in DATASHEET –A of this specification.

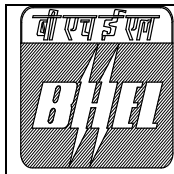
The filtering medium shall be granulated activated carbon, meeting following minimum requirements.

Total Surface area	:	> 850 sq.m/gm.
Bulk density	:	> 400 kg/M3.
Iodine number	:	850 minimum
Grade	:	Decolorinated
Particle density wetted in water	:	1.3-1.4 gm/cc
Uniformity coefficient	:	1.5-1.6
Mean particle diameter	:	1.2-1.4 mm
Moisture content	:	5% maximum
Ash content	:	8% maximum

The filter shall be provided with all necessary valves and connections for manual backwashing and rinsing with demineralized water. Rate set valves shall be provided with adjustable limit stops for setting backwash and rinse rates.

5.05.14 DM WATER STORAGE TANKS (NOT IN BIDDER' SCOPE) FOR CONDENSATE POLISHING PLANT

DM water required for CPU regeneration as well as resin transfer operations shall be drawn from DM Water Storage Tanks (DM water storage tanks not in bidder's scope) of DM plant. A terminal point of DM water line shall be provided by BHEL at 5 m distance from CPU regeneration Building. Bidder to consider the piping from the BHEL terminal point to CPU regeneration cum resin transfer pumps along with pneumatic/electric actuated on –off valves, required flanges, counter flanges, fittings & instruments (2 nos. PT in suction line of CPU regeneration cum resin transfer pumps and other required instruments). Further Bidder to consider interlock (trip) of these pumps from the Pressure transmitter provided in suction line of CPU regeneration cum resin transfer pumps. In addition to the



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tripping of CPU regeneration cum resin transfer pumps from these PT's bidder to also include the tripping of these pumps from the level transmitter provided on the DM water storage tanks. Necessary signal multiplier and other instruments required for the same shall be in bidder's scope. These signals shall be also brought by Bidder to DCS for tripping and auto operation of the CPU regeneration cum resin transfer pumps and avoid dry run of these pumps.

5.05.15 RESIN INJECTION HOPPER

The bidder shall provide a hopper type tank for resin make-up, using water slurry, to the condensate polishing systems. This make-up system will constitute a portion of the condensate polishing external regeneration system. The resin hopper shall have a conical bottom and a flat top. The top shall have a piano type hinged port, having a lifting handle, of sufficient size for easy resin loading. The resin shall discharge through a bottom connection to a water ejector for transport. Water shall be added to the hopper to assist in the resin transfer. The ejector discharge shall be to the resin separation-cation regeneration vessel. Demineralized water shall be used throughout for the resin transfer. Piping of the resin make-up system shall be the responsibility of the Bidder as a part of the external resin regeneration system.

a) **Capacity:** The resin make-up hopper tank shall be sized to handle up to 150 liters of as received new resin per single injection.

b) **Material:** The resin make-up hopper tank shall be fabricated of mild carbon steel having a minimum thickness of 6 mm and Rubber lined.

5.05.16 PIPING

1) Bidder shall design, supply and erect the piping between the service unit and the common external regeneration facility, for transferring the exhausted and regenerated resins as required.

2) All piping shall be laid above ground and generally laid in pipe trestles including crossing of road/pipe/cable trenches if any. Piping of between chemical tanks area and regeneration area etc. may be laid on pedestals if layout permits.

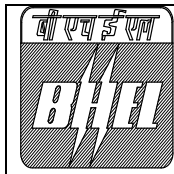
3) Complete supporting system for the pipeline shall be designed, fabricated and supplied by the Bidder. Inside the building, the overhead portion of the pipeline may be supported from the building structures. In outdoors, the pipeline may run on steel posts. Crossing of the roads shall be on a pipe bridge with a clear height of at least 6.1 meters over the road surface. All the steel structures of the pipe bridge and the supporting posts along with all necessary hanger, clamps, connecting steel, fixing bolts, nuts, etc. shall be supplied and erected by the bidder.

4) Routing of this pipe line shall be developed by the bidder and shall be finalized in coordination with the BHEL/Customer, based on the space available and the final layout as enclosed with this technical specification.

5) The resin transfer pipeline arrangement shall avoid any sharp bends which cause segregation of the mixed resins, and pockets where the resins can get trapped. Suitable observation ports shall be provided in all critical areas to enable the operator to monitor completeness of the resin transfer operations. All necessary arrangements for venting and draining of the pipeline shall be provided.

6) The resin transfer pipeline shall be sized for a flow velocity of between 2.0 to 3.0 meters/sec.

7) The condensate pipeline shall be sized for a flow velocity between 3 and 5 m/sec.



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8) Remotely operated valves suitably interlocked with the plant operation, shall ensure that the resins get transferred to and from only the particular service vessel which has been selected by the operator.

9) All lined vessel connections and connections in unlined vessels (25 Nb and larger) shall be flanged to ANSI 150 lb (min.) class except the polisher service vessels which shall be ANSI 300 lb (min.) class: Flat face flanges shall be used throughout. Nozzle material shall be ASTM A105 Gr.B. Sch.80 pipe for all vessels. All flanged connections shall be supplied complete with matching counter flanges, nuts, bolts and full face gaskets. All the pipeline in service vessels area where pressure may attain same as service vessel shall be designed for 300 lb class.

10) Bidder to also refer the detailed specification for low pressure piping & DATASHEET-A for piping inside regeneration area & power cycle piping & DATASHEET-A for piping inside service vessel area which is enclosed elsewhere in this specification.

5.05.17 VALVES

1) All valves shall be designed as per applicable AWWA/IS/BS or equivalent international standard / codes.

2) The isolation valves on the resin transfer line shall be of eccentric plug type/ball valve (full bore type) of stainless steel construction.

3) Emergency bypass control valve shall be of double flanged butterfly type control valve. Double flanged butterfly type isolation valves (resilient material seated, to ensure bubble-tight shut off) on the upstream and downstream sides of the control valve.

4) Isolation Valves handling Acid, Alkali, Ammonia etc. shall be diaphragm type and MOC and pressure rating shall be as per DATASHEET –A of condensate polishing unit.

5) Isolation Valves handling DM water shall be Butterfly or gate or globe type and shall be SS construction. Isolation valves handling DM water can also be of diaphragm type MOC and pressure rating shall be as per DATASHEET –A of condensate polishing unit.

6) Non-return valves for DM Water & alkali shall be SS 316 construction and for acid non-return valve shall be lined type or as per manufacturer's standard practice.

7) All valves in service vessels area where pressure may attain same as service vessel shall be designed for 300 lb class.

8) MOC of butterfly valve at inlet of service vessel Body- CS, Disc- SS and outlet of service vessel Body – SS, disc- SS.

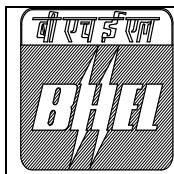
5.05.18 PRESSURE VESSELS, ATMOSPHERIC TANKS & MISCELLANEOUS ITEMS

1) Design pressure of the condensate Polisher Service Vessels shall be as indicated in the data sheet. For all other pressure vessels, unless otherwise mentioned design pressure shall be at least 10 kg/cm² (g).

2) All pressure vessels shall be designed and constructed in strictly in accordance with the ASME code Section VIII or IS-2825 or acceptable equivalent international standard.

3) All pressure vessels shall be fabricated from carbon steel plates as per SA-515/516 Gr. 60/70 and lined internally.

4) Lining used shall be natural rubber having a shore durometer reading of 65 ± 5 Shore 'A' as



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per IS 4682 Part I.

5) The lining shall be applied in three layers, resulting in a total thickness of not less than 4.5 mm anywhere on the internal surfaces of the vessels. The lining shall extend over the full face of all flanged connections and shall have a minimum thickness of 3 mm in all such external areas.

6) Design of all vertical cylindrical atmospheric storage tanks containing water, acid, alkali and other chemicals shall conform to IS: 803.

7) Design of all horizontal cylindrical storage tanks containing water, acid, alkali and other chemicals shall conform to BS EN12285-2:2005.

8) Unless otherwise mentioned design temperature of all pressure vessels and storage tanks shall be 10 deg.C higher than the maximum temperature that any part of the vessel/tank is likely to attain during operation.

9) In case, tank is subjected to vacuum, the same shall be taken care in designing the tank.

10) The design of Demineralized water storage tanks (Vertical type) shall conform to IS: 803. Supporting frame where required shall be in accordance with IS: 800. The tank shall be "Non-pressure" fixed roof type with atmospheric vents.

11) CPU service vessels shall be of spherical shape.

12) All vessels/tanks without inside rubber lining shall have a corrosion allowance of minimum 2 mm and mill allowance (minimum 0.3 mm) for shell and dished ends. Thinning allowance of 2 mm (minimum) shall be considered for dished end.

13) All the atmospheric tanks shall have sufficient free board above the "Level High /Normal Level" as the case may be. The overflow level shall be kept at least 30 cm or 10% of vessel height whichever is higher, above the "Level High /Normal Level" for all the tank except for the DM tanks for which a minimum height of 300 mm shall be provided over the "High Level". Further, a minimum 100 mm free board shall be provided above the top of overflow level to the top of tank.

5.05.19 MATERIAL

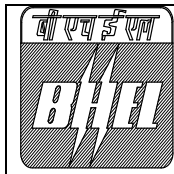
1) All pressure vessels shall be designed and constructed in strict accordance with the ASME code Section VIII or acceptable equivalent international standard. Suitable mill tolerances shall be considered for determining the thickness of the shells and dished ends. A minimum thinning allowance of 2 mm shall be considered for the dished ends.

2) Pressure vessel ends shall be of dished design and constructed by forging, pressing or spinning process. Spherical vessels for CPU service vessels are acceptable only. Conical or flat ends shall not be accepted. All the atmospheric vessels shall be at least 6 mm thickness.

3) All pressure vessels shall be fabricated from carbon steel plates or Stainless steel as specified in DATASHEET-A and lined internally. The lining shall be of rubber having a hardness of 65 plus/minus 5 shore -A meeting the requirements of IS: 4682, Part-I. The lining shall be applied in three layers, resulting in a total thickness of not less than 4.5 mm anywhere on the internal surfaces of the vessels. The lining shall extend over the full face of all flanged connections and shall have a minimum thickness of 3 mm in all such external areas.

5.05.20 VESSEL INTERNALS REQUIREMENTS:

Vessel internal shall meet the following requirements:



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1) **Inlet water and regenerant distributor** - Hub and internals diffuser splash plate or header and perforated laterals. Material of construction shall be SS-316.

2) **Under Drains**:- The under drain system shall be provided same as above with screened laterals with internal perforated pipes and rubber lined flat bottom. For resin separation/regeneration/ mixed resin vessels, it may have fully screened bottom (NEVA – clog type with pora-septanurese screen, fully supported by subway grid or equal) /Fasteners.

All internal fasteners shall be of SS-316 and heavy duty locknuts shall be used throughout.

5.05.21 RESIN TRAP & CARBON TRAP:

1) Resin Traps: Outlet of each condensate polisher vessel, activated carbon filter and waste effluent header of the common regeneration shall be provided with a resin trap. Pressure drop at design flow through a clean resin trap shall not exceed 0.35 kg/sq.cm. Housing of Resin trap shall be of Stainless steel (SS-316) construction and internals shall be of SS-316 construction. Resin traps of process effluent line shall have screen opening not exceeding 120 percent of associated process vessel under drain screen opening. Other resin traps shall have screen opening of 60 mesh. In place manual back flushing shall be provided for all resin traps.

2) Carbon Trap (for ACF): Each Activated Carbon filter shall be provided with one Carbon trap (media trap) at service outlet and one no. at rinse outlet line. MOC of carbon trap Housing shall be SS316 and for internals (cord & screen) MOC shall be SS-316. In place manual back flushing shall be provided for Carbon trap.

6.00.00 OPERATION & CONTROL PHILOSOPHY OF CPU PLANT

The control & operation of condensate polishing unit shall be plant water system DDCMIS based control system. CPU service vessel area control & operation shall be done through RIO panel of plant water system DDCMIS and 1 no. GIU located inside TG hall area. Further CPU regeneration area control & operation shall be done through plant water system DDCMIS located in plant water control room. For control & operation of CPU regeneration area drives 1 no. OWS & 2 nos. GIU (i.e. One no. for Acid Dosing system & one no. for alkali dosing system) shall be provided. Further This system shall be suitably interlocked with Main Plant DDCMIS for monitoring purpose of critical signals.

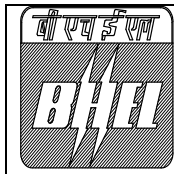
The control of the CPU system shall be done from Plant water system DDCMIS located in plant water control room.

Service vessel: RIO panel shall be located in TG hall area near CPU service vessels. 1 no. GIU shall be also be provided in service vessel area for the local operation (On/OFF) of CPU Service vessel area drives (i.e. blowers etc.).

Regeneration system: The operation of regeneration system shall be carried out by OWS Plant water system DDCMIS located in plant water control room. 2 nos. GIU shall also be provided in regeneration area for the local operation (On/OFF) of CPU regeneration area drives (i.e. One no. for Acid Dosing system & one no. for alkali dosing system).

The regeneration system shall be external. Under normal conditions, it will hold a complete charge of freshly regenerated and mixed resin, ready for use, in its storage tank. For regeneration, resin from the exhausted exchanger vessel shall be transferred hydraulically/ hydro pneumatically to this facility.

The empty exchanger vessel will then be filled up with the already regenerated resin which was stored in the regeneration facility. This exchange vessel shall come into service soon after requisite condition is satisfied or as and when desired by the operator. In the meantime, the exhausted resin shall be cleaned, separated, regenerated, mixed and rinsed before being stored for next use.



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The common influent headers of each polisher service unit will be connected to an automatic bypass line to be provided. This bypass line shall include a differential pressure device, which on a high signal will cause an automatic valve to open, bypassing the service vessels.

It shall be possible to operate the regeneration plant in auto/semiauto/manual mode. In 'Auto' mode, once the sequence has been initiated, it shall proceed from step to step automatically. In 'Semi-auto' mode each step shall be performed only after initiation by the operator. In Manual mode, complete operation shall be by the operator by operation from the control panel. On DDCMIS failure, it shall be possible to operate the valves by means of manual operation of solenoid valves also.

The condensate-polishing unit shall be controlled from Plant Water System DDCMIS. This system shall be suitably interlocked with the regeneration system.

Each of the solenoid valves in CPU plant shall be provided with 'close- Auto-open control switches. In 'Auto' position of the control switch the solenoid valve shall receive close/open command from the Automatic sequence logic.

It shall be possible to select each of the CPU vessels for any of the following operations.

- ☐ Service
- ☐ Resin Transfer from CPU vessel to Regeneration plant.
- ☐ Resin Transfer from Regeneration Plant to CPU vessel.
- ☐ Isolation from service.
- ☐ Rinse Recycle.

6.01.00 GENERAL

- 6.01.01 It is not the intent to specify here the complete details of the control system. Basic type of controls required has been specified below. The bidder shall submit with the proposal the complete detail of the system offered by him like the extent of automation offered, operation of the complete system, logic/flow diagrams, type and details of the presentation of information, the type of mimic, hardware details etc. along with detailed circuit descriptions.
- 6.01.02 It shall be possible to operate the regeneration plant in Auto / Semi auto / Manual mode. In 'Auto mode, once the sequence has been initiated, it shall proceed from step to step automatically. In 'Semi auto' mode each step shall be performed only after initiation by the operator. In 'manual' mode complete operation shall be by the operator.
- 6.01.03 The control system shall link the various steps such as closing/ opening of different valves, starting / stopping of various pumps etc. which form a sequence. The logic system shall adhere to the correct sequence of operation and predetermined time intervals. The system shall have interlocks so that, criteria necessary for each step are complete prior to proceeding to the next step.
- 6.01.04 It shall be possible to switch mode of operation from one to the other at any moment and the operation shall proceed on the newly selected mode from that time.
- 6.01.05 For steps, which require frequent time adjustment, it shall be possible to change the time setting from the OWS/OWES. For all other steps it shall be possible to adjust the time setting from inside the OWS/OWES.
- 6.01.06 For all sequences, the current step number, set time of the step, elapsed time of the step and the total elapsed time of the sequence shall be indicated in the OWS/OWES.
- 6.01.07 The system shall incorporate the necessary safety features. During automatic sequential operation, if any pre-requisite criterion is not fulfilled or missing for a pre-determined time



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interval, the steps should not proceed further, and Alarm shall be provided. Missing criteria, sequence, which is under hold up etc., shall be displayed.

- 6.01.08 The safety system for any sequence/step shall check the opening of the required valves and closure of the remaining valves of the plant to avoid mal-operation.
- 6.01.09 Wherever standby equipments are provided, it shall be possible to select each of the drive on 'standby' duty.
- 6.01.10 The detailed logic for the sequence and for each of the drive shall be subject to the BHEL/Customer's approval.
- 6.01.11 Start, progress and stop of each of the sequence shall be annunciated.
- 6.01.12 The status of vessels of Condensate Polishing Plants shall be available in all the CPP panels of all TG unit and as well as in the regeneration plant control panel. Similarly the status of regeneration plant status shall be available in the panels of Condensate Polishing Plant of TG unit.

6.02.00 CONDENSATE POLISHER CONTROL SYSTEM

- 6.02.01 Operation of the complete Condensate Polishing System shall be through DDCMIS only The control of the CPU system shall be done from LCR (Local Control Room) located in regeneration area.
- 6.02.02 Plant schematic for monitoring & operation shall be available on OWS, list of important signal along with applicable schematic for monitoring in DDCMIS shall be submitted during detail engineering.
- 6.02.03 All the major parameters/status shall be available in main control room. However, operation of the Condensate polishing unit shall be recommended from local only.
- 6.02.04 The Condensate polishing unit is designed for fully automatic / manual operation through the DPU of Plant DDCMIS. Taking the equipment into service and regeneration of mixed-bed units shall be initiated manually from the OWS of control system or local panel and balance operation shall be carried out sequentially by the control system. Manual override facility is also provided for all operations.
- 6.02.05 Open and Close limit switch feed backs of valves are to be connected to DDCMIS for remote viewing and for interlocks and protection.
- 6.02.06 Remote and local indications of various important parameters to the process requirement shall be provided.
- 6.02.07 The instruments shall be offered as per the process requirement for complete auto operation. All the instruments/equipment/electrical items shall be provided & designed with maximum star rating as available in line with energy conservation policies notified by BEE, GOI.
- 6.02.08 All instruments & analyzers required for CPU package shall be supplied, mounted on the gauge board racks, along with accessories like impulse pipe, fittings & valve manifolds etc.
- 6.02.09 Necessary instruments pressure gauges, Temperature gauges, DP instruments, Pressure transmitters, Radar Level transmitters, Differential pressure transmitters, Temperature Elements Various analysers, Magnetic type level indicators, shall be provided. The junction boxes and instruments / electronics housing used shall be Non – corrosive material.
- 6.02.10 Flow transmitters at each CPU service vessel inlet shall be provided for monitoring the performance and accountability.



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- 6.02.11 Annunciations for abnormal conditions (as per system requirement) shall be provided in the Control Panel.
- 6.02.12 All bidirectional drives shall be provided with integral starter.
- 6.02.13 Pneumatic actuators with all accessories shall be controlled using solenoid valves, which shall be energized from OWS / Control Panel. The opening and closing of these valves is based on system requirement, which is programmed in the Control system. Feed backs to the control system regarding the valve open / close position are set through the limit switches.
- 6.02.14 Each of the solenoid valves in CPU plant shall be provided with 'close-Auto-open control switches. In 'Auto' position of the control switch the solenoid valve shall receive close/open command from the Automatic sequence logic.
- 6.02.15 Time synchronization of CPU-DDCMIS with master clock system is to be carried out. Necessary hardware/software for the same shall be provided.
- 6.02.16 2 x 100% parallel redundant UPS, 1X100% Bypass stabilizer & 1 set of battery bank for minimum 60 minute back up at 100% load shall be provided.
- 6.02.17 Smart positioners shall be provided for pneumatically controlled valves.
- 6.02.15 Each condensate polishing system shall be provided with same family of Plant DDCMIS based local panel that will clearly show the status of each service vessel. It shall be possible to select each of the CPU vessel for any of the following operations or mode:
- Service.
 - Isolation from service.
 - Exhausted Resin Transfer from CPU vessel to Regeneration plant.
 - Regenerated Resin Transfer from Regeneration Plant to CPU vessel.
 - Rinse recycle mode.
- 6.02.16 A mimic diagram shall be provided for the CPU scheme on the OWS and as well as front of the CPU control panel. Status of various valves shall be indicated by LED's on the mimic diagram.

Condensate polishing system shall be provided with a DCS based local panel that will clearly show the status of each service vessel. From this panel it shall be possible to initiate any of the following operating modes. This panel shall be located near the respective condensate polishing vessels.

The following requirements of the control system shall be included:

➤ **RINSE RECYCLE MODE**

The rinse recycle shall be manually initiated in full automatic sequence. This sequence shall include the rinse down step using condensate at the rate of 0.4 to 0.6 cu.m/min/sq.m until the unit effluent quality is acceptable for boiler feed water. The effluent quality shall be determined by conductivity monitoring of the rinse water outlet which is returned to the condenser hotwell for recycle. A panel mounted cation conductivity indicator shall be interlocked to prevent advancing of the automatic sequence until the rinse down is complete.

➤ **SERVICE MODE**

Service flow rate for each polishing vessel shall be monitored by panel mounted flow indicators. During periods of low condensate flow the operator may select to remove one of the vessels from service by a manually initiated automatic sequence. A differential pressure transmitter



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installed between the influent and effluent headers will on a high signal cause an annunciator alarm. By observing the individual vessel flow indicators, or conductivity at vessel outlet the operator can determine which vessel is contributing most to the pressure drop and is in need of resin cleaning.

Panel mounted cation conductivity indicators shall monitor the polishing system influent and effluent streams as well as the discharge of each service vessel. A high influent conductivity annunciator alarm will alert the plant operator that a problem condition such as air or condenser cooling water leakage has occurred. This conductivity analyzer shall also provide contacts for an alarm at the power station main control room. A high effluent header or service vessel conductivity annunciator alarm will alert the operator to the need for regeneration of a polishing vessel.

➤ **ISOLATION FROM SERVICE**

Normally "Service vessel" once exhausted shall be isolated from service till the "Resin Transfer" operation is complete.

➤ The sequence 'Resin Transfer from CPU Vessel to Regeneration plant' and Resin Transfer from Regeneration plant to CPU Vessel' shall be initiated from the condensate polishing unit control panel but shall be controlled by the DCS panel located in the Regeneration area.

6.03.00 EXTERNAL REGENERATION CONTROL SYSTEM

6.03.01 One external regeneration system shall be provided to serve the condensate polishing for the unit. This system shall be designed for physical cleaning and chemical regeneration of the resin system will consist of required number of resin separation and regeneration vessels, a mixed resin storage vessel, the tank for introducing the required regeneration solutions and means for adding make-up resin. It will have acid, alkali, and ammonia (if required) dosing system and alkali preparation facilities.

6.03.02 Manually initiated automatic sequences shall be provided for transferring resin from a vessel to the remote facility for physical cleaning and chemical regeneration and for returning fresh resin to that vessel. Control for chemical dosing system and alkali preparation facility shall also be provided in it.

6.03.03 Regeneration shall include hydraulic reclassification of the resins and the transfer of the resins to the respective regeneration vessels shall be hydraulically. The separated resins shall then be backwashed, cation and anion regenerated with hydrochloric acid and sodium hydroxide solutions respectively, rinsed and then followed air scrubbing and a good backwash. The resin is then transferred back to the resin separation vessel and the resins are air mixed. The mixed resins after regeneration are given a final rinse with the discharge conductivity being monitored. If the quality is satisfactory, the mixed resin shall be transferred to the resin storage vessel otherwise regeneration sequence shall be repeated.

6.03.04 REGENERATION CONTROL SYSTEM

a) A manually initiated automatic sequence for physical cleaning and chemical regeneration of the resin shall be provided. Control for chemical dosing system and alkali preparation facility shall also be provided in it.

b) Demineralized water shall be used throughout the regeneration process for backwashing, regenerant diluents, rinsing and resin transfer.

c) A conical bottom hopper having a water ejector will be used for resin make-up.

d) The complete detail of the regeneration system shall be supplier specific and the extent of



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automation offered, operation of the complete system, logic/flow diagrams, type and details of the presentation of information, the type of mimic, hardware details etc. along with detailed circuit descriptions shall be provided during detail engineering.

e) The complete control and operation of the regeneration plant shall be through DCS based control panel.

6.03.05 RESIN TRANSFER

Manually initiated automatic sequences shall be provided for transferring resin from a Service vessel to the remote common facility for physical cleaning and chemical regeneration and for returning fresh resin to that Service vessel.

The sequence resin transfer from Service vessel to regeneration plant and from regeneration plant to CPU vessel shall be initiated from the condensate polishing unit control panel but shall be controlled by the DDCMIS provided in the regeneration control panel.

The transfer of resin from the service vessel shall include isolation of the service vessel, hydraulic/hydro -pneumatic transfer of the resin to the external regeneration system (resin separation vessel) and the complete drain down of the service vessel to the hot well.

6.03.06 The complete control and operation of the Regeneration Plant shall be through DCS.

6.03.07 It shall be possible to operate the Regeneration Plant in Auto/Semi-Auto/Manual mode.

6.03.08 Following operations shall be possible from the Regeneration Control Panel.

- a) Complete Regeneration.
- b) Resin Transfer from CPU vessel to Regeneration Plant.
- c) Resin Transfer from Regeneration Plant to CPU vessel.

Operation (a) shall be initiated from the Regeneration Control panel whereas operation (b) & (c) shall be initiated from the CPU service vessel Remote I/O panel.

6.03.09 In 'Auto' mode, once the sequence has been initiated, it shall proceed from step to step automatically.

6.03.10 In 'Semi-auto' mode each step shall be performed only after initiation by the operator.

6.03.11 In 'Manual' mode complete operation shall be by the operator by operation of the Control switches on the panel.

6.03.12 'Close-Auto-Open' control switches shall be provided on the panel for the various drives. In 'Auto' position, the drives shall receive stop/start command from the DCS.

6.03.13 'Start-Auto-Start' Control switches shall be provided on the panel from the various drives. In 'Auto' position, the valves shall receive close/open command from the DCS.

6.03.14 On DCS failure, it shall be possible to operate the valves by means of manual operation of solenoid valves also.

6.03.15 It shall be possible to switch mode of operation from one to the other at any moment and the operation shall proceed on the newly selected mode from that time.

6.03.16 For steps which require frequent time adjustment, it shall be possible to change the time setting from the front of the panel. For all other steps it shall be possible to adjust the time setting from inside the panel.

6.03.17 For all sequences, the current step number, set time of the step, elapsed time of the step and



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the total elapsed time of the sequence shall be indicated on the front of the panel.

- 6.03.18 A mimic diagram of the Regeneration system shall be provided on the front of the panel. The status of various drives and valves shall be indicated by LED on the mimic diagram.
- 6.03.19 The system shall incorporate the necessary safety features. During automatic sequential operation, if any pre-requisite criteria is not fulfilled or missing for a pre-determined time interval, the steps should not proceed further, the Alarm shall be provided. Missing criteria, sequence which is under hold up etc. shall be displayed on the panel.
- 6.03.20 The safety system for any sequence/step shall check the opening of the required valves and closure of the remaining valves of the plant to avoid mal-operation.
- 6.03.21 Wherever standby equipments are provided, it shall be possible to select each of the drive on 'standby' duty.
- 6.03.22 Start, progress and stop of each of the sequence shall be annunciated in all the control panels.
- 6.03.23 At any time only one of the sequence shall be in progress.
- 6.04.00 SPECIFIC INTERLOCKS RELATED TO SERVICE & REGENERATION SYSTEM**
- All interlocks for safe operation of the plant shall be provided. The following interlocks as a bare minimum requirement of the system shall be provided:
- 6.04.01 Service vessels shall be taken back in service, only after they have been pressurized.
- 6.04.02 Service vessels can be taken up for resin transfer only after they have been completely isolated from the condensate system and depressurized.
- 6.04.03 Resin can be transferred to and from only one service vessel at a time.
- 6.04.04 Resin transfer between the service and the regeneration skids shall be permitted only when the receiving vessel is initially empty.
- 6.04.05 Regeneration sequence can commence, only when the level in the DM plant N-Pit is low enough to receive the entire waste water from the regeneration operation.
- 6.04.06 Wherever possible, completion of all timed steps in the regeneration and resin transfer process shall be physically verified by effluent conductivity etc. as applicable. The automatic sequence shall be prevented from advancing to next step, till these required physical conditions are achieved, and at the same time this delay shall be annunciated in the control panel, to draw the attention of the operator. The automatic sequence of operations shall be interruptive at any time by the operator and he shall be able to take over the control to manual from that step onwards. Further operator should be able to override sequence, if required.
- 6.04.07 It shall be possible for the operator to extend the timing of the particular step by isolating the timer for the duration. The timer will restart once the operator puts back the system on 'auto' and the other steps will then follow as programmed.
- 6.04.08 The regeneration sequence shall be prevented from advancing further in the event of tripping of a running motor or other fault condition, which do not permit the various desired parameter of this step to be achieved. A manual over ride for this shall also be provided.
- 6.04.09 Annunciation logic shall be carefully designed so that the alarms are activated only under abnormal conditions. As for example, low flow of diluent water is only relevant when the chemical dosing is in progress. All other times, when no diluent water flow is required, this



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annunciation should be blocked. In general, Normal and trouble free operation of the plant shall not activate any of these alarms.

6.04.10 Adequate diluent water flow shall be established before starting of the ejectors/dosing pumps for acid and alkali regeneration.

6.04.11 The immersion heater in the hot water tank can be put on only when there is adequate water level in the tank.

6.05.12 CPU service vessel inlet & isolation valves will close automatically in the event of tripping of condensate extraction pump.

Note: Bidder to note that for complete control & operation of the CPU plant bidder to also refer the respective Control & Instrumentation (Sub-Section IC& IIC) & Electrical (Sub-section IB& IIB).



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PROJECT**

**TECHNICAL SPECIFICATION FOR CONDENSATE
POLISHING UNIT**

**SPECIFICATION NO. PE-TS-426-155-
A001**

SECTION : I

SUB-SECTION: I A

REV. NO. 00

DATE :

ANNEXURE I

QUALITY PLAN

CHAPTER 11 : QUALITY ASSURANCE REQUIREMENTS

1.0 INTRODUCTION

1.1 The minimum Quality Assurance / Quality Control (QA/QC) requirements and the services the Contractor is expected to provide to assure "Quality Assurance" are described in this section. "Quality Assurance" is defined as the entire programme adopted by the Contractor during engineering, procurement and construction to assure conformity with the contract specifications. Quality Assurance/Quality Control procedures proposed by the Contractor should address the QA/QC requirements under the following phases of the project:

- (a) Engineering
- (b) Procurement
- (c) Construction including commissioning and testing

1.2 Contractor shall submit documents to demonstrate that the Contractor and his sub-vendors possess, QA/QC programs meeting the requirements set forth in this section. Contractor shall prepare the quality assurance plans for all the offered equipments to cover the overall quality assurance requirements. Contractor shall submit a quality assurance plan along with the bid as per the format enclosed for all applicable equipment & systems.

1.3 The Contractor must submit an organization chart defining the permanent positions responsible for QA/QC accompanied by a brief description of each position's function and responsibility. A second organization chart along with a descriptive write up should also be provided outlining the proposed QA/QC program for this particular project. This chart and write up should identify the personnel responsible for the Engineering Quality Assurance Plan for the completion duration of the project.

2.0 ENGINEERING

2.1 Prior to finalization of contract

Prior to finalization of the Contract, the Contractor shall prepare and submit a project Quality Assurance Plan that covers the engineering phase of the Works. The plan shall be designed for this project and shall address the specifics of how the Contractor will control, monitor and verify the requirements contained in this section. The Contractor shall utilize all of his QA/QC resources, manuals and procedures when preparing the plan. Purchaser shall review the plan prior to utilization and upon issue the plan shall become the basis by which Purchaser will evaluate the Contractor's engineering QA/QC activities as they relate to this project.

2.2 Purchaser's Participation

The Purchaser reserves the right to audit and verify procedures set forth in the Engineering Quality Assurance Plan. This audit right in no way relieves the Contractor from performing the control verification procedures outlined in the plan.

2.3 Engineering Quality Assurance and Quality Control Requirements

Following are the minimum Quality Assurance and Quality Control requirements for the project. The Contractor's Engineering Quality Assurance Plan shall set forth in detail the procedures to satisfy these QA/QC requirements.

2.3.1 Design Control

The Contractor shall define, document and advise the appropriate handling of the following design controls:

- (a) Establish internal as well as external discipline relationships.
- (b) Qualifications of personnel assigned for each task.
- (c) Establish audit procedures to ensure that the design conforms to the requirements.
- (d) Define and outline the number of multi-discipline design reviews.
- (e) Establish procedures for handling design changes.
- (f) Establish guidelines to handle all issues in pre-award, award and pre-fabrication with Manufacturer's and Sub-contractors.

2.3.2 Document Control

The Contractor must include in its QA/QC Plan the document control procedures defining:

- (a) Authorized use of documents
- (b) Receipt, logging and distribution of documents
- (c) Procedure for updating and implementation of additions and revisions.
- (d) Procedure for document transmittal to Purchaser. Some of the requirements for document transmittal may be covered in other parts of this specification.

2.3.3 Audits

All documents shall be audited by the Contractor for conformance with the QA/QC procedures.

The Purchaser reserves the right to review design details, either directly or through their Consultants. The Purchaser may audit detailed design related design, structural/foundation designs / piping design and other areas.

2.3.4 Engineering Sub-Contractor

The subcontracting of detailed engineering to third parties does not relieve the Contractor the responsibility for Engineering Quality Assurance.

2.4 Procurement

2.4.1 Source Quality Control

It is the Purchaser's intent that the Contractor deal only with Sub-Contractors and Manufacturers (Vendors) who have established and demonstrated effective quality assurance and quality control programs. Purchaser does require, however, that the Contractor perform such normal inspection of Sub-contractors'/Vendors' work as is necessary to obtain equipment and materials conforming to the project specifications and their supporting documents (applicable codes and industry consensus standards) and good engineering, fabrication practices as described herein. Source Quality Control is also a valuable input for confirmation of delivery performance.

Minimum inspection requirements in respect of electrical and instrumentation / control equipment and civil works are covered in their respective specifications. Prior to finalization of the contract, the Contractor shall prepare and submit a Project Quality Assurance Plan that covers Procurement and a requirement for procured items for the complete Works.

2.4.2 After Award of Subcontract

Once Sub-contractors and manufacturers are established, Purchaser and the Contractor shall review item-by-item all major engineered equipment and systems and any special fabrication/fitting to reach an agreement on the need for prefabrication/pre-inspection meetings.

2.4.3 Purchaser's Participation

2.4.3.1 The Purchaser reserves the right to audit the performance of the Sub-contractors/manufacturers and the Contractor's inspection effort. This is normally accomplished by visiting the Sub-contractors/Manufacturers with the Contractor's Inspector at pre-selected points during manufacture. Contractor shall identify notification points so that the Purchaser's can be present at particularly important stages of fabrication should the Purchaser wish to attend. The notification points are not hold points unless specifically identified as such. Should Purchaser elect not to or fail to attend, the Work shall proceed without interruption. The Purchaser reserves the right, however, to make announced spot-checks to facilitate evaluation of the Sub-Contractor and/or the Contractor's inspection effort. Purchaser may wish to hold technical meeting with the machinery Sub-Contractor during the design and fabrication of the machinery. Should Purchaser desire to hold technical meetings, the Contractor will be advised at a reasonable notice.

2.4.3.2 During audit visits to fabricator shops, Purchaser may elect to spot-check base materials and welds to verify proper metallurgy using whatever methods Purchaser may wish to utilize, but only in the presence of Contractor's Inspector unless otherwise agreed. Some of these requirements have been identified in the minimum inspection requirements listed in this section.

2.4.4 Communication

2.4.4.1 Direct, timely communication between the Contractor's Inspectors and Purchaser's auditing Inspectors is mandatory, especially in notification points and in the event of problems, Purchaser shall be advised in a timely manner of all situations where changes or compromises in specifications are considered or where non-conformances are being encountered. Suggested format for inspection request is enclosed with this section. The Contractor shall give advance notice of thirty (30) days for all overseas travel and fifteen (15) days for travel inside India.

2.4.4.2 Rejection reports shall be faxed by the Contractor's Inspector from works directly to Purchaser's Representative at the same time as faxed to the Contractor's home office. Reports shall be faxed to Contractor's home office for typing, editing and transmitting to Purchaser.

2.5 QA / QC Requirements

2.5.1 Inspection Plan

Inspection plans with detailed instructions for the Inspector's guidance shall be provided for each item. QA plans for the components indicated therein are enclosed in Tables 1 to 3 at end of this chapter. The Contractor shall develop the QA plans for all other equipment/systems on a similar basis as indicated in the Tables above. The Contractor's procurement Inspection function shall begin with the award of the purchase order and concludes when the Inspector (including inspection by client's inspector wherever applicable) has duly released the equipment in the Sub-contractor's shop.

2.5.2 Inspection Office

- 2.5.2.1 The Contractor shall identify the key inspection office located at its engineering and construction office. All inspection assignments, inspection instructions, after placement of the purchase order shall be covered from this designated office.
- 2.5.2.2 One individual in the Contractor's key inspection office shall be designated to fill the function outlined in 2.5.3 and must report to the Contractor's Manager of inspection. Additional staff may be added as necessary, provided they are under the supervision of the individual designated. This individual will hereafter be referred to as the "Quality Control Project Inspector (QCPI)".
- 2.5.2.3 For technical problems arising during manufacturing, after purchase orders are placed, the QCPI is responsible for clearing such technical problems with Engineering and/or Purchaser. All purchase orders shall have a clause requiring the Sub-Contractor to submit all questions of a technical nature concurrently to the QCPI and requisitioning Purchaser in writing through fax or letter for resolution. The QCPI shall be responsible for obtaining replies from engineering, documenting the response to the Sub-Contractor and making distribution. The assigned QCPI shall be on distribution for all other correspondence. When technical requests arise from rejection made by the Contractor's source Inspector, the source Inspector's rejection report must be attached to the Sub-Contractor's request for engineering evaluation.

2.5.3 Inspection Co-ordination and Responsibility

The QCPI shall have the overall coordination responsibility for inspection activities. The QCPI's responsibilities shall include, but not be limited to the following:

- (a) Issue assignments for source inspection.
- (b) Issue specific inspection instructions when required to the assigned source inspector.
- (c) Indicate the required type of report forms.
- (d) Coordinate and respond to questions of a technical nature.
- (e) Monitor inspection reports to determine if inspections are being performed as per written instructions.
- (f) Forward all related order correspondence to the assigned source Inspector.
- (g) Receive inspection reports from the source Inspector and make distribution as required.

- (h) Ensure that comprehensive files are maintained for each job.

2.5.4 Inspector's Qualifications

The Contractor shall submit with their QA/QC Manual resumes of contractor's inspectors detailing their experience, education and qualifications for Purchasers review/approval. The Inspectors shall have sufficient prior experience and qualifications for the equipment assigned.

2.5.5 Inspectors responsibilities

After receiving the assignment from the QCPI, the source Inspector shall review the order, conduct a pre-inspection meeting (when instructed), perform the inspections outlined, maintain field file in an organized manner and report the results to the key office and Purchaser. The following is a more detailed, but not inclusive, list of what Purchaser typically expects from the Contractor's source QCPI:

- (a) Pre-fabrication meeting – the Contractor's Inspector shall conduct a pre-fabrication meeting with the Sub-contractor prior to start of fabrication. The discussion shall include, but not be limited to a review of the following items:
 - (i) Purchase order requirements with emphasis on any special requirements (technical and quality).
 - (ii) Code Requirements.
 - (iii) Sub-contractors Quality Control Programs.
 - (iv) Fabrication Schedule.
 - (v) Major Sub-contractors.
 - (vi) Welding Procedure Specification (WPS), Procedure Qualification Record (PQR) and Welder Performance Records (WPR).
 - (vii) Non-Destructive Examination Requirements.
 - (viii) Testing – Hydrostatic and Pneumatic.
 - (ix) Manufacturer's Data Reports.
 - (x) Preservation, Packing and Shipping.
 - (xi) Extent of Purchaser / Contractor Inspection.
 - (xii) Witness Points and Hold Points and Notice requirements.
- (b) Initial inspection visit: The Inspector shall perform as a minimum, the following inspection activities prior to start of fabrication.
 - (i) Review fabrication schedule to ensure required Quality Control examinations and other intermediate tests have been included.
 - (ii) Establish approval of major Sub-contractors.

- (iii) Verify that Welding Procedures and Procedure Qualifications have been approved.
 - (iv) Verify that all welders assigned to job are qualified.
 - (v) Review Mill Test Reports to verify materials meet specifications.
 - (vi) Review Sub-contractor's Examination and Inspection Plan.
 - (vii) Review Sub-contractor's procedure for identifying and transferring material markings.
 - (viii) Make a visual examination of major materials, verify Sub-contractor's examination of all materials, and verify proper storage facilities (environment and security).
- (c) Progressive inspection visits: The following minimum activities, where applicable, shall be executed and reported upon by the Inspector:
- (i) Monitor on a random basis the transfer of material marking throughout the fabrication.
 - (ii) Initial and random inspection of edge preparation, root gap and fit up for all vessel and fabricated machinery components.
 - (iii) Initial and random witnessing of production welding to verify approved procedures, qualified welders and proper techniques are being used.
 - (iv) Ensure that welding materials are being properly controlled.
 - (v) Inspect major weld seams, nozzle and attachment welds, overlay welding and any weld repairs.
 - (vi) Perform random check of back gouging of pressure retaining welds.
 - (vii) Inspect critical/major materials from sub-Sub-contractors.
 - (viii) Check nozzles / man ways for size, rating and extension.
 - (ix) Check dimensions and workmanship of components.
 - (x) Examine gaskets and bolting against specifications.
 - (xi) Check location and attachment welds for support clips, lugs, brackets and saddles.
 - (xii) Make final visual inspection for quality of work and for damage.
 - (xiii) Make complete dimensional inspection.
 - (xiv) Witness all hydrostatic and pneumatic testing.
 - (xv) Witness routine and special testing as may be outlined in project specifications or data sheets for Electrical and Instrumentation chapters.

(xvi) Assure electrical and instrument function and operational checks have been performed as per project specifications.

(d) Non-destructive Examination (NDE) – The Inspector shall perform as a minimum, the following NDE activities during progressive inspections:-

(i) Radiographic examination (RE)

- Review Sub-contractor's radiography procedures for approval.
- Review all radiographs progressively through out fabrication.
- Evaluate for acceptable film quality and weld quality.

(ii) Ultrasonic examination (UE)

- Review Sub-contractor's procedures and Inspector qualifications.
- Witness at least 25% Ultrasonic examinations
- Review certified results

(iii) Magnetic particle examination (MPE)

- Review Sub-contractor's procedures and Inspector qualifications.
- Witness the initial MPE examinations and 10% minimum of all MPE examinations, as well as all examinations after repair.

(iv) Liquid penetrant examination (LPE)

- Same as for MPE

(v) Hardness testing – production welds

- Review procedure and witness initial tests
- Verify 10% of hardness values during progressive inspections.
- Review all hardness readings for acceptance per specifications and require certified results.

(e) Shipping

- (i) Verify that all shipping requirements related to cleaning, dry out, surface preparation.
- (ii) Verify that pressure equipment is appropriately code stamped and all "Manufacturer's Certified Data Reports" are complete and properly signed.
- (iii) Verify required documentation for acceptance and record is complete.

2.5.6 Inspection Reports

2.5.6.1 Inspection reports for interim inspection visits shall be consecutively numbered and identify non-conformance and exceptions found /corrected at that time. Final checklists should indicate all items inspected during interim inspections.

2.5.6.2 Inspection rejection reports shall be by telefax to the key office and Purchaser when the Sub-Contractor's proposed resolution deviates from order specifications, or would require repairing.

- 2.5.6.3 Final inspection reports shall be by check off for all major equipment and bulk piping components. The check off indicates the inspections were performed and would be covered on an interim inspection report.
- 2.5.6.4 Inspection release certificate shall be issued by the assigned Inspector only after all the requirements of the purchase order have been met. The Sub-contractor shall be given the inspection release certificate as authorization to present final billing to the Contractor and a copy of same shall be attached to the packing list to serve as notification to the job site of inspection approval.

2.6 Construction

2.6.1 Purchaser's Participation

Purchaser will have a Quality Assurance/Quality Control organization to audit the Contractor's QC effort. The assigned Purchaser's personnel will provide assurance to Purchaser's management that the Work meets specifications, however, the basic inspection and quality control responsibility is vested with Contractor.

Purchaser's auditing may include spot checks of materials including their testing in the field to ensure that inadvertent substitutions have not been made in the fabrication shops or mixing point or in field ordered materials. Purchaser's auditing shall also include testing of concrete, cement mortar, etc.

2.6.2 Communication

- 2.6.2.1 Direct, informal communication between the Contractor's field Inspectors and Purchaser's auditing Inspectors is mandatory. Further Purchaser shall be advised when major problems related to design or fabrication is uncovered.
- 2.6.2.2 Contractor's in-progress inspection reports, follow up/punch out sheets, records of radiograph inspections, etc. shall be available to Purchaser's auditing Inspectors during the course of the Works.
- 2.6.2.3 At the end of the Work, Contractor's standard inspection reports, check off sheets, radiographs, master copy of loop diagrams, electrical test data sheets, etc. shall be turned over to Purchaser in an organized, agreed upon format. Contractor shall verify that all of the required documentation of the equipment has been received and placed in the equipment files. The Contractor is responsible for obtaining any outstanding documentation from the suppliers.

2.6.3 Construction QA/QC requirements

- 2.6.3.1 It is the Purchaser's intent that the Contractor (and any Sub-contractors employed) provides sufficient qualified Inspectors to assure that facilities are installed in accordance with the plans and Purchaser's specifications and intents and that the level of quality called for therein is obtained. Prior to finalization of Contract award, the Contractor shall submit a detailed Field Quality Assurance Program for Purchaser's review. The program must be tailored to show compatibility with engineering design, compliance with applicable codes, specifications, standards, drawings, support documents, governmental regulations and this document.
- 2.6.3.2 For the construction period, the Contractor shall provide a full time, dedicated Quality Assurance Organization. As a minimum the Contractor's Construction Quality Assurance Program shall include the following: -

(a) **Quality Control Program**

Details of the program to be implemented, its use, control and identification of hold and inspection points shall be submitted to Purchaser for approval.

(b) **Organization, Authority and Responsibility**

Delineate the Contractor's Quality Control organization, responsibility and authority for performance of QC functions by discipline.

(c) **Inspector Qualifications**

The Contractor's Construction Assurance organization shall consist of people with qualifications similar to the requirements outlined in clause 2.5.4. The field QA organization will be a full time organization, with no other construction-related duties. As with engineering and procurement, Purchaser will review Construction QA staffing plans/

(d) **Document Control**

This system shall ensure that the latest issues of drawings, specifications, standards, and supporting documents shall be used for fabrication and installation and that field changes are incorporated into final "As Built" drawings.

(e) **Receiving Control**

Procedure for receipt of purchased items delivered at the job site initial identification, qualification and review of supporting documents shall be described. In addition, the procedure shall ensure that spare parts supplied by Contractor are properly labeled by the Sub-Contractor with description and purchase order number.

(f) **Receiving inspection**

This shall establish the method of notification and inspection to be performed on received items to verify the condition and conformance to the appropriate acceptance standards reference or contained in the purchased documents.

(g) **Sub-contractor Non-conformance**

This shall provide for documentation and disposition of non-conformances resulting from Sub-contractor errors and shipping damage to material, fabrications and equipment received at the job site. It also provides for interface with the design engineer when the non-conformance does not comply with the engineering design.

(h) **Storage and Maintenance of Materials and Equipment**

This system shall describe the controls and inspection performed to show that the handling, storage and preservation of materials and equipment are performed to prevent damage or harmful deterioration to the materials and equipment received at the job site.

2.6.5 Inspection, examination and testing of on-site fabrication and installation

2.6.5.1 This section shall establish the responsibility for performance and recording of examinations, tests and inspections as required by the engineering design.

2.6.5.2 Inspection of work in progress to determine conformance with drawings, specifications, any field definition agreed to shall be included. Some of the inspections are listed below:

- (a) Soil testing
- (b) Pile driving record data (if applicable)
- (c) Structural concrete
- (d) Performing random dimensional check and visual material verification of field fabricated pressure equipment and of any piping, vessel, electrical and instrumentation installation.
- (e) Internal checking of all vessels for:
 - (i) Cleanliness
 - (ii) Proper internals. This involves opening the vessel manways and removal of internals.
- (f) Witness testing and installation of items such as:
 - i.) Welder testing and qualifications and maintenance of records thereof.
 - ii.) Weld examination and maintenance of records thereof in accordance with applicable codes and specifications.
 - iii.) Hydrotests, hydro-pneumatic tests, pneumatic tests, lead and service tests.
 - iv.) Electrical inspection and testing which includes witnessing of Hipot testing, megger testing, AC power factor testing etc.
 - v.) Instrument model/name plate data verification
 - vi.) Instrument installation checkout
 - vii.) Instrument loop checks
 - viii.) Mechanical and electrical equipment bearing flushing and filling.
 - ix.) Mechanical equipment cold alignment checks and rotation verification.
 - x.) Witness verification that piping loads on machinery equipment meet specifications.
 - xi.) Pump installation check out
 - xii.) Coating and lining tests
 - xiii.) Surface preparation, paint application and thickness verification.
- (g) Final checking of installed facilities, completing check out forms, and signing on behalf of the Contractor documents attesting completion of the work, as called for in the Contractor documents.
- (h) Monitoring or inspecting the work of Sub-contractors - This requires pre-award and pre-field start meetings for major subcontracts with

Contractor's / Sub-Contractor / Purchaser participation to establish quality (QA/QC) requirements and how they will be met. Typical areas/disciplines may include, but not be limited to the following:

- (i) Foundations
- (ii) Field fabricated vessel
- (iii) Tanks
- (iv) Piping
- (v) Electrical
- (vi) Instrumentation
- (vii) Insulation
- (viii) Painting
- (ix) Buildings

- (i) Execute Contractor's standard quality tracking program.
- (j) Perform final check of installed facilities with Purchaser's representatives to verify completeness and accuracy in accordance with P and ID's / Engineering Flow Diagrams and other scope documents as may be required.
- (k) "Source" inspect/monitor any field award shop fabrication orders as specified.
- (l) See that proper protective procedures are employed and maintained for early installed equipment and equipment stored in offsite staging areas.

2.6.6 Non-conformances of on-site Fabrication and Installation

This section shall control on-site fabrication and installation items, which do not conform to the engineering design or for which the engineering design is incorrect.

2.6.7 Calibration of test equipment

Calibration of tools, gauges, instruments and other measuring and testing devices shall be included.

2.6.8 QA personnel qualification and certification

The qualification required of QA/QC personnel shall be outlined.

2.6.9 Quality assurance / Quality Control Records

The system, which shall ensure that all quality assurance records are maintained for ready reference and shall also provide for the accumulation, evaluation, retention and distribution of QA/QC records.

2.6.10 Interface with Statutory Authorities

Participation of statutory authorities, which require testing, witnessing and inspection, shall be provided.

2.6.11 Audits

Requirements for audits to verify implementation of the QA/QC program on a regular basis shall be included.

2.6.12 Mechanical Completion Acceptance

Contractor shall perform final inspection of the Work in accordance with the Contract documents.

- 2.6.13 Periodic reporting of QA/QC activities (once a month or earlier) as required shall be submitted.

2.7 Inspection at Works

Purchaser shall witness all the tests including performance tests of all the items like fans, pumps and all other equipment in contractor's/sub-contractor's works before dispatch.

INSPECTION REQUEST FORM			
From :			
To :			
Attn :			
Dear Sirs,			
Items detailed below are ready for inspection. Please arrange inspection and confirm the date of inspection.			
1.	Purchaser	:	
2.	Project	:	
3.	Purchaser's order reference	:	
4.	Consultant's reference	:	
5.	Sub-order reference	:	
6.	Sub-contractor's name and full address	:	
7.	Place of Inspection (full address)	:	
8.	Contact person, telephone no. and fax no.	:	
9.	Description of item and quantity	:	
10.	Nature of inspection required	:	
11.	Proposed date(s)	:	
12.	Weekly holiday	:	
We confirm that the items have been fully inspected/tested by us at all stages, of inspection as per quality plan, and all material test certificates, QC records, test Reports, calibration records of measuring/testing instruments with tractability to national level are available with us.			
Thanking you and awaiting your confirmation.			
Yours faithfully,			
Cc: Sub-contractor			

Section M15 : WATER TREATMENT & WATER SYSTEM

Tests / Check	Material Test	WPS/PQR/Welder Qualification	DPT/MPI	Assembly Fit up	Dimension	RT	Hydraulic / Water Fill	Performance Test	Test as per relevant Std / Appd.	Other Tests
Items / Components										
1. Horizontal Centrifugal Pumps				Y	Y			Y ¹	Y	
1.1. Casing	Y ^a		Y ^b				Y			
1.2. Impeller	Y ^a		Y ^b							Y ^d
1.3. Shaft	Y ^a		Y						Y ^c	
2. Vertical Pumps				Y	Y			Y ¹	Y	
2.1. Casing	Y ^a		Y ^b				Y			
2.2. Impeller	Y ^a		Y ^b							Y ^d
2.3. Shaft	Y ^a		Y						Y ^c	
2.4. Fabricated Parts	Y ^a	Y	Y ^b			Y ²	Y			
3. Dosing / Metering Pumps	Y ^a						Y	Y ¹	Y	
4. Gate / Globe / Check Valves	Y ^a		Y ^b		Y		Y	Y	Y	Y ⁶
5. Dual Plate Check Valves	Y ^a		Y ^b		Y		Y	Y	Y	Y ¹²
6 Diaphragm Valves	Y ^a				Y		Y ³		Y	Y ⁴
6. Butterfly Valves (Low Pr.)				Y	Y		Y ³	Y		Y ⁵
7.1 Body (Cast)	Y ^a		Y ^b							
7.2 Disc (Cast)	Y ^a		Y ^b							
7.3 Shaft	Y ^a		Y ^b							Y ^c
8. Plug / Ball Valves (Low Pr.)	Y ^a		Y ^b	Y	Y		Y	Y	Y	
9. Blowers	Y ^a		Y ^b	Y	Y		Y	Y	Y	Y ^{dc}
10. Atmospheric Storage Tanks/ Pressure Vessels	Y ^a	Y	Y ^b	Y	Y	Y ⁸	Y		Y ^c	Y ⁷
11. Rubber lining	Y ^a				Y				Y	Y ⁹
12. Reactor Clarifier	Y ^a	Y	Y ^b	Y	Y				Y	Y ¹⁰
13. Clariflocculator / Plate or Tube Settler	Y ^a			Y	Y				Y	
14. Hoists & Cranes	Y ^a	Y	Y ^b	Y	Y	Y ⁸		Y	Y	
15. Chlorine	Y ^a	Y	Y ^b	Y	Y	Y ⁸	Y			

Tonner										
16. Chlorine Evaporator	Y ^a	Y	Y	Y	Y	Y	Y			
17. Chlorinator & injector	Y ^a			Y	Y		Y	Y		
18. Agitators / Flash Mixer / Flocculator	Y ^a	Y	Y ^b	Y	Y			Y		Y ¹⁰
19. Pipes	Y ^a	Y		Y	Y		Y		Y	
20. Ventilation / Exhaust Fan	Y ^a		Y ^b	Y	Y			Y ¹¹	Y	Y ^{dc}
21. Resins / Activated Carbon Filter	Y ^a	Y	Y ^b	Y	Y				Y	Y ¹⁰
22. BUTTERFLY VALVES (HP)	Y ^a			Y	Y		Y	Y		
23. BALL VALVES (HP)	Y ^a			Y	Y		Y	Y		

LEGEND:

Y	Applicable
Y ^a	One per Heat/Heat Treatment batch/Lot
Y ^b	On machined surfaces only. Also 100% on Butt Welds & 10% on Fillet Welds.
Y ^c	UT shall be done for shafts with Dia 50 mm or above & Plates of Thickness 20 mm or above.
Y ^d	Dynamic Balancing per ISO: 1940, Grade 6.3 minimum.
Y ¹	As per HIS, USA
Y ²	10% RT to be conducted on butt welds for Thk >10 mm.
Y ³	Seat Leakage Test for actuator operated valves shall be done by closing the valve with job actuator.
Y ⁴	Tests on Rubber Diaphragms per batch of Rubber mix such as Tensile, Elongation, Hardness, Thickness, Bleed Resistance, Flex Test for 1500 cycles etc. shall be conducted. In addition, Type Test for 50,000 cycles for each type of diaphragm shall also be conducted, if not carried out earlier
Y ⁵	Seat Leakage Test is required to be done in both directions. Disc strength test as per relevant code shall be carried out.
Y ⁶	Blue Matching, Wear Travel for Gate Valves, reduced pressure test for check valves shall be conducted per relevant standards
Y ⁷	Heat Treatment of the Tank/Vessel shall be done per fabrication code requirement. Welded dished ends shall be stress relieved. Dished ends manufactured by cold working shall be stress relieved as per the requirement of code
Y ⁸	RT as per fabrication code requirements. However, dished ends welds, if manufactured by using welded plates shall be subjected to 100% RT
Y ⁹	Rubber Lining Mix shall be subjected to Bleed Resistance Test on mould sample. Adhesion Test, Spark Test and Hardness Test for the Rubber lined jobs shall also be conducted
Y ¹⁰	Gear Boxes shall be checked for smooth No Load Operation at shop to verify noise and vibration levels. Gear Ratio and Kerosene Leak Test shall also be conducted

Y ¹¹	One Fan of each type & size shall be routine performance tested as per corresponding code for air flow, static pressure, total pressure, speed, Efficiency, power consumption, noise & temperature rise. Also all Fans shall be subjected to run test of 4 hours during which noise, vibration, temperature rise and current drawn shall be measured
Y ¹²	Blue Matching, reduced pressure test for check valves shall be conducted per relevant standards. Dry cycle test on valve spring for 1, 00,000 cycles shall be carried out as type test, if not carried out earlier, for the similar MOC, size and type of spring

1. For piping, valves, fillings in service vessel area quality requirements please also refer power cycle piping quality plan.
2. Quality requirements specified here if contradicting as specified elsewhere in this chapter, then stringent quality requirements shall be followed by the bidder for all items without any price and delivery implications to BHEL/customer.
3. The Quality requirements mentioned here in this annexure for different mechanical, electrical & C&I items are bare minimum, if any other quality requirements required for these items as per BHEL & customer during detail engineering the same shall be accepted and provided by bidder without any price and delivery implication to BHEL & customer.

5.0 POWER CYCLE PIPING

5.1 H.P.PIPING FOR STEAM GENERATOR AND AUX.

I. Piping:

- a) All raw materials used shall have co-related mill test certificate meeting material specification. All test, as given in respective material code (other than supplementary requirements), shall be carried out as minimum. This includes the tests wherein it is specified in the ASTM code that the tests is to be carried out when specified by the purchaser or any such indication, in the code.
- b) All pipe lengths shall be 100 % ultrasonic tested. However for critical piping applications (Main Steam, CRH, HRH, Feed water, spray to superheater and Reheater, HP/LP Bypass, Upstream of Aux PRDS and any other system in which alloy steel is used) shall be subjected to 100% ultrasonic examination as per EN 10246:7 1996 or equivalent with longitudinal calibration notch of depth 5% of wall thickness (0.3 mm min. and 1.5mm max.) shall be adhered to.
- c) The edge preparation for shop and site welds in stainless steel /alloy steel shall be subjected to a dye penetrate check.
- d) Pipe bend shall be checked for ovality and thinning by ultrasonic or other acceptable methods on first off lot & on random samples for subsequent pieces for high pressure applications. Outer surface of bends shall be subjected to magnetic particle examination/LPI.
- e) Non-destructive examination of welds shall be carried out after post weld heat treatment, if any.
- f) All butt welds in alloy steel piping of P-91, X -20 , X-22 & material P-5B group & above shall be checked for RT/ UT & MPI after SR.
- g) For welds in P91, X20 & X22 and material P5B group & above Materials requiring heat treatment, induction type of heating shall be deployed for post weld heat treatment, or heat treatment can be carried out in furnace.
- h) Non-destructive examination of welds shall be carried out in accordance with the relevant design/manufacturing codes. However, as a minimum, the following requirements shall be met. Further statutory requirement, wherever applicable shall also be complied with
 1. Temperature > 400 Deg, C and/Or pressure exceeding 71 bar.
 - i. 100% RT/UT on butt welds and full penetration branch welds.
 - ii. 100% MPE.
 2. Temperature > 175 Deg, C upto 400 Deg. C and/or pressure exceeding 17 bar and upto 71 bar.
 - i. 100% RT/UT on butt welds and full penetration branch welds for pipe dia more than 100 NB.
 - ii. 10% RT/UT on butt welds and full penetration branch for pipe dia upto 100NB.

iii. 100% MPE.

3. For all other pipes not covered above, shall be subjected 100% MPE/ DPT in case of underground pipes and 10% MPE/DPT in case of piping above the ground. Further, 10% of butt welds of underground piping shall be subjected to RT.

i) Wherever SR/PWHT is envisaged for alloy steel, above NDTs shall be after SR/PWHT.

j) Hardness survey of welds shall be carried out on alloy steel/stainless steel piping (100% Hardness survey of welds on P91, X20 & X22 & above material grade of P5B above piping) and 3% hardness survey on welds of other alloy steel).

II. Fittings:

a) Raw material of all forged/formed fitting shall be ultrasonically tested. All mother pipes used for fitting shall be ultrasonically tested or hydraulic tested. Forged fitting shall be ultrasonically tested and formed fittings shall be MPI tested.

b) Fittings shall be subjected to suitable NDT as per applicable standards. However, following minimum NDE requirements shall be applicable / met.

i. 100% RT/UT shall be carried out both on alloy steel fittings and on carbon steel fittings.

- for use above 71 bar design condition.
- for use above 400°C design condition.

ii. For fittings X20, P-91 and material group 5B & above

- 100% MPI &
- 10% hardness check.
- Also 100% UT/RT, For fittings of 200 NB & above

iii. 100% UT/RT for fittings of 200 NB & above for boiler feed discharge, recirculation and spray piping of boiler feed system.

iv. 100% UT/RT for fittings of all other piping of size OD 508mm & above.

III. Hangers & Supports:

a) All raw materials used shall have co-related mill test certificate meeting mandatory checks of material specification.

b) Completed springs shall be tested for Scragging Test & Load vs Deflection Test and for dia. > 25mm MPI shall be carried out.

c) Butt Welds shall be tested for UT and fillet welds shall be tested for MPI.

d) Turn buckle/ pipe clamps/ Hangers of thickness > 25mm shall be checked by MPI/DPT on bent portion.

e) Assembled Hangers shall be checked for Variation in deflection and Travel vs Load test.

IV. Thermal Insulation & Lagging, Cladding:

a) Insulation:

Insulation shall confirm to and tested as per relevant clauses of Indian Standards and shall meet the requirements of specification. Type tests except Thermal Conductivity shall be regularly carried out once in three months, Thermal Conductivity Type Test shall be carried out minimum once in twelve months by the manufacturer. Requirements of various components like Binding wires, Lacing wires, Wire mesh, etc. shall be as per specification.

b) Lagging & Cladding:

Aluminium sheeting confirming to ASTM B-203-1060 temper H14 from reputed manufacturer meeting the requirements of specification.

V. Valves:

- a) Pressure retaining parts of valves shall be subjected to (min.) NDT as per Table 1.
- b) Hardened/stellitted valve disc and seat are to be subjected to LPI and hardness check.
- c) Color matching of valve disc/plug and seat shall be carried out to ensure min. 80% contact and no through passage.
- d) Hydraulic pressure test and seat leak test shall be carried out as per ANSI 16.34/IBR.
- e) Air seat leak test shall be carried out as per applicable Standards/Codes.
- f) Functional testing shall be carried out on each valve to check the following as per the approved valve data sheet
 - i. Smooth operation
 - ii. Valve travel, closing and opening time.
 - iii. (Current drawn by actuators.
- g) Springs for safety valves shall be tested with suitable NDT and for spring rate.
- h) Safety and safety relief valves shall be tested for performance.
 - i. All forgings rounds above diameter 40 mm shall be ultrasonically tested.

Valve size NB in mm	ANSI Class upto 300	ANSI Class above 300 upto 600	ANSI Class above 600 below 900	ANSI Class 900 & above & below 4500
Less than 50	Visual	Visual	Visual	MPI
50 & above But below 100	Visual	Visual	MPI	MPI & RT (on 10% of valves on 100% area)
100 & above but less than 300	Visual	MPI	MPI & RT (on 10% of valves on change of section & weld ends)	MPI & RT (on 100% area)

300 and above	MPI	MPI	MPI & RT (on change of sections & weld ends)	MPI, RT on 100% area)
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NOTE: For body and bonnet forgings UT with MPI may be adopted in place of RT for austenitic steel MPI may be replaced by LPI.

SECTION M2 : STEAM TURBINE GENERATOR**1.0. GENERAL REQUIREMENTS****a) Shop Tests**

Shop tests shall include all tests to be carried out at Contractor's works, at works of his sub-contractor and at works where raw material supplied from manufacture of equipment is manufactured. Testing requirement of major equipment over and above the respective code / standard requirements are given for ST & Aux. including Condenser, HP Bypass System & Vibration Isolating System.

b) Site Tests

The Contractor shall prepare and submit detailed field quality plans by setting out the quality practice and procedures to be adopted by him for assuring quality for each equipment of material at this specification from the receipt of material at site, during storage erection, pre commissioning to final commissioning of the plant. These procedures shall necessarily include all checks/tests conducted at site for preservation, assembly, alignment, positioning of the equipment, foundation preparation, welding/bolting heat treatment, non-destructive examination, hydraulic test, running test, performance test etc. The Contractor shall also furnish detailed quality procedure proposed by him for storage, preservation, painting, acid cleaning, alkali boil out, steam blowing, hydraulic test air/gas tightness test etc. to the Owner. The same shall be discussed and finalized with the Owner and six numbers of such finalized copies shall be submitted.

6.0. FEED WATER HEATER, DRAIN COOLERS, GLAND STEAM CONDENSER, HEAT EXCHANGERS & PRESSURE VESSELS / STORAGE TANKS

- 6.1.** All raw materials used shall have co-related mill test certificate meeting mandatory and supplementary checks of material specification.
- 6.2.** Material for Tube plates shall be ultrasonically tested. Finished plates shall be subjected to suitable NDT. For clad plates, bonding shall be checked by UT. Vendor shall furnish their practice regarding manufacturing & NDT for supply of clad plates for Owner review. Drilled Tube plates shall be checked for ovality of holes, ligaments, surface finish etc.
- 6.3.** Dished ends shall be subjected to 100% MPI and RT/UT on welded joints. Knuckle portion shall be checked by MPI for surface defects and thinning shall be checked by UT.
- 6.4.** Butt Welded / Full penetration joints shall be checked by suitable RT / UT. Fillet welds shall be checked by MPI / DPT.
- 6.5.** Tubes shall be tested as per the relevant codes / specification / standards.
- 6.6.** Before tubes expansion in the tube sheets, the mockup test for expansions shall be carried out, in case not done earlier. Torque setting of expander shall be based on mock up tests. Joints shall be checked for tube thinning.
- 6.7.** Completed assemblies shall be pressure tested with working-fluid/ hydraulically/ pneumatically. The heat exchangers shall be tested on both tube side and shell side. After hydro test, the heat exchangers shall be suitably dried and nitrogen capped. Atmospheric tanks shall be tested for leakage by water fill test for at least 12 hrs.

7.0. PIPING, BELLOWS AND THERMAL INSULATION FOR TURBINE & AUX SYSTEMS

7.1. Piping and Fittings

- a) All raw materials used shall have co-related mill test certificate meeting mandatory and supplementary checks of material specification.
- b) All pipe lengths shall be subjected to 100% ultrasonic examination or hydraulic tests and UT/RT on longitudinal welds at the tube mill.
- c) All mother pipes used for fittings shall be subjected to a hydraulic test or an ultrasonic test at the tube mill. Raw material of all forged fittings shall be ultrasonically tested. Forged fittings shall be ultrasonically tested.
- d) Welded and cast fittings, if any, shall be subjected to suitable NDT as per applicable standards. However, as a minimum 100% RT shall be carried out on all alloy steel fittings and on carbon steel fittings for use above 71 bar design conditions.
- e) The edge preparation for shop and site welds shall be checked by MPI/LPI however edge preparation in stainless steel alloy/ steel shall be subjected to a Dye penetrant check.
- f) Thickness of pipe bends shall be checked by ultrasonic or other acceptable methods on sample basis for high pressure applications. Outer surface of bends shall be subjected to magnetic particle examination / LPI.
- g) Non-destructive examination of welds shall be carried out after post weld heat treatment, if any.
- h) Non-Destructive Examination of welds shall be carried out in accordance with the relevant design/manufacturing codes. However, as a minimum, the following requirements shall be met (except for oil piping). Further statutory requirement, wherever applicable shall also be complied with
 - 1) Temperature > 400°C and / or pressure exceeding 71 bar.
 - i. 100% RT/UT on butt welds and full penetration branch welds.
 - ii. 100% MPE.
 - 2) Temperature > 175°C up to 400°C and / or pressure exceeding 17 bar and up to 71 bar.
 - i. 100% RT / UT on butt welds and full penetration branch welds for pipe dia more than 100 NB.
 - ii. 10% RT / UT on butt welds and full penetration branch welds for pipe dia up to 100 NB.
 - iii. 100% MPE.
 - 3) Wherever SR/PWHT is envisaged, above NDTs shall be after SR/PWHT.
 - 4) For all other pipes not covered above (except oil piping), shall be subjected 100% MPE / DPT in case of underground pipes and 10% MPE/DPT in case of piping above the ground. Further, 10% of butt welds of underground piping shall be subjected to RT.
 - 5) Hardness survey of welds shall be carried out on alloy steel/stainless steel piping. (100% Hardness survey of welds on P91, X20 & X22 material grade pipings).

- 6) For welds in P91, X20 & X22 materials, only induction type of heating shall be deployed for heat treatment.
- i) Oil piping shall be subjected to following NDT.
 - 1) Butt welds of Oil piping shall be subjected to 10% RT and 10% DP Test. For Jacking oil lines 100% RT & 100% DPT shall be carried out on butt welds.
 - 2) Fillet welds with load transfer shall be subjected to 100% MPE/DPT and fillet welds without load transfer shall be subjected to 10% MPE/DPT.
- j) Rubber lined pipes shall be hydraulically tested before rubber lining. All rubber lining is to be subjected to following tests as per IS-4682 part-I or acceptable equivalent:
 - 1) Adhesion test
 - 2) Check for resistance to bleeding
 - 3) Measurement of thickness
 - 4) Shore hardness test
 - 5) Visual examination and spark test at 5 kv/mm of thickness.

8.0. VALVES

- 8.1.** Inspection and testing requirements for valves other than extraction line valves and butterfly valves shall be as follows:-

- a) Pressure retaining parts of valves shall be subjected to NDT as per Table 1.
- b) Bar stock/forging above 40mm diameter for valve trim shall be subjected to UT
- c) Hardened / stellitted valve disc and seat are to be subjected to LPI and hardness check.
- d) Colour matching of valve disc/plug and seat shall be carried out to ensure contact.
- e) Hydraulic pressure test and seat leak test shall be carried out as per ANSI 16.34.
- f) Air seat leak test shall be carried out as per applicable Standards/Codes.
- g) Functional testing shall be carried out on each valve to check the following as per the approved valve data sheet:
 - 1) Smooth operation
 - 2) Valve travel, closing and opening time.
 - 3) Current drawn by actuators..
- h) Springs for safety valves shall be tested with suitable NDT and for spring rate.
- i) Safety and safety relief valves shall be tested for performance.

TABLE-1**NDT REQUIREMENTS FOR PRESSURE RETAINING COMPONENTS OF VALVES**

Valve size NB in mm	ANSI Class upto 300	ANSI Class above 300 below 600	ANSI Class above 600 below 900	ANSI Class 900 & above & below 4500
Less than 50	Visual	Visual	Visual	MPI
50 & above but below 100	Visual	Visual	MPI	MPI & RT (on 10% of valves on 100% area)
100 & above but less than 300	Visual	MPI	MPI & RT (on 10% of valves on change of section & weld ends)	MPI & RT on 100% area)
300 and above	MPI	MPI	MPI & RT (on change of sections & weld ends)	MPI, RT (on 100% area)

Note:

- i. For body and bonnet forgings UT with MPI may be adopted in place of RT. For austenitic steel MPI may be replaced by LPI.
- ii. Weld Edge Preparation shall be subjected to MPI/LPI

8.2. Extraction Line Valves

- a) Surface crack examination and hardness check shall be carried out on all hard faced/stellieted surfaces, if any.
- b) As a minimum requirement of castings for all valves on cold reheat and extraction lines shall be subjected to 100% MPI on all areas and RT on Butt Weld ends and change of Section. For forgings minimum requirement shall be 100% UT and 100% MPI.
- c) Bar stock for valves stem shall be subjected to UT. Finish machined valve stem shall be subjected to magnetic particle examination/dye penetration test.
- d) Wall thickness measurement by ultrasonic for critical and highly stressed zones of the casting/forging shall be carried out.
- e) Colour matching of the valve disc and seat to ensure required contact area shall be carried out.
- f) Hydraulic pressure tests shall be carried out on each valve to check body and bonnet strength. Seat leakage and back seat leakage test (wherever applicable) shall be carried out. Air seat leakage test shall also be carried out. Minimum test requirements of pressure shall be as per ANSI B 16.34.
- g) Functional testing shall be carried out on each valve to check for freedom of movement, adherence to clearance, opening/ closing etc. Type tests for discharge co-efficient and pressure drop co-efficient, shall be carried out. In case the type tests have been carried out in the past and documents generated, the same shall be furnished to the Owner for approval.

8.3. Butterfly valves

- a) Valve disc shall be checked for surface and sub-surface defects by magnetic particle examination.
- b) Stubs and driving shafts shall be tested for internal defects by ultrasonic method.
- c) Dye penetration test shall be carried out on shafts, seat rings etc.
- d) Test samples for rubber seal shall be subjected to tensile and hardness test for vulcanizing and after ageing. Hydraulic stability test and ozone crack resistance tests also be carried out.
- e) Valve shall be subjected to hydraulic pressure test for body and air seat leakage tests as per AWWA-C504
- f) Proof of design tests for valves and actuator shall be carried out as per AWWA-C504. In case the test has already been carried out on previous supplies, the contractor may submit the test certification of same for approval of Owner.
- g) After complete assembly each valve with actuator will be subjected to performance test by opening and closing the valve from fully closed to fully open position and the reverse, under no flow for at least 25 cycles to check.
 - 1) Smooth uninterrupted movement of valve.
 - 2) Closing and opening time.

- 3) Current drawn by actuator.
- 4) Operation of tripping switch and position indicator.
- h) After assembly, one valve of each size with respective actuator shall be shop operated over the full range of movement in both the directions, with the body subjected to the full hydrostatic pressure conditions, to demonstrate that the unit is in working order without any leakage through the joints and torque switches/clutches, limit switches are operating satisfactorily. During the test, hand wheel operation, opening/closing time and current drawn shall also be checked. The test shall be conducted for three consecutive cycles with valve shaft both in vertical and horizontal planes.

9.0. MISC. ITEMS / EQUIPMENTS

9.1. Filters / Strainers

- a) Filters / strainers shall be tested as per the requirements of relevant codes / standards.
- b) Filters / strainer shall be performance tested for pressure drop, flow, particle size. If performance test is earlier established, then records shall be reviewed.

9.2. BLOWERS/ EXHAUSTERS

- a) Rotors shall be dynamically balanced. Leakage tests (if applicable) shall be carried out.
- b) Performance tests including noise and vibration tests shall be carried out as per relevant standards / codes.

15.0. LOW PRESSURE PIPING

Sl.No.	Tests/Check Items / Components	Material Test	DPT/MPI	Ultrasonic Test	WPS/ WQS/PQR	Balancing	Hydraulic / Water Fill Test	Pneumatic Test	Assembly Fit up	Dimensions	Functional/operation al Test	Performance Test	Other tests	All Tests as per Relevant Std	Adhesion / Spark	Remarks
1)	Pipes & Fittings and Metered Bends	Y ^a	Y ^b		Y		Y									
2)	Diaphragm Valves	Y ^a					Y ⁵			Y				Y ⁶		
3)	Butterfly Valves (Low Pressure)															
a)	Casted Butterfly Valves															
(i)	Body (Cast)	Y ^a	Y ^b				Y		Y	Y	Y		Y ⁷			
(ii)	Disc (Cast)	Y ^a	Y ^b													
(iii)	Shaft	Y ^a	Y	Y ^c												
b)	Fabricated Butterfly Valves															Ref . Not e14
4)	Gate / Globe / Swing Check Valves	Y ^a	Y ^b	Y ^c			Y ⁵	Y	Y				Y ⁸			
5)	Dual Plate Check Valves	Y ^a	Y ^b	Y ^c			Y	Y	Y				Y ⁴			
6)	Rolled & Welded Pipes	Y ^a	Y ³		Y		Y ¹			Y						
7)	Coating & Wrapping of Pipes	Y ²											Y ²			
8)	Tanks & Vessels	Y ^a	Y ^b		Y		Y									
9)	Strainers	Y ^a	Y ^b				Y						Y ¹¹			
10)	Rubber Expansion Joints	Y ^a					Y ¹²		Y				Y ¹³			
11)	Rubber Lining of Pipes	Y ^a	Y ^b		Y		Y			Y				Y ⁹	Y	

Sl.No.	Tests/Check Items / Components	Material Test	DPT/MPI	Ultrasonic Test	WPS/ WQS/PQR	Balancing	Hydraulic / Water Fill Test	Pneumatic Test	Assembly Fit up	Dimensions	Functional/operatio n al Test	Performance Test	Other tests	All Tests as per Relevant Std	Adhesion / Spark	Remarks
12)	Hangers & Supports	Y ^a						Y								
13)	Fastners	Y ^a		Y ^b				Y								
14)	Site Welding		Y ¹		Y		Y									

Notes:

- Weld Joints not subjected to hydraulic test shall be subjected to 100% RT.
- Spark Test, Adhesion Test and Material Test for primer and enameled & Coal Tar Tapes as per AWWA-C-203-91
- DPT on route run and after back gouging and on finish welds.
- Dry Cycle Test (Spring Cycle Test) for one lakh Cycles shall be carried out as a type test.
- Seat Leakage Test for Actuator Operated Valves, shall be done with by closing the valves with actuator.
- Tests on rubber parts per batch of rubber mix such as hardness, adhesion, spark test, bleed test and flex test on diaphragm, type test for diaphragm for 50,000 cycles.
- Hydraulic Test of Body, Seat and disc-strength shall be carried out in accordance with latest edition of AWWA-C-504 in presence of Owner representatives. Actuator operated valves shall be checked for Seat Leakage by closing the valves with actuator. Seat Leakage Test shall be carried out in both directions.
- Blue matching, wear travel for gates, valves, pneumatic seat leakage, reduced pressure test for check valves shall be done as per relevant standard. Maximum allowable vacuum loss is 0.5 mm of Hg abs. for valves to be tested for vacuum operation for internal pressure 25 mm of Hg abs. for a period of 15 minutes 9.
- Hardness, Bleeding Test and Ozone resistance test shall be done on rubber material
- 2% of welds shall be subjected to DPT.
- Pressure drop across the strainer for each type and size as a special test shall be carried out
- During hydraulic and vacuum tests at 25mm Hg abs in 3 positions, the change in the circumference of arch should not be more than 1.5%. 24 hrs after the test permanent set in dimension should not exceed 0.5%.
- Tests on rubber for tensile, elongation, hardness, hydraulic stability check as per ASTM D 471, ozone resistance test as per ASTM D 1149 aging test and adhesion strength of rubber to fabric, rubber to metal adhesion shall be carried out.

14. For fabricated butterfly valves: UT as per ASTM A-435 on plates material for body and disc. 100% RT as per ASTM, Section-VIII, Division-I, on butt joins of body and disc and post weld heat treatment as per ASME, Section-VIII, Division- I on butt joints of body and disc of thickness above 30mm shall be carried out in addition to other tests indicated for cast butter fly valves.
- a) One per heat/heat treatment batch/lot.
 - b) On machined surfaces only for castings and on finished butt welds.
For shaft/spindles $> \text{ or } = 50$

		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
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
		Hardness , surface defects after hardfacing and machining/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	
									D*	M	C	N	
1	2	3	4	5	6	7	8	9		**	10		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 identified agency prior to carrying out welding at 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 LAMPS 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	
	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 * DIMENSION	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	

	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
4.0	FINAL INSPECTION									
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:3938	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 TEST.	CR	TEST AT 125 % OF-SWL	100%	IS:3938	IS:3938	INSPN. REPORT	√ P W V	CHP
5	PAINTING									
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.									
	LEGND									
	* RECORDS IDENTIFIED WITH 'TICK' SHALL BE ESSENTIALLY INCLUDED BY MANUFACTURER IN QA DOCUMENTATION.									
	** M: MANUFACTURER/SUBCONTRACTOR									
	C: BHEL/BHEL NOMINATED THIRD PARTY INSPECTION AGENCY									
	N: CUSTOMER/CUSTOMER'S CONSULTANT/CUSTOMER'S APPOINTED THIRD PARTY									
MANUFACTURER/ SUB CONTRACTOR	P- PERFORM, W- WITNESS AND V- VERIFICATION									
SIGNATURE	CHP CUSTOMER HOLD POINT									
	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: 1 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	RAW MATERIAL & B/OUT ITEMS:											
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% 100%	MATERIAL SPECIFICATION AS PER APPROVED DRAWINGS. HOOK TC FROM COMPETENT AUTHORITY ASTM A-388 (REFER NOTE D) IS 15560 NO RELEVANT INDICATION 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 P	V V V V V V	

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

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

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	
					6.					10.			
1.	2.	3.	4.	5.			7.	8.	9.				11.

1.3	RAW MATL. (BAR /FORGING) FOR GEAR BLANKS/SHAFTS/ PINIONS/AXLE/ RATCHET PAWL / RATCHET WHEEL & PLATES FOR FABRICATION ETC	CHEMICAL COMPOSITION	MA	Review	ONE SAMPLE PER HEAT	Material specification as per approved drawings.		MFR’ S TC	✓	P	V	V	TC or inspection report for components shall be given. For rounds ≥50mm and plates ≥25 mm.
		MECHANICAL	MA	Review					✓	P	V	V	
		INTERNAL DEFECTS	MA	UT	100%	ASTM A-388 REFER NOTE 1		IR	✓	P	V	V	
		NDT AFTER MACHINING	MA	DPT	100%	ASTM E-165 NO RELEVANT INDICATION		TC	✓	P	V	V	
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	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
SUB-CONTRACTOR			
SIGNATURE			

	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	
					6.				10.	
1.	2.	3.	4.	5.		7.	8.	9.		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 DIMENSION	MA MA MA MA	HT CHART HARDNESS DPT FOR SURFACE CRACK MEASURE	100% 10% 100% 10%	IS 1875/IS 4367/IS 3832 --DO-- ASTM E 165	NO DEFECT	IR IR IR IR	✓ ✓ ✓ ✓	P P P P	V V V V	V V V V	
3.0	FINAL INSPECTION												
3.1	COMPLETE ASSEMBLY	OVERALL DIMENSION ENDURANCE TYPE TEST OPERATIONAL PROOF LOAD & LIGHT LOAD TEST, EFFORT. HEIGHT OF LIFT	CR MA CR MA	MEASUREMENT TYPE TEST LOAD TEST VISUAL	100 % 1 PER SIZE 100% 100 %	IS:3832 /APPD DRG IS 3832 -DO- -DO-	IS:3832 /APPD DRG IS 3832 -DO- -DO-	IR TC IR IR	✓ ✓ ✓ ✓	P P P P	W V W W	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 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.	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	
					6.					10.			
1.	2.	3.	4.	5.			7.	8.	9.				11.

		SWIVELING OF HOOK	MA	VISUAL	100%	APPROVED DRG	APPROVED DRG	IR	✓	P	W	V	
		EFFORT	MA	PULL ON CHAIN	100%	-DO-	-DO-	IR	✓	P	W	V	
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: ** 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

E13: AC & DC MOTORS

ATTRIBUTES CHARACTERISTICS 																
	Visual	Dimensional	Make/Type/Rating/General Physical Inspection	Mech/Chem. Properties	NDT /DP/MPI/UT	Metallography	Electrical Characteristics	Welding/Brazing(WPS/PQR)	Heat Treatment	Magnetic Characteristics	Hydraulic/Leak/Pressure Test	Thermal Characteristics	Run out	Dynamic Balancing	All tests as per IS-325/IS-4722/IS 9283	Vibration
ITEMS, COMPONENTS, SUB SYSTEM ASSEMBLY																
Plates for stator frame, end shield, spider etc.	Y	Y	Y	Y	Y				Y							
Shaft	Y	Y	Y	Y	Y	Y			Y							
Magnetic Material	Y	Y	Y	Y			Y			Y		Y				
Rotor Copper/Aluminium	Y	Y	Y	Y			Y		Y							
Stator copper	Y	Y	Y	Y			Y		Y			Y				
SC Ring	Y	Y	Y	Y	Y	Y	Y	Y	Y							
Insulating Material	Y		Y	Y			Y					Y				
Tubes for Cooler	Y	Y	Y	Y	Y				Y		Y					
Sleeve Bearing	Y	Y	Y	Y	Y				Y		Y					
Stator/Rotor, Exciter Coils	Y	Y	Y				Y	Y								
Castings, stator frame,terminal box and bearing housing etc.	Y	Y	Y	Y	Y			Y								
Fabrication & machining of stator, rotor, terminal box	Y	Y			Y				Y							
Wound stator	Y	Y					Y	Y								
Wound Exciter	Y	Y					Y	Y								
Rotor complete	Y	Y					Y						Y	Y		

Exciter, Stator, Rotor, Terminal Box assembly	Y	Y					Y									
Accessories, RTD, BTD, CT, Space heater, antifriction bearing, gaskets etc.	Y	Y	Y													
Complete Motor	Y	Y	Y												Y	Y
Note: 1. This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating the practices & Procedure followed along with relevant supporting documents during QP finalisation. However QP approval is not envisaged for LT motors up to 50 KW. 2. Additional routine tests for flameproof motors shall be applicable as per relevant standard. 3. Makes of all major bought out items shall be subject to Owner/Owner Engineer approval. Y1 = for HT Motor / Machines only.																

		QUALITY PLAN	CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
			BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
		SHEET 1 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION		VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.0	RAW MATERIAL & BOUGHT OUT CONTROL											
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	-DO-	3	-	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	-DO-	-DO-	-DO-	INSPEC. REPORT	3	-	2	
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, UN-EVENNESS ETC.	-DO-	3	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	MANFR'S DRG./SPEC BOOK	RELEVANT IS/SPEC.	SUPPLIERS TC & LOG	3	-	2	PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK	3	-	2	
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	MANFR'S DRG./SPEC	RELEVANT IS/	SUPPLIER'S TC	3	-	2	HEAT NO. SHALL BE VERIFIED
		3.DIMENSIONS	MA	MEASUREMENT	100%	MANUFR'S DRG.	MANUFR'S DRG.	LOG BOOK	3	-	2	
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	LOG BOOK	3	-	2	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN		CUSTOMER :		PROJECT			SPECIFICATION :				
				BIDDER/		TITLE			NUMBER :				
				VENDOR		QUALITY PLAN			SPECIFICATION :				
SHEET 2 OF 9		SYSTEM		NUMBER PED-506-00-Q-007, REV-03			TITLE			SECTION			
ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		VOLUME III											
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS	
									P	W	V		
1	2	3	4	5	6	7	8	9	10			11	
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED	
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	MFG. DRG. SPEC.	RELEVANT IS	SUPPLIER'S TC	3	-	2		
		3. DIMENSIONS	MA	MEASUREMENT	100%	-DO-	MANUFR'S DRG.	LOG BOOK	3	-	2		
		4.INTERNAL FLAWS	CR	UT	-DO-	ASTM-A388	MANUFR'S SPEC. BHEL SPEC.	-DO-	3	2	1	FOR DIA OF 55 MM & ABOVE	
1.6	SPACE HEATERS, CONNNECTORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	-DO-	MANUFR'S DRG. SPEC.	MANUFR'S DRG. SPEC.	-DO-	3	-	2		
		2. PHYSICAL COND.	MA	-DO-	-DO-	-	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	-DO-	3	-	2		
		3.DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG./ SPEC.	MANUFR'S DRG. / SPEC.	-DO-	3	-	2		
		4.PERFORMANCE/ CALIBRATION	MA	TEST	100%	-DO-	-DO-	INSP. REPORT	3	-	2		
BHEL			PARTICULARS		BIDDER/VENDOR								
			NAME										
			SIGNATURE										
			DATE					BIDDER'S/VENDORS COMPANY SEAL					

		QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :		
				BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE		
		SHEET 3 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION		VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC.	MA	VISUAL	100%	-	NO VISUAL DEFECTS	INSPT. REPORT	3	-	2	FOR MV MOTOR INSULATION/VARNISH THICKNESS SHALL BE MORE THAN THE BURS HEIGHT
		2. OTHER CHARACTERISTICS	MA	TEST	SAMPLE	MANUF'S SPEC.	MANUF'S SPEC.	LOG BOOK AND OR SUPPLIER'S TC	3	-	2	
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND.	MA	VISUAL	100%	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK	3	-	-	
		2.DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG. .	MANUFR'S DRG.	-DO-	3	-	2	
		3. ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	-DO-	MANUF'S SPEC./ RELEVANT IS	RELEVANT IS	SUPPLIER'S TC	3	-	2	
1.9	CONDUCTORS	1. SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	LOG BOOK	3*	-	2*	* MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY BHEL/CUSTOMER.
		2.ELECT. PROP, & MECH. PROP	MA	ELECT. & MECH.TEST	SAMPLES	RELEVANT IS/ BS OR OTHER STANDARDS	RELEVANT IS/ BS OR OTHER STANDARDS	SUPPLIERS TC & VENDOR'S INSPN. REPORTS	3	-	2	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN		CUSTOMER :		PROJECT TITLE			SPECIFICATION : NUMBER :			
				BIDDER/ VENDOR :		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
		SHEET 4 OF 9		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION		VOLUME III	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.10	BEARINGS	3.DIMENSIONS	MA	MEASUREMENT	-DO-	-DO-	-DO-	Log Book	3	-	2	
		1.MAKE & TYPE	MA	VISUAL	100%	MANFR'S DRG./ APPROVED DATASHEET	MANFR'S DRG./ APPROVED DATASHEET	-DO-	3	-	2	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	BHEL DATA SHEET	BHEL DATA SHEET BEARING MANUF'S CATALOGUES	-DO-	3	-	2	
		3.SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	2	
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND.	MA	VISUAL	100%	-	-DO-	-DO-	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	-DO-	MANUF'S SPEC./ BHEL SPEC.	MANUF'S SPEC./ BHEL SPEC.	-DO-	3	-	2	
		4.HV/IR	MA	-DO-	100%	-DO-	-DO-	-DO-	3	-	2	
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	MANUF'S DRG/SPECS	MANUF'S DRG./ SPECS.	-DO-	3	-	-	
		2.SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE									
												BIDDER'S/VENDORS COMPANY SEAL

		QUALITY PLAN		CUSTOMER :		PROJECT			SPECIFICATION :			
				BIDDER/ :		TITLE			NUMBER :			
		SHEET 5 OF 9		VENDOR		QUALITY PLAN			SPECIFICATION :			
		SYSTEM		NUMBER PED-506-00-Q-007, REV-03			TITLE			SECTION		
				ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			VOLUME III					
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
2.0	IN PROCESS											
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNES	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	3/2	2	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	2	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-	
		3.SHAFT SURFACE FLOWS	MA	PT	-DO-	RELEVANT SPEC./ ASTM-E165	MANUF'S SPEC./ BHEL SPEC./	-DO-	2	-	1	
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	MANFR'S SPEC/BHEL SPEC./ RELEVANT STAND	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-DO-	-DO-	-DO-	2	-	-	
		3.SHADE	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-	
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	-DO-	-DO-	-DO-	Log Book	2	-	-	
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE					BIDDER'S/VENDORS COMPANY SEAL				

		QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :		
				BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE		
		SHEET 6 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION		VOLUME III
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	10			11
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	MANUFR'S SPEC.	MANUFR'S SPEC.	Log Book	2	-	-	(FOR MOTORS OF 2MW AND ABOVE) * ON 10% RANDOM SAMPLE
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-DO-	-DO-	Log Book	2	-	-	
		3.CORE LOSS & HOTSPOT	MA	ELECT.TEST	-DO-	-DO-	-DO-	Log Book	2	1*	1	
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	MANUFR'S SPEC./BHEL SPEC.	MANUFR'S SPEC./BHEL SPEC.	Log Book	2	-	-	
		2.CLEANLINESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.IR-HV-IR	CR	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2	-	1	
		4.RESISTANCE	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		6.SURGE WITH STAND AND TAN. DELTA TEST	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-	FOR MV MOTOR
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-DO-	-DO-	Log Book	2	-	-	
		3.NO. OF DIPS	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN		CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :			
				BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
		SHEET 7 OF 9		SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION		VOLUME III	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS	
1	2	3	4	5	6	7	8	9	10	P	W	V	11
2.7	COMPLETE STATOR ASSEMBLY	4.DURATION	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1		VERIFICATION FOR MV MOTOR ONLY
		1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-DO-	-DO-	Log Book	2	-	-		
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-		
		2.SOUNDNESS	CR	MALLET TEST & UT	-DO-	-DO-	-DO-	Log Book	2		1		
		3.HV	MA	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2		1		
2.9	COMPLETE ROTOR ASSEMBLY	1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	-DO-	MFG SPEC./ ISO 1940	MFG. DWG.	Log Book	2		1		
		2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	-DO-	MFG. SPEC.	MFG. SPEC.	Log Book	2		1		
2.10	ASSEMBLY	1.ALIGNMENT	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	-		
		2.WORKMANSHIP	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-		
		3.AXIAL PLAY	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	1		
		4.DIMENSIONS	MA	-DO-	-DO-	MFG.DRG./ MFG SPEC.	MFG. DRG/ RELEVANT IS	Log Book	2	-	-		
		5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2	-	-		
		6. RTD, BTD & SPACE HEATER MOUNTING.	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2		1		
BHEL			PARTICULARS		BIDDER/VENDOR								
			NAME										
			SIGNATURE										
			DATE					BIDDER'S/VENDORS COMPANY SEAL					

		QUALITY PLAN		CUSTOMER :		PROJECT			SPECIFICATION :			
				BIDDER/ :		TITLE			NUMBER :			
		SHEET 8 OF 9		VENDOR		QUALITY PLAN			SPECIFICATION :			
		SYSTEM		NUMBER PED-506-00-Q-007, REV-03			TITLE			SECTION		
				ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			VOLUME III					
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
3.0	TESTS	1. TYPE TESTS INCLUDING SPECIAL TESTS AS PER BHEL SPEC.	MA	ELECT. TEST	1/TYPE/SIZE	IS-325/ BHEL SPEC./ DATA SHEET	IS-325/ BHEL SPEC./ DATA SHEET	TEST REPORT	2	1*	1	* NOTE - 1
		2. ROUTINE TESTS INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1\$	1	\$ NOTE - 2
		3. VIBRATION & NOISE LEVEL	MA	-DO-	100%	IS-12075 & IS-12065	IS-12075 & IS-12065	-DO-	2	1\$	1	\$ NOTE - 2
		4. OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPC. REPORT	2	1	-	
		5. DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	RELEVANT IS	BHEL SPEC. AND DATA SHEET	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1\$	1	\$ NOTE - 2
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1\$	1	\$ NOTE - 2
		8. NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPC. REPORT	2	1\$	1	\$ NOTE - 2
		9. EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	IS-3682 IS-8239 IS-8240	IS-3682 IS-8239 IS-8240	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	BHEL SPEC. & DATA SHEET	BHEL SPEC. & DATA SHEET	TC	2	1\$	1	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY \$ NOTE - 2
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			



		QUALITY PLAN		CUSTOMER :		PROJECT TITLE			SPECIFICATION : NUMBER :			
				BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
		SHEET 9 OF 9		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION		VOLUME III	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
NOTES: 1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED. 2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON. 3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THESE TEST MAY NOT BE REPEATED. 4 WHEREVER CUSTOMER IS INVOLVED IN INSPECTION, AGENCY (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. <u>Legends for Inspection agency</u> 1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER) P. PERFORM W. WITNESS V. VERIFY												
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

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

		QUALITY PLAN		CUSTOMER :		PROJECT			SPECIFICATION :			
				BIDDER/ :		TITLE			NUMBER :			
		SHEET 2 OF 2		VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION : TITLE :			
		SYSTEM		ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION		VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1	-	
NOTES: 1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON 2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. 3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY. <u>Legends for Inspection agency</u> 1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER) P. PERFORM W. WITNESS V. VERIFY												
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

CI.2. MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)

MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)									
TESTS ITEMS	Dimensions (R)	Make, Model, Type, Rating (R)	Process / Electrical connection (R)	Calibration (R)	Test as per standard(R)	Insulation Resistance (R)	IBR Certification (if applicable)(R)	Hydro Test(R)	Material Test certificate ®
1. PR Gauge (IS-3624)	Y	Y	Y	Y	Y				
2. Temp. Gauge (BS-5235)	Y	Y	Y	Y	Y				
3. Pr./D.P.Switch (BS-6134)	Y	Y	Y	Y	Y	Y			
4. Electronic Transmitter (IEC-770)	Y	Y	Y	Y	Y	Y			
5. Temp. Switch	Y	Y	Y	Y	Y	Y			
6. Recorder (IS-9319/ANSI C-39.4)	Y	Y	Y	Y	Y	Y			
7. Vertical indicators	Y	Y	Y	Y		Y			
8. Digital Indicators	Y	Y	Y	Y		Y			
9. Integrators	Y	Y	Y	Y					
10. Electrical Metering Instrument (IS-1248)	Y	Y	Y	Y	Y	Y			
11. Transducer (IEC-688)	Y	Y	Y	Y	Y	Y			
12. Thermocouples (ANSI-MC-96.1)	Y	Y	Y	Y	Y	Y			
13. RTD (IEC-751)	Y	Y	Y	Y	Y	Y			
14. Thermowell	Y		Y				Y	Y	Y
R-Routine Test A- Acceptance Test Y – Test applicable									
Note: 1) Detailed procedure of Burn-in and Elevated Temperature test shall be as per Quality Assurance Programme in General Technical Conditions. 2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted along with relevant supporting documents. 3) Acceptance tests shall be carried out in presence of owner's representative.									

ITEMS	TESTS											
	Dimensions (R)	Make, Model, Type, Rating (R)	Process / Electrical connection	Calibration (R)	Requirement as per standard (R)	WPS approval (A)	Non-destructive testing (R)	Calculation for accuracy (R)	Insulation Resistance (R)	IBR Certification as applicable (R)	Hydro test (R)	Material test certificate (A)
15. Cold junction compensation box	Y	Y	Y	Y					Y			
16. Orifice plate(BS-1042)	Y	Y	Y	Y *	Y	Y *	Y *			Y	Y *	Y
17. Flow nozzle(BS-1042)	Y	Y	Y	Y *	Y	Y	Y			Y	Y	Y
18. Impact head type element	Y	Y	Y					Y				Y
19. Level transmitter/float type switch	Y	Y	Y	Y					Y	Y	Y	Y
20. Flue Gas analyser	Y	Y	Y	Y								
21. Dust emission monitors	Y	Y	Y	Y								
*Calibration to be carried out on one flow element of each type and size if calibration carried out as type test same shall not be repeated.												
** If applicable												
R-Routine Test A- Acceptance Test Y – Test applicable												
Note: 1) Detailed procedure of Burn-in and Elevated Temperature test shall be as per Quality Assurance Programme in General Technical Conditions 2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted along with relevant supporting documents. 3) Acceptance tests shall be carried out in presence of owner's representative.												

CI.8. CONTROL VALVES AND ACTUATORS

CONTROL VALVE ACTUATORS AND ACCESSORIES.																	
TESTS	ITEMS																
		Make, model, tag (R)	Dimension®	Surface finish®	Heat Treatment®	Material Test Certificates®	IBR Certificates®	Hydraulic Test®	UT/Radiography for >900 lb rating®	MPI/DP®	Pressure Resistance®	Seat leakage®	Timeing Open/Close®	Linearity/Hysterisis®	Functional Test, review for make and TC of accessories®		
		CONTROL VALVE AND ACTUATOR															
		Overall	Y	Y	Y			Y	Y				Y	Y	Y	Y	
		Body		Y	Y	Y	Y			Y	Y	Y					
		Bonnet		Y	Y	Y	Y										
		Trim		Y			Y			Y*							
		Pneumatic actuator	Y	Y								Y					
		R- Routine Test		A - Acceptance Test						Y - Test Applicable							
		Y* - UT on spindle dia >= 40 mm.															
Note :																	
1) Detailed procedure of Burn-in and Elevated Temperature test shall be as per Quality Assurance Programme General Technical Conditions																	
2) This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating his practice & Procedure along with relevant supporting documents during QP finalisation for all item.																	
3) Acceptance tests shall be carried out in presence of owner's representative.																	

CI.9. ELECTRICAL ACTUATORS WITH INTEGRAL STARTER

ELECTRICAL ACTUATOR WITH INTEGRAL STARTER													
Test/Attributes Characteristics													
ITEM/ COPONENT/ SUB SYSTEM ASSEMBLY/ TESTING	RPM ®	No Load Current ®	IR & HV Test®	Mounting Dimension®	All routine Test as per Standard & Specification®	Correct Phase Sequence®	Operation & Setting of limit Switch/Torque Switch®	Stall Torque/Current (A)	Hand Wheel operation/ Auto de clutch function (A)	Function of Aux. like Potentiometer, space heater, position indicator ®	EPT output ®	Grease leakage ®	Local/ Remote (Open-Stop-Close) Operation® Safety check (Single phasing, Phase correction, Tripping etc.) (A)
ELECTRICAL ACTUATOR WITH INTEGRAL STARTER(IS_933 4)													
Motor	Y	Y	Y	Y	Y								
Final Testing	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Note: 1) Detailed procedure of Burn-in and Elevated Temperature test shall be as per Quality Assurance Programme in General Technical Conditions 2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the practices and procedure adopted along with relevant supporting documents.													
® - Routine Test (A) - Acceptance Test Y - Test applicable													

CI.6. PROCESS CONNECTION AND PIPING

ITEMS	Visual ®	GA, BOM, Layout of component & construction feature®	Dimension ®	Paint Shade/thickness ®	Flattening,flaring,hydrotet,hardness check as per ASTM standard (A)	Component Ratings ®	Wiring ®	Make, Model, Type, Rating®	IR & HV ®	Review of TC for instrument/devices (R)	Accessability TBs/Devices ®	Illumination,grounding ®	Tubing ®	Leak/Hydro test(A)	Chemical/physical properties of material (A)	Proof pressure test,Dismantling & reassembly test,Hydraulic impulse and vibration test (R)	Tests as per standards & specification
Local Instrument enclosure	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y			
Local instruments racks	Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y			
Junction Box	Y	Y	Y	Y *		Y		Y	Y								
Gauge Board	Y	Y	Y	Y		Y		Y		Y			Y	Y			
Impulse pipes and tubes	Y		Y		Y			Y							Y		
Socket weld fittings ANSI B-16.11	Y		Y					Y							Y		Y
Compression fittings	Y		Y					Y						Y	Y	Y	
Instrument valves & Valve manifolds	Y		Y					Y						Y	Y		
Copper tubings ASTM B75	Y							Y									Y

*-applicable for painted junction boxes.

Note: R-Routine Test A- Acceptance Test Y – Test applicable

Note: This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted along with relevant supporting documents.

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								SHEET 1		OF 7		
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks
			P	W	V							
1.0	MATERIAL											
1.1	Body & Bonnet casting / forgings, plug, valve stem, seat ring/cage.	1. Physical, Chemical properties	MA	Physical, Chemical tests	One/ Heat(HT Batch)	Approved drg. / data sheet / BHEL specn.	Approved drg. / data sheet / BHEL specn.	Test Certificate	3	---	2,1	
		2. Heat Treatment	MA	Review of H.T. Chart	Each H.T.	Approved drg. / data sheet / BHEL specn.	Approved drg. / data sheet / BHEL specn.	Test Certificate	3/2	2	1	IBR Certification (if applicable) to be verified by BHEL
		3. Internal quality of castings	MA	RT for Body & UT for Bonnet(NDT)	100%	ASME B 16.34	ASME B 16.34	Test Report / FILM	3/2	2	1	Only for rating ANSI 900 and above. Applicable for Body and Bonnet only. For Lower rating only if called for in specification.
		4. Surface Quality	MA	1. Visual	100%	MSS-SP-55	MSS-SP-55	Test Certificate	3/2	---	2,1	
				2. MT/PT	100%	ASME B 16.34	ASME B 16.34	Test Certificate	3	2	1	After Machining on machined surface only

LEGEND: * CR - Critical characteristics
 MA - Major characteristics
 MI - Minor characteristics

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^{\$} P - Agency Performing the Test.
 W - Agency Witnessing the Test.
 V - Agency Verifying the Test.

1 - BHEL
 2 - Vendor
 3 - Sub-vendor

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Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks
									P	W	V	
		5. Pressure test for shell	MA	Hyd. Test	100%	ISA-S-75.19/ ASME B 16.34	ISA-S-75.19/ ASME B 16.34	Test Certificate	2	2	1	For Body & Bonnet after machining
1.2	Diaphragm	1. Surface Quality	MA	Visual	100%	Mfr. standard	Mfr. standard	Test Certificate	3/2	---	2,1	
		2. Hardness	MA	Measurement	100%	Mfr. standard	Mfr. standard	Test Certificate	3/2	---	2,1	
		3. Endurance / Life cycle	MA	Cyclic test 10,000 cycles	One / Type	10,000 cycles/ Mfr. standard.	No damage	Test Certificate	3/2		2,1	
1.3	Spring	1. Composition	MA	Chemical- Analysis	One sample/ Heat	Material spec. / Mfr. standard	Material spec. / Mfr. standard	Test Certificate	3	---	2,1	
		2. Mech. Properties	MA	Mech. Test	One sample/ Heat	Material spec. / Mfr. standard	Material spec. / Mfr. standard	Test Certificate	3	---	2,1	
		3. Performance	MA	1. Stiffness ratio	100%	Material spec. / Mfr. standard	Material spec. / Mfr. standard	Test Certificate	3	---	2,1	
				2. Scragging	100%	Material spec. / Mfr. standard	Material spec. / Mfr. standard	Test Certificate	3	---	2,1	
				3. Cyclic test (Endurance)	One / type	10,000 cycles	Material spec. / Mfr. standard	Test Certificate	3	---	2,1	
				4. Dimension (Measurement)	One sample/ Lot	Mfr. standard	Appd Drg	Record	3	---	2,1	

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks
									P	W	V	
1.4	Electrical items [Limit switches, Solenoids, Position Transmitter(if provided externally)]	1. Routine Test	MA	HV, IR, Continuity function	100%	Rele. Standards	Rele. Standards	Test Certificate	3	---	2,1	In case TC is not available, Actual test shall be conducted
		2. Degree of protection	MA	IP/NEMA Tests	One sample / type	Approved Data sheet	Approved Data sheet	Test Certificate	3	---	2,1	
1.5	Pressure Gauges	1. Performance	MA	Review of calibration certificates	100%	Mfr. Standard	Mfr. Standard	Test Certificate	3	---	2,1	
		2. Marking	MA	Visual	100%	Mfr. standard	Mfr. standard	Records	3	---	2,1	
2.0 IN PROCESS INSPECTION												
2.1	After machining, i, Body ii Bonnet iii Plug iv Valve Stem v seat ring/cage	1. Surface flaws	MA	Visual & MT/PT	100% (on accessible surfaces)	ASME B 16.34	ASME B 16.34	Test Records	2	---	1	Butt weld ends shall be included.
		2. Dimensional checks	MA	Measurement	100%	Mfr. Standard	Mfr. Standard	Records	2	---	1	
		3. Hard facing (wherever applicable)	MA	Hardness Measurement	One sample/Lot	Mfr. Standard	Mfr. Standard	Records	2	---	1	
2.2	Lapping	Machining surface contact	MA	Blue Matching	One sample/lot	-----	Proper Physical Contact	---	2	---	---	
3.0 TESTS ON COMPLETED VALVE												
LEGEND: * CR - Critical characteristics RT- Radiographic Test PT – Dye penetrant Test ^{\$} P - Agency Performing the Test. 1 - BHEL MA - Major characteristics UT – Ultrasonic Test MT- Magnetic Test W - Agency Witnessing the Test. 2 - Vendor MI - Minor characteristics V - Agency Verifying the Test. 3 - Sub-vendor												

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									P	W	V	
3.1	Actuator Chamber	Leakage & Strength	MA	Pneumatic test	100%	Mfr. Standard	No Leakage	Test Certificate	2	1	1	Refer Note-4
3.2	Body	Leakage and Pressure test (Body Mount Leakage)	MA	Hydro test	100%	ISA - S-75.19	No Leakage	Test Certificate	2	1	1	Refer Note-4
3.3	Seat leakage test for completed valve	Seat Leakage	MA	Pneumatic Test	100%	FCI-70.2	FCI-70.2	Test Certificate	2	1	1	Refer Note-4
4.0	OPERATION TEST ON COMPLETED VALVE (Final inspection)	1. Valve Travel	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4
		2. Opening/Closing time	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4
		3. Linearity/cam characteristic	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4
		4. Repeatability	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4
		5. Hysteresis	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4
		6. Sensitivity	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4
		7. Accuracy (Overall)	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4
		8. Control Valve characteristics / CV Test	MA	◆ Measurement (Press. vs. discharge and discharge vs. opening 0- 100% in steps of 10%)	One per type	As per specs/ Approved drg. / data sheet	As per specs/ Approved drg. / data sheet	Test Certificate	2	--	1	◆ Size = Body & port size Or Body size & CV for non std port. Refer Note 1.

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks
									P	W	V	
		9. Operation of limit switch & solenoids and other accessories	MA	Function	100%	Approved drg. / data sheet	As per specs/ Approved drg. / data sheet	Test Report	2	1	1	On assembled valve Refer Note-4
		10. Overall dimensions	MI	Visual and dimensional	100%	Approved drg. / data sheet	As per specs/ Approved drg. / data sheet	Records	2	1	1	Refer Note-4
		11. Pre defined valve position in case of air failure	MA	Visual	100%	As per spec & Appd drg	As per spec & Appd drg	Test Certificate	2	1	1	
		12. Cleanliness, painting, stamping (for direction of flow), Tag No.	MA	Visual and dimensional	100%	Approved drg. / data sheet	As per specs/ Approved drg. / data sheet	Test Certificate	2	1	1	
5.0	AUXILIARY ITEMS (Performance test of auxiliary items shall be performed on the completely assembled valve)											
5.1	Positioner	Overall leakage after assembly including Nozzles leakage	MA	Leak Test (in the steady state input signal)	100 %	Mfr. Standard	No leakage	Test Certificate	3/2	---	1	Overall leakage including tubing
5.2	Air filter regulator	1. Normal air consumption	MA	Measurement	Each type	Mfr. Standard	No leakage	Test Certificate	3/2	---	1	
		2. Overall leakage	MA	Visual (soap solution)	100 %	Mfr. Standard	No leakage	Test Certificate	3/2	---	1	
5.3	Air lock relay	Performance Test	MA	Leakage test	100%	Mfr. Standard	No leakage	Test Certificate	3/2	---	1	
5.4	Electronic position transmitter(not applicable if provided integral to smart positioner)	1. Accuracy	MA	Operation	100%	Approved data sheet /	Approved data sheet /	Test Certificate	2	1	1	

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks
									P	W	V	
5.5	Current to Pneumatic converter(not applicable for smart positioner)	1. Physical Verification Make/Model	MA	Visual	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Certificate	2	---	2,1	
		2. Degree of Protection	MA	IP/NEMA test	Each type	Relevant Standard	Relevant Standard	Test Certificate	3	---	2,1	
		3. Linearity	CR	Measurement	100%	Approved drg. / data sheet / BHEL specn.	Approved drg. / data sheet / BHEL specn.	Inspection Report	2	---	1	
		4. Hysterisis	CR	Measurement	100%	Approved drg. / data sheet / BHEL specn.	Approved drg. / data sheet / BHEL specn.	Inspection Report	2	---	1	
5.6	Smart Positioner (As Applicable)	1. Physical Verification Make/Model	MA	Visual	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Certificate	2	---	2,1	
		2. Degree of Protection	MA	IP/NEMA test	Each type	Relevant Standard	Relevant Standard	Test Certificate	3	---	2,1	
		3. Linearity	CR	Measurement	100%	Approved drg. / data sheet / BHEL specn.	Approved drg. / data sheet / BHEL specn.	Inspection Report	2	---	1	
		4. Hysterisis	CR	Measurement	100%	Approved drg. / data sheet / BHEL specn.	Approved drg. / data sheet / BHEL specn.	Inspection Report	2	---	1	
		5. Calibration with Hand Held Communicator	MA	Measurement	Each type	Approved data sheet / Mfr. Standard	Approved data sheet / Mfr. Standard	Test Certificate	2	1	1	
6.0	PAINTING	Soundness of Painting	MA	Visual and Measurement	100%	BHEL specn. / Mfr. Standard	BHEL specn. / Mfr. Standard	Inspection Report	2	---	---	Refer Note-2
7.0	PACKING	Soundness of Packing against transit damage	MA	Visual	100%	Mfr. Standard	Mfr. Standard	Inspection Report	2	---	---	Refer Note-3
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									P	W	V		

NOTES:

1. In case valid CV test certificate for a similar control valve(Same type, Same size, Same CV) is not submitted to BHEL by the vendor, CV test shall be conducted at FCRI/Any govt. approved laboratory/ BHEL approved Laboratory.
2. In the absence of BHEL spec. for painting, vendor to obtain BHEL's approval on their painting specification / procedure.
3. Sea worthy packing shall be provided, if applicable.
4. The quantum of check shall be 100% for manufacturer and 10% for BHEL/BHEL nominated inspection agency.
5. IBR certificates in Form III-C shall be submitted if called for in the specification/datasheet.
6. Copies of all TC's(Test Certificates) for materials duly correlated with Heat Nos., TC's for electrical items and mechanical tests(Leak/Operation) shall be submitted to BHEL for verification and acceptance.

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								SHEET 1 OF 7					
Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks	
									P	W	V		
1.0	Sheet Steel (CRCA & HR)	1. Chemical Composition	MA	Chemical analysis	Sample	Relevant standard	Relevant standard	Test Certificate	3	---	2		
		2. Bend Test	CR	Mech. test	Sample	Relevant standard	Relevant standard	Log Book	2	---	---		
		3. Surface finish	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---		
		4. Waviness	MA	Visual	100%	Factory Standard	No Waviness	Log Book	2	---	---		
		5. Thickness	MA	Measurement	100%	BHEL Spec.	BHEL Spec.	Log Book	2	---	---		
		6. Mill marking	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	1		
2.0	Flats / Angles / Channels	1. Dimensions	MA	Measurement	Sample	Relevant standard	Relevant standard	Log Book	2	---	---		
		2. Surface Defects	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---		
		3. Straightness	MA	Measurement	100%	Factory Std.	Factory Std.	Log Book	2	---	---		
		4. Mill marking	MA	Visual	100%	Relevant standard	Relevant standard	Log Book	2	---	1		
3.0	Cables / Wires	1. Visual / Surface defects	MA	Visual	100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	2	---	---		
		2. IR and HV	MA	Electrical	100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	2	---	---		
LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics													
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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks
									P	W	V	
		3. Conductor a) Resistance b) Size c) Sheet colour	MA MA MA	Electrical Measurement Visual	100% 100% 100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	2	---	---	
		4. Type / Routine Test Certificates	MA	Verification	100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	3	---	2	
4.0	Electrical Components like Annunciator Transformers Lamps Switches PBs Contactors Relays Timers Space Heaters Thermostat Indicating meters etc.	1. Verification at make and Type 2. Verification of Test Certificates 3. Operation / Functional check 4. I.R. 5. H.V. 6. Calibration 7. Pick up / Drop off Voltage	CR CR CR MA MA MA MA	Visual Scrutiny of Type / Routine T.Cs. Electrical Electrical Electrical Electrical	Sample 100% Sample+ 100% 100% 100% 100%	BHEL Spec. and BOM Relevant standard Relevant standard & Catalogue Relevant standard & Catalogue Relevant standard & Catalogue Relevant standard & Catalogue Relevant standard & Catalogue	BHEL Spec. and BOM Relevant standard Relevant standard & Catalogue Relevant standard & Catalogue Relevant standard & Catalogue Relevant standard & Catalogue Relevant standard & Catalogue	Log Book Log Book Log Book Log Book Log Book Log Book Log Book	2 2 2 2 2 2 2	--- --- --- --- --- --- ---	--- --- --- --- --- --- ---	+ for relay & contactors only @ for all components except relays & contactors. 1
LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics ^{\$} P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test. 1 - BHEL 2 - Vendor 3 - Sub-vendor												

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									P	W	V	
5.0	Misc. Components like Gaskets, Terminal Blocks etc.	1. Verification of Type / Make	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
		2. Surface defects	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
		3. IR / HV on Terminal Blocks	MA	Electrical	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
6.0	IN PROCESS Blanking / Bending / Forming	1. Dimensions	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
		2. Surface defects after bending	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	---	
7.0	Nibbling / Punching	1. Cutout Sizes	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
		2. Deburring	MA	Visual	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
8.0	ASSEMBLY Frame Assembly & Sheet fixing	1. Dimensions	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		2. Alignment	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		3. Welding Quality	MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		4. Surface defects	MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
LEGEND: * CR - Critical characteristics MA - Major characteristics MI - Minor characteristics												
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									P	W	V	
9.0	Pre-treatment and Painting	1. Pretreatment Process	MA	Visual	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
		2. Process parameters like bath temp. concentration etc.	MA	Measurement	Periodic	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
		3. Dipping / Removal Time	MA	Measurement	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
		4. Surface quality after every dip	MA	Visual	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
		5. Primer after phosphating	MA	Visual, Thickness	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
		6. Putty Application & Rubbing after primer	MA	Visual	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
		7. Paint first coat	MA	Visual, Thickness	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
		8. Putty Application and Rubbing after first coat of paint	MA	Visual	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
		9. Paint second coat	MA	Visual, Thickness, Scratch test Colour adhesion	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	
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									P	W	V	
10.	Panel Wiring	1. Wiring Layout	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		2. Wiring Termination (Crimped Lugs)	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		3. Ferrule numbers	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	
		4. Colour of wiring	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
		5. Size of Conductor	MA	Measurement	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1	
11.	Component Mounting	1. Correct components	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
		2. Fixing	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	
12.	FINAL Final Inspection	1. Workmanship	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.
		2. Component layout (neatness, accessibility & safety) Mounting / Proper fixing of all components	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		3. Components identification Marking / Name plates	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	

LEGEND: * CR - Critical characteristics
 MA - Major characteristics
 MI - Minor characteristics

^{\$} P - Agency Performing the Test.
 W - Agency Witnessing the Test.
 V - Agency Verifying the Test.

1 - BHEL
 2 - Vendor
 3 - Sub-vendor

 PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL							STD QUALITY PLAN NO.: PE-QP-999-145-I056			
									VOLUME IIB			
									SECTION D			
									REV. NO. 01		DATE: 22-02-2008	
									SHEET 6		OF 7	
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks
									P	W	V	
		5. Dimensions	MA	Measurement	100%	BHEL approved drg. / Spec., BOM	BHEL approved drg. / Spec., BOM	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.
		6. Door functioning	MA	Functional	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		7. Paint Shade	CR	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		8. Paint Thickness	CR	Measurement	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	
		9. Workmanship of Gaskets	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1	
		10. Wiring Layout	MA	Visual	100%	BHEL approved drg.	BHEL approved drg.	Inspection Report	2	1	1	
		11. Wire Termination	MA	Pulling manually	Sample	-----	Firm termination	Inspection Report	2	1	1	
		12. Continuity	MA	Electrical	100%	-----	Continuity OK	Inspection Report	2	1	1	

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 PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL							STD QUALITY PLAN NO.: PE-QP-999-145-I056			
									VOLUME IIB			
									SECTION D			
									REV. NO. 01 DATE: 22-02-2008			
										SHEET 7 OF 7		
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks
									P	W	V	
13.	TYPE TEST	Degree of Protection	CR	Mech. Protection	Sample	BHEL approved spec., drg relevant IEC-60947, IEC-60079	BHEL approved spec., drg relevant IEC-60947, IEC-60079	Type Test Certificate	3	---	1	
14	ROUTINE TEST	IR before & after HV Test	CR	Electrical	100%	BHEL approved spec., drg., BOM & relevant standard	BHEL approved spec., drg., BOM & relevant standard	Test Report	2	1	1	
15	FUNCTIONAL TEST	1. Control Logic Operation	CR	Electrical	100%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1	
		2. Instrument Calibration	CR	Electrical	10%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1	
		3. Temperature rise	CR	Electrical	100%	BHEL approved spec/drg. & relevant standard	BHEL approved spec/drg & relevant standard	Inspection Report	2	1	1	

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 MA - Major characteristics
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INSTRUMENT CHECK LISTS



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

CHECK LIST FOR TRANSMITTER

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

Legend :

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

Note :

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



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

CHECK LIST FOR PRESSURE & DP GAUGE

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

Legend :

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P = Perform, W = Witness, V = Verification

Note :

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



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

CHECK LIST FOR LEVEL GAUGE

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

Legend :

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P = Perform, W = Witness, V = Verification

Note :

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



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

CHECK LIST FOR ANNUNCIATORS

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

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Note :

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

	TITLE : 1 X 660 MW PANKI TPS EXTENSION PROJECT	SPECIFICATION NO. PE-TS-426-155A-A001	
		SECTION : I	
	TECHNICAL SPECIFICATION FOR CONDENSATE POLISHING UNIT	SUB-SECTION: IA	
		REV. NO. 00	DATE :

ANNEXURE II**LIST OF MAKES OF SUB-VENDOR ITEMS**

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

	TITLE : 1 X 660 MW PANKI TPS EXTENSION PROJECT	SPECIFICATION NO. PE-TS-426-155A-A001	
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		REV. NO. 00	DATE :

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

	TITLE : 1 X 660 MW PANKI TPS EXTENSION PROJECT	SPECIFICATION NO. PE-TS-426-155A-A001	
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SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
9.	HORIZONTAL CENTRIFUGAL PUMPS (RUBBER LINED)	KISHORE PUMPS	PUNE	
		SU MOTORS	MUMBAI	
10.	NON METALLIC (PP/FRP) HORIZONTAL CENTRIFUGAL PUMPS	ENGINEERS COMBINE	THANE	
		ANTICORROSIVE	VALSAD	
		LEAK PROOF PUMPS PVT. LTD. (RAJEDIA)	-	
11.	MISC. PUMP VERTICAL TURBINE TYPE	KBL	PUNE	
		M&P	PUNE	
		WPIL	GHAZIABAD	
		KISHORE PUMPS	PUNE	
		FLOWMORE	SAHIBABAD	
12.	DC BATTERY CHARGER FOR PLC	AMARA RAJA POWER SYSTEMS LIMITED	TAMIL NADU	
		CHHABI ELECTRICALS PVT.LTD.	MAHARASHTRA	
		CHLORIDE POWER SYSTEMS & SOLUTIONS LIMITED	KOLKATA	
		DUBAS ENGG PVT LTD	BANGALORE	
		EMERSON NETWORK POWER (INDIA) PVT. LTD.	MAHARASHTRA	
		HBL POWER SYSTEMS LTD	HYDERABAD	
		JEMA ENERGY	SPAIN	FOR STATIC SCR TYPE FULL WAVE FULLY CONTROL TYPE
		MASS-TECH CONTROLS PVT.LTD.	MUMBAI	
13.	UNDER BED NOZZLE	STATCON POWER CONTROLS LTD	NOIDA (U.P)	
		JONSONS SCREEN	AUSTRALIA/ IRELAND	
14.	COATING & WRAPPING MATERIAL TAPE	IWL LTD.	CHENNAI	
		MP TAR PRODUCT	BHILAI	
		PORWAL INDUSTRIES	RAIPUR	
		RUSTECH	KOLKATA	
		STP	JAMSHEDPUR	
15.	HEATER	ESCORTS	FARIDABAD	
		RACOLDS	FARIDABAD	
16.	RESIN	ROHM & HASS	FRANCE / USA	
		LANXESS	GERMANY	
		PUROLITE	ROMANIA/CHINA	
17.	HIGH PRESSURE BUTTERFLY VALVE	DeZURICK (Upto 400 NB)	USA	
		TYCO VALVES (UPTO 450 NB)	USA	
		BRAY	-	
18.	BALL VALVE (HIGH	VELAN	CANADA	

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		SECTION : I	
	TECHNICAL SPECIFICATION FOR CONDENSATE POLISHING UNIT	SUB-SECTION: IA	
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SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
	PRESSURE) SIZE 100 NB	BRAY	USA	
19.	CAST IRON GATE/GLV/NRV/SRV	A.V. VALVES LTD	AGRA	
		ATAM VALVES PVT. LTD.	JALANDHAR	
		FLUIDLINE VALVES COMPANY PVT.LTD.	GHAZIABAD	
		G.M. DALUI AND SONS PVT.LTD.	HOWRAH	
		H.SARKER AND COMPANY	HOWRAH	
		LEADER VALVES LTD.	JALANDHAR	
		VENUS PUMPS AND ENGG. WORKS	KOLKATA	
20.	BALL VALVE (MANUAL /PNEUMATIC/ ELECTRIC) CLASS 150	A.V. VALVES LTD	AGRA	
		AKAY INDUSTRIES PVT.LTD.	DHARWAD	
		BELGAUM AQUA VALVES PVT. LTD.	BELGAUN	
		ASIAN INDUSTRIAL VALVES & INSTRUMENTS.	CHENNAI	
		ATAM VALVES PVT. LTD.	JALANDHAR	
		DEMBLA VALVES LTD.	THANE	
		M/S GM ENGINEERING	RAJKOT	
		HAWA VALVES (INDIA) PVT. LTD.	NAVI MUMBAI	
		INTERVALVE (INDIA) LTD.	PUNE	
		LEADER VALVES LTD.	JALANDHAR	
		MICROFINISH VALVES PVT LTD.	HUBLI	
		NILON VALVES PRIVATE LIMITED	AHMEDABAD	
		SURYA VALVES AND INSTRUMENTS MFG CO.	CHENNAI	
		UNIFLOW	CHENNAI	
		VALTECH INDUSTRIES	MUMBAI	
		VAAS AUTOMATION PVT. LTD.	NEW DELHI	
		WEIR BDK VALVES- A UNIT OF WEIR INDIA PVT. LTD.	NEW DELHI	
21.	ELECTRIC MOTOR	CROMPTON GREAVES	NEW DELHI	
		LAXMI HYDRAULICS PVT. LTD	MAHARASHTRA	
		RAJINDRA ELECT INDUSTRIES	MUMBAI	
		GE-POWER	CHENNAI	
		BHARAT BIJLEE LTD.	NEW DELHI	
		SIEMENS	GURGAON	
		NGEF	NEW DELHI	
		KIRLOSKAR ELECTRIC CO LTD.	BANGALORE	

	TITLE : 1 X 660 MW PANKI TPS EXTENSION PROJECT	SPECIFICATION NO. PE-TS-426-155A-A001	
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		REV. NO. 00	DATE :

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
22.	BUTTER-FLY VALVE	ASEA BROWN BOVERI (ABB)	HARYANA	
		MARATHON	FARIDABAD	
		ADVANCE VALVES PVT. LTD.	NOIDA	
		FLUIDLINE VALVES COMPANY PVT.LTD.	GHAZIABAD	
		INSTRUMENTATION LTD.	PALAKKAD	
		INTERVALVE (INDIA) LTD.	PUNE	
		R AND D MULTIPLES (METAL CAST) PVT LTD	MUMBAI	
		SURYA VALVES AND INSTRUMENTS MFG CO.	CHENNAI	
		PENTAIR VALVES AND CONTROLS INDIA PRIVATE LIMITED	NAVI MUMBAI	
		UPADHAYA VALVES MANUFACTURERS PRIVATE LIMITED,	KOLKATA	
		VENUS PUMPS AND ENGG. WORKS	KOLKATA	
		WEIR BDK VALVES- A UNIT OF WEIR INDIA PVT. LTD.	NEW DELHI	
		WEIR BDK	HUBLI	
		CRANE FLOW PROCESS	SATARA	
23.	DIAPHRAGM VALVE (MANUAL / PNEUMATIC) CLASS 150	PROCON	MUMBAI	
		MAJESTIC VALVES (LABLINE)	-	
		HAWA ENGINEERS	AHMEDABAD	
		ADVANCE VALVES PVT. LTD.	NOIDA	
		FLUIDLINE VALVES COMPANY PVT.LTD.	GHAZIABAD	1. DUAL PLATE CHECK VALVE CI - CLASS 150 & UP TO 600NB, 2. DUAL PLATE CHECK VALVE CCS - CLASS 150 & UP TO 500NB
24.	DUAL PLATE CHECK VALVES	R AND D MULTIPLES (METAL CAST) PVT LTD	MUMBAI	
		VENUS PUMPS AND ENGG. WORKS	KOLKATA	CI, CCS & STAINLESS STEEL SPRING ASSISTED DUAL PLATE CHECK VALVES UPTO 700 NB AND 150 CLASS RATING.
		OTOKLIN GLOBAL BUSINESS LIMITED	MUMBAI	
25.	Y-TYPE STRAINER / STRAINER (WATER SERVICE)	GRAND PRIX	NEW DELHI	

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	TECHNICAL SPECIFICATION FOR CONDENSATE POLISHING UNIT	SUB-SECTION: IA	
		REV. NO. 00	DATE :

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		JAYPEE	NEW DELHI	
		GREAVES COTTON	MUMBAI	
		MULTITEX FILTRATION ENGINEERS LIMITED,	NEW DELHI / NOIDA	
		FILTRATION ENGINEERS (I) PVT. LTD	MUMBAI	
		FLUIDNYE	-	
		SUNGOV ENGINEERING PVT. LTD.	DELHI	
		GRAND PRIX	FARIDABAD	
		JAYPEE INDUSTRIES PVT. LTD.	DELHI	
		BHATIA ENGINEERING CO.	DELHI	
26.	RUBBER FLAP TYPE CHECK VALVES	ASHVIK VALVES	-	
		FLOW WAY VALVES	-	
		BDK	-	
		MAJESTIC VALVES (LABLINE INST)	-	
		ADVANCE VALVES	-	
27.	MEMBRANES	DOW		
		TORAY		
		KOCH		
		HYDRONOTICS		
		NORIT		
28.	CHAIN PULLEY BLOCK	ARMSEL MHE PVT. LTD	BANGALORE	
		CENTURY CRANE ENGINEERS PVT. LTD.	FARIDABAD	
		HERCULES HOISTS LTD.	RAIGAD	
		LIFTING EQUIPMENTS AND ACCESSORIES	DELHI	
		TUOBRO FURGUSON (INDIA) PVT LTD	KOLKATA	UPTO 10 TONNE.
		TRACTEL TIRFOR INDIA PVT. LTD.	FARIDABAD	
		TECHNO INDUSTRIES	AHMEDABAD	
		ARMSEL MHE PVT. LTD	BANGALORE	
		ALPHA SERVICES	BHIWADI	
		CONSOLIDATED HOISTS PVT LTD	PUNE	UPTO 20 TONNES
		CENTURY CRANE ENGINEERS PVT. LTD.	FARIDABAD	
		EDDY CRANES PVT. LTD.	MUMBAI	CAPACITY UPTO 10 TONS. BOIS BHEL APP.SUB-VENDORS.
		GRIP ENGINEERS PVT. LTD.,	FARIDABAD,	

	TITLE : 1 X 660 MW PANKI TPS EXTENSION PROJECT	SPECIFICATION NO. PE-TS-426-155A-A001	
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SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		GLOBAL TECHNOLOGIES	HYDERABAD	
		HERCULES HOISTS LTD.	RAIGAD	
		LIFTING EQUIPMENTS AND ACCESSORIES	DELHI	
		MANGLA HOISTS PVT LTD	NEW DELHI	
		MEEKA MACHINERY PVT. LTD.	AHMEDABAD	
		REVA INDUSTRIES LTD.	FARIDABAD	UPTO 25.0 T CAPACITY.
		ROCKWELL HOISTO CRANES PVT. LTD.	BAHADURGARH	
		SAFEX ENERGY PVT. LTD.	AHMEDABAD	
		TUOBRO FURGUSON (INDIA) PVT LTD	KOLKATA	UPTO 15 TONNES.
		TECHNO INDUSTRIES	AHMEDABAD	
29.	ELECTRIC HOIST	ARMSEL MHE PVT. LTD	BANGALORE	
		ALPHA SERVICES	BHIWADI	
		CONSOLIDATED HOISTS PVT LTD	PUNE	UPTO 20 TONNES
		CENTURY CRANE ENGINEERS PVT. LTD.	FARIDABAD	
		EDDY CRANES PVT. LTD.	MUMBAI	CAPACITY UPTO 10 TONS. BOIS BHEL APP.SUB-VENDORS.
		GRIP ENGINEERS PVT. LTD.,	FARIDABAD,	
		GLOBAL TECHNOLOGIES	HYDERABAD	
		HERCULES HOISTS LTD.	RAIGAD	
		LIFTING EQUIPMENTS AND ACCESSORIES	DELHI	
		MANGLA HOISTS PVT LTD	NEW DELHI	
		MEEKA MACHINERY PVT. LTD.	AHMEDABAD	
		REVA INDUSTRIES LTD.	FARIDABAD	UPTO 25.0 T CAPACITY.
		ROCKWELL HOISTO CRANES PVT. LTD.	BAHADURGARH	
		SAFEX ENERGY PVT. LTD.	AHMEDABAD	
		TUOBRO FURGUSON (INDIA) PVT LTD	KOLKATA	UPTO 15 TONNES.
		TECHNO INDUSTRIES	AHMEDABAD	
30.	CABLE GLAND	ALLIED TRADERS & EXPORTERS	NOIDA (U.P.)	
		ARUP ENGG & FOUNDRY WORKS	CALCUTTA	
		BALIGA LIGHTING EQPT.PVT.LTD.	CHENNAI	
		COMMET BRASS PRODUCTS	MUMBAI	
		DOWELLS	MUMBAI	
		ELECTROMAC INDUSTRIES	MUMBAI	

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SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		INCAB	KOLKATA	
31.	CABLE LUGS	DOWELLS	MUMBAI	
		UNIVERSAL MACHINES LTD.	CALCUTTA	
32.	MS PLATES	SAIL		
		ESSAR STEEL		
		TISCO		
		RINL		
		JINDAL		
		LLOYD		
		ISPAT		
		INDIAN IRON & STEEL CO. LTD		
33.	CS PIPE (ASTM A 106 GR. B)	INDIAN SEAMLESS METAL TUBES	AHMEDABAD	UPTO 150 NB
		MAHARASHTRA SEAMLESS	RAIGAD	UPTO 350 NB
34.	MS PIPES (IS: 1239 & 3589)	SAIL	ROURKELA	
		JINDAL	GHAZIBAD/HISSAR	
		SURYA ROSHNI	BAHADUR GARH	
		TATA TUBE	JAMSHEDPUR	
		PSL	CHENNAI/VIZAG/KUTCH/DAMAN	
		LALIT PROFILE	THANE	
		SAMSHI PIPES INDUSTRIES	VADODARA	
		MUKUT PIPES	RAJPURA	
		INDUS TUBES	G B NAGAR	
		MANN IND	INDORE	
		SURENDRA ENGG	RAJPURA	
		PRATIBHA PIPES & STRUCTURE PVT LTD	THANE	
		JCO GAS PIPE	CHINDWARA	
		NUKAT TANKS AND VESSELS	TARAPUR	
		DADU PIPES	SIKRANDRABAD	
		GOOD LUCK TUBES	SIKANDRABAD	
		ADVANCE STEEL TUBES	SAHIBABAD	
		BIHAR TUBES	SIKANDRABAD	
		HI TECH PIPES	SIKANDRABAD	
		RATNAMANI	KUTCH/AHMEDABAD/CHHATRAL	
		MAHARASHTRA SEAMLESS	RAIGAD	
		WELSPUN	ANJAR/BHARUCH	
35.	SS PIPES / TUBES	APEX TUBES	BEHROR (ALWAR)	
		RATNAMANI	CHATRAL	

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36.	SAFETY SHOWER	REMI	TARAPUR	
		PRAKASH STEELAGE	-	
		UNICARE	-	
		MOHAN INDUSTRIES	-	
		SUPER SAFETY SERVICES	-	
37.	FRP TANKS & FITTINGS	GLOBAL COMPOSITE	-	
		EPP	-	
		DEEPA COMPOSITE	-	
		COROSEAL INDUSTRIES	-	
		CHEMICAL PROCESS & EQUIPMENT PVT LTD	-	
		J.R FIBRE INDUSTRIES PVT LTD	-	
		POLYPLAST	-	
38.	EJECTOR	ESSEM TECHNOLOGIES	-	
		RATNA PRASAD	-	
39.	TANK (FRP)	INDUSTRIAL SERVICE	KOLKATA	
		SUNRISE	BARODA	
		GANDHI & ASSOCIATES	AHMEDABAD	
		MODERN EQUIPMENTS	CHENNAI	
		EAGLE PLAST	PUNE	
		OMEGA PLAST	MUMBAI	
40.	STROKE CONTROLLER	V K PUMPS	NASIK	
		METACHEM	MUMBAI	
		SWELORE	AHMEDABAD	
		MILTON ROY INDIA	CHENNAI	
41.	SAFETY VALVES/RELIEF VALVES	METACHEM	MUMBAI	
		KEYSTONE	BARODA	
		V K PUMPS	NASIK	
		MILTON ROY	CHENNAI	
42.	DUPLEX STRAINER	JAYPEE INDUSTRIES PVT. LTD.	NEW DELHI	
		MULTITEX FILTRATION ENGINEERS LIMITED,	NEW DELHI	
		OTOKLIN GLOBAL BUSINESS LIMITED	MUMBAI	
		SUNGOV ENGINEERING PVT. LTD.	CHENNAI	
43.	STEEL GATE/GLOBE/NR VALVES	A.V. VALVES LTD	AGRA	
		ATAM VALVES PVT. LTD.	JALANDHAR	(1) CARBON STEEL GATE VALVES & NON RETURN VALVES: 15 NB TO 50 NB (#800) & 65



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				NB TO 300 NB (#150) (2) CARBON STEEL GLOBE VALVES: 15 NB TO 50 NB (#800) & 65 NB TO 200 NB (#150)
		FLUIDLINE VALVES COMPANY PVT.LTD.	KAUSHAMBI	
		M/S GM ENGINEERING	RAJKOT	
		INTERVALVE (INDIA) LTD.	PUNE	A) STEEL GATE VALVES: UPTO 50NB, #800 AND 65NB TO 150NB, #150 B) STEEL GLOBE VALVES: UPTO 50NB, #800 AND 65NB TO 100NB, #150 C)SUPPLIER NOT REGISTERED FOR NR VALVES
		LEADER VALVES LTD.	JALANDHAR	
		NITON VALVE INDUSTRIES PVT LTD	MUMBAI	
		NSSL LIMITED.	NAGPUR	
		STEEL STRONG VALVES (I) PVT.LTD.,	NAVI MUMBAI	LIMITED TO RANGES & CLASSES AS AVAILABLE IN VD FILE.
		VENUS PUMPS AND ENGG. WORKS	KOLKATA	CC/CSS-GATE-BBT- UPTO600NB CL UPTO300,GATE- PSBT UPTO250NB CL 1500,GLV-BBT- UPTO300NB CL UPTO600,SCNRV- BBT-UPTO600NB CL UPTO150,SCNRV- BBT-UPTO300NB CL 300,SCNRV- PSBT-UPTO150NB CL UPTO900
		VALTECH INDUSTRIES	MUMBAI	CAST CARBON & ALLOY STEEL - VALVE/RATING/SIZ E- GV/150/900,GV/300/ 400, GV/600/300 ,



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				GV/GLV/NRV/900/250 , GLV/300/300, GLV/150/350/ , SCNRV/150/700, SCNRV/300/350, SCNRV/600/250.
		V.K. VALVES PVT. LTD.,	JALANDHAR	
		WEIR BDK VALVES- A UNIT OF WEIR INDIA PVT. LTD.	NEW DELHI	
44.	SLUICE GATE	H SARKAR	KOLKATA	
		JASH ENGINEERING	-	
		YASHWANT INDUSTRIES	-	
45.	3 WAY VALVE	HI TECH	AHMEDABAD	
		ADVANCE VALVES PVT.LTD	NOIDA	
		BDK	HUBLI	
		FOURESS ENGG.INDIA LTD.	MUMBAI	
		FLUIDLINEVALVES COMPANY PRIVATE LTD.,	MUMBAI	
		INSTRUMENTATION LTD.	PALAKAD	
		KIRLOSKAR BROTHERS LTD.	PUNE	
		VENUS PUMP & ENGG. WORKS	KOLKATA	
		SURYA VALVES AND INSTRUMENTS MANUFACTURING COMPANY	CHENNAI	
		STAFFORD CONTROLS LIMITED	PUNE	
		MICON VALVES (INDIA) PVT.LTD	MUMBAI	
46.	PLUG VALVE(MANUAL)	BDK	HUBLI	
		HAWA ENGINEERS / MARCK & CARE	-	
		MICON VALVES	-	
		MICON VALVES (INDIA) PVT.LTD	MUMBAI	
47.	FITTINGS (CS/SS)	M.S. FITTINGS	KOLKATA	
		METAL LLOYDS	MUMBAI	
		TRUE FORGE	FARIDABAD	
		TUBE PRODUCTS	BARODA	
		NL HAZRA	KOLKATA	
		GUJRAT INFRA PIPES	BARODA	
		EDWARDS	USA	
		PIPEFIT ENGINEERS	BARODA	
		SIDDARTH & GAUTAM	FARIDABAD	

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		EBY	MUMBAI	
48.	FLANGES (SS/CS)	PRADEEP METALS LTD	MUMBAI	
		TUBE PRODUCT INCORPORATION	BARODA	
		MS FITTINGS	KOLKATA	
		HAWA ENGINEERING	-	
		ALIANCE PIPE & PLANGES	KOLKATA	
		JAI AMBE	MUMBAI	
49.	PIPE & FITTING (PP,HDPE,PVC & CPVC)	GEROGE FISHCHER	DELHI	
		ASTROL PLYTECHINC LTD	AHMEDABAD	
		JAIN IRRIGATION	-	
		ORIPLAST	-	
50.	VALVES (GATE/GLOBE/NRV/BALL)- (PP,HDPE,PVC & CPVC)	GEROGE FISHCHER IPING SYSTEMS PVT LTD	DELHI	
		ASTROL PLYTECHINC LTD	AHMEDABAD	
		JAIN IRRIGATION	-	
		ORIPLAST	-	
51.	FILTER MEDIA	GLOBAL ABSORBENT	KOLKATA	
		BHARAT MINERALS		
52.	DC LEAD ACID BATTERIES	EXIDE INDUSTRIES LTD	NEW DELHI	
		HBL POWER SYSTEMS LTD	HYDERABAD	TUBULAR TYPE
		HOPPECKE BATTERIEN GMBH & CO.KG,	GERMANY	
53.	DC NI CD BATTERIES	AMCO SAFT INDIA LTD	BANGALORE	
		HBL POWER SYSTEMS LTD	HYDERABAD	
54.	PAINT	ASIAN PAINTS (I) LTD.		
		BERGER PAINTS INDIA LTD		
		GOODLASS NEROLAC		
		JENSON & NICHOLSON (I) LTD		
		CDC CARBOLINE (I) LTD.		
		SHALIMAR PAINTS LTD.		
		ADDISON PAINTS LTD		
		GRAND POLYCOAT		
		BOMBAY PAINTS		
		HEMPLE PAINTS (SINGAPORE)		
		JOTUN PAINTS		
55.	PNEUMATIC ACTUATOR	PROCON ENGINEERS	-	
		TYCO	-	
		CRANE PROCESS	-	
		BDK	-	
		INTERVALVE	-	

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		BRAY CONTROL	-	
56.	FRP CABLE TRAYS & ACCESSORIES	EPP COMPOSITES PRIVATE LIMITED	Rajkot-Gujarat	
		SUMIP COMPOSITES PVT.LTD.	Ahmedabad-Gujarat	

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.

BIDDER TO PROPOSE SUB VENDOR WITHIN 4 WEEKS OF PLACEMENT OF LOI. THEREAFTER NO REQUEST FOR ADDITIONAL SUB-VENDOR SHALL BE ENTERTAINED.
2. DEALERS ARE NOT ACCEPTABLE FOR ANY ITEM OF THE PACKAGE. BIDDER SHALL PROCURE ALL ITEMS INCLUDING PLATES, STRUCTURAL, FLANGES; COUNTER FLANGES ETC. FROM APPROVED SUB VENDOR ONLY.
3. THE INSPECTION CATEGORY WILL BE INTIMATED AFTER AWARD OF CONTRACT BY BHEL/CUSTOMER. HOWEVER THE SAME WILL BE ADHERED BY THE BIDDER WITHOUT ANY COMMERCIAL AND DELIVERY IMPLICATION TO BHEL/ CUSTOMER.

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LIST OF MAKES OF SUB-VENDOR C&I ITEMS

SI No	Package Name	Supplier Name
1	CONTROL VALVE	SAMSON CONTROLS PVT. LTD.
2	CONTROL VALVE	FORBES MARSHALL ARCA PVT.LTD.
3	CONTROL VALVE	INSTRUMENTATION LTD.
4	CONTROL VALVE	Koso India Private Limited,
5	CONTROL VALVE	KSB MIL CONTROLS LTD.
6	CONTROL VALVE	SUZHOU DELAN ENERGY SCIENCE & TECHNOLOGY CO., LTD.
7	CONTROL VALVE	Valvitalia S.P.A. ,
8	CONTROL VALVE	R.K.CONTROL INSTRUMENTS PVT. LTD.
9	CONTROL VALVE	Mascot Valves Pvt. Ltd.
10	CONTROL VALVE	BOMAFASPECIAL VALVE SOLUTIONS PVT LTD
11	CONTROL VALVE	DRESSER VALVE INDIA PVT. LTD
12	CONTROL VALVE	Severn Glocon India Pvt. Ltd.
13	CONTROL VALVE	EMERSON PROCESS MANAGEMENT CHENNAI LIMITED
14	CONTROL VALVE	WALDEMAR PRUSS ARMATURENFABRIK GMBH
15	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	SWITZER PROCESS INSTRUMENTS PVT. LTD.
16	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	DRESSER INDUSTRIES INC.
17	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	Barksdale GmbH, Germany
18	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	GENERAL INSTRUMENTS CONSORTIUM
19	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	PRECISION MASS PRODUCTS PVT. LTD.
20	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	SOR INC.
21	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	INFOS (INDIA) LIMITED
22	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	INFOS INDUSTRIES LIMITED
23	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	Kaustubha Udyog,
24	ANALYTICAL INSTS.SAMPLE COOLER	EMERSON PROCESS MANAGEMENT (INDIA) PVT.LTD.
25	ANALYTICAL INSTS.SAMPLE COOLER	FORBES MARSHAL PVT. LTD.
26	ANALYTICAL INSTS.SAMPLE COOLER	SIEMENS LIMITED
27	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	BOSE PANDA INSTRUMENTS PVT.LTD.
28	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	A.N. INSTRUMENTS PVT. LTD.
29	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INDUSTRIES
30	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	PRECISION MASS PRODUCTS PVT. LTD.
31	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD
32	PRESSURE GAUGE/ DIFF.PRESSURE	Baumer Technologies India Pvt. Ltd.

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	GAUGE	
33	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	FORBES MARSHALL (HYD) LTD.
34	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	GAUGE BOURDON INDIA PVT. LTD.
35	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	Nesstech Instruments Private Limited
36	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,
37	TEMPERATURE GAUGE	GOA INSTRUMENTS INDUSTRIES PVT.LTD.,
38	TEMPERATURE GAUGE	FORBES MARSHALL (HYD) LTD.
39	TEMPERATURE GAUGE	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD
40	TEMPERATURE GAUGE	GAUGE BOURDON INDIA PVT. LTD.
41	TEMPERATURE GAUGE	H.GURU INDUSTRIES
42	TEMPERATURE GAUGE	GOA THERMOSTATIC INSTRUMENTS PVT.LTD.
43	TEMPERATURE GAUGE	A.N. INSTRUMENTS PVT. LTD.
44	TEMPERATURE GAUGE	Baumer Technologies India Pvt. Ltd.
45	TEMPERATURE GAUGE	PRECISION MASS PRODUCTS PVT. LTD.
46	LEVEL GAUGE	TOSHNIWAL BROTHERS PVT.LTD.
47	LEVEL GAUGE	SIGMA INSTRUMENTS CO.
48	LEVEL GAUGE	BLISS ANAND PVT. LTD.
49	FLOW ELEMENT	MICRO PRECISION PRODUCTS PVT. LTD.
50	FLOW ELEMENT	STAR-MECH CONTROLS (I) PVT.LTD.
51	FLOW ELEMENT	INSTRUMENTATION LTD.
52	FLOW ELEMENT	TM TECNOMATIC SPA
53	TEMP. ELEMENT	PYRO ELECTRIC INSTRUMENTS GOA PVT.LTD.
54	TEMP. ELEMENT	Baumer Technologies India Pvt. Ltd.
55	TEMP. ELEMENT	DETRIVE INSTRUMENTATION & ELECTRONICS LTD.
56	TEMP. ELEMENT	Nesstech Instruments Private Limited
57	TEMP. ELEMENT	Thermal Instrument India Pvt. Ltd.
58	TEMP. ELEMENT	GAUGE BOURDON INDIA PVT. LTD.
59	TEMP. ELEMENT	GOA INSTRUMENTS INDUSTRIES PVT.LTD.,
60	TEMP. ELEMENT	TOSHNIWAL INDUSTRIES PVT. LTD.,
61	TEMP. ELEMENT	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,
62	TEMP. ELEMENT	Tempsens Instrument (I) Pvt Ltd
63	TRANSMITTERS	YOKOGAWA INDIA LIMITED,
64	TRANSMITTERS	ABB INDIA LIMITED
65	TRANSMITTERS	V. AUTOMAT & INSTRUMENTS (P) LTD.
66	TRANSMITTERS	Pune Techtrol Pvt. Ltd.
67	TRANSMITTERS	TOSHNIWAL INDUSTRIES PVT. LTD.,
68	TRANSMITTERS	SBEM PVT. LTD.
69	TRANSMITTERS	Endress + Hauser (India) Pvt. Ltd.,
70	TRANSMITTERS	Moore Industries International Inc.
71	TRANSMITTERS	PANAM ENGINEERS
72	TRANSMITTERS	Honeywell Automation India Limited
73	TRANSMITTERS	EMERSON PROCESS MANAGEMENT (INDIA) PVT.LTD.
74	TRANSMITTERS	SMART INSTRUMENTS LTD, BRAZIL
75	TRANSMITTERS	SIEMENS LIMITED

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76	TRANSMITTERS	NIVO CONTROLS PVT. LTD.
77	TEMPERATURE SWITCH	SOR INC.
78	TEMPERATURE SWITCH	TOSHNIWAL BROTHERS PVT.LTD.
79	TEMPERATURE SWITCH	DRESSER INDUSTRIES INC.
80	TEMPERATURE SWITCH	INDFOS (INDIA) LIMITED
81	TEMPERATURE SWITCH	SWITZER PROCESS INSTRUMENTS PVT. LTD.
82	SIGHT FLOW INDICATORS	V. AUTOMAT & INSTRUMENTS (P) LTD.
83	SIGHT FLOW INDICATORS	BLISS ANAND PVT. LTD.
84	SIGHT FLOW INDICATORS	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,
85	SIGHT FLOW INDICATORS	B.K.EQUIPMENTS PVT.LTD.
86	SIGHT FLOW INDICATORS	SIGMA INSTRUMENTS CO.
87	SIGHT FLOW INDICATORS	INSTRUMENTATION ENGINEERS PVT LTD
88	DIFFERENTIAL PRESSURE SWITCH	SOR INC.
89	JUNCTION BOX	K.S.INSTRUMENTS PVT.LTD.
90	JUNCTION BOX	SUCHITRA INDUSTRIES
91	JUNCTION BOX	Shrenik & Company,
92	JUNCTION BOX	FLEXPRO ELECTRICALS PVT. LTD.
93	JUNCTION BOX	AJMERA INDUSTRIAL & ENGINEERING WORKS
94	INSTRUMENTS TUBE FITTINGS	VIKAS INDUSTRIAL PRODUCTS
95	INSTRUMENTS TUBE FITTINGS	Fluid Controls Pvt. Ltd.
96	INSTRUMENTS TUBE FITTINGS	PRECISION ENGINEERING INDUSTRIES
97	INSTRUMENTS TUBE FITTINGS	AURA INCORPORATED
98	VENTURI METER	MICRO PRECISION PRODUCTS PVT. LTD.
99	VENTURI METER	TM TECNOMATIC SPA
100	VENTURI METER	STAR-MECH CONTROLS (I) PVT.LTD.
101	ROTAMETER	INSTRUMENTATION ENGINEERS PVT LTD
102	ROTAMETER	Flow Star Engineering Pvt. Ltd.,
103	ROTAMETER	TANSA EQUIPMENTS PVT. LTD.
104	ROTAMETER	EUREKA INDUSTRIAL EQUIPMENTS PVT.LTD.
105	ROTAMETER	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,
106	LEVEL SWITCH-CAPACITANCE TYPE	SIGMA INSTRUMENTS CO.
107	LEVEL SWITCH-CAPACITANCE TYPE	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,
108	LEVEL SWITCH-CAPACITANCE TYPE	V. AUTOMAT & INSTRUMENTS (P) LTD.
109	LEVEL SWITCH-CAPACITANCE TYPE	LEVCON INSTRUMENTS PVT. LTD.
110	LEVEL SWITCH-CAPACITANCE TYPE	Flow Star Engineering Pvt. Ltd.,
111	LEVEL SWITCH-CAPACITANCE TYPE	Pune Techtrol Pvt. Ltd.
112	LEVEL SWITCH-CAPACITANCE TYPE	Baumer Technologies India Pvt. Ltd.
113	LEVEL SWITCH-CONDUCTIVITY TYPE	Sapcon Instrument Pvt Ltd.
114	LEVEL SWITCH-CONDUCTIVITY TYPE	LEVCON INSTRUMENTS PVT. LTD.
115	LEVEL SWITCH-CONDUCTIVITY TYPE	BLISS ANAND PVT. LTD.
116	LEVEL SWITCH-CONDUCTIVITY TYPE	V. AUTOMAT & INSTRUMENTS (P) LTD.
117	LEVEL SWITCH-CONDUCTIVITY TYPE	HI-TECH SYSTEMS & SERVICES LTD.
118	LEVEL SWITCH-CONDUCTIVITY TYPE	RAMAN INSTRUMENTS PVT.LTD.
119	LEVEL SWITCH-CONDUCTIVITY TYPE	SIGMA INSTRUMENTS CO.
120	LEVEL SWITCH-CONDUCTIVITY TYPE	SOR INC.
121	LEVEL SWITCH-FLOAT TYPE	Pune Techtrol Pvt. Ltd.
122	LEVEL SWITCH-FLOAT TYPE	D.K. INSTRUMENTS PVT.LTD.
123	LEVEL SWITCH-FLOAT TYPE	V. AUTOMAT & INSTRUMENTS (P) LTD.
124	LEVEL SWITCH-FLOAT TYPE	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,

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125	LEVEL SWITCH-FLOAT TYPE	LEVCON INSTRUMENTS PVT. LTD.
126	LEVEL SWITCH-FLOAT TYPE	GENERAL INSTRUMENTS CONSORTIUM
127	LEVEL SWITCH-FLOAT TYPE	SBEM PVT. LTD.
128	LEVEL SWITCH-FLOAT TYPE	Baumer Technologies India Pvt. Ltd.
129	LEVEL SWITCH-FLOAT TYPE	SIGMA INSTRUMENTS CO.
130	LEVEL SWITCH-FLOAT TYPE	SOR INC.
131	INSTRUMENTS PIPE FITTINGS	VIKAS INDUSTRIAL PRODUCTS
132	INSTRUMENTS PIPE FITTINGS	Fluid Controls Pvt. Ltd.
133	INSTRUMENTS PIPE FITTINGS	AURA INCORPORATED
134	INSTRUMENTS PIPE FITTINGS	PRECISION ENGINEERING INDUSTRIES
135	FLOW ELEMENT - ORIFICE	TANSA EQUIPMENTS PVT. LTD.
136	FLOW ELEMENT - ORIFICE	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,
137	FLOW ELEMENT - ORIFICE	MINCO (INDIA) PRIVATE LIMITED
138	FLOW ELEMENT - ORIFICE	CHEMTROLS INDUSTRIES PVT. LTD.
139	FLOW ELEMENT - ORIFICE	INSTRUMENTATION LTD.
140	FLOW ELEMENT - ORIFICE	HYDROPNEUMATICS PVT. LTD.
141	FLOW ELEMENT - ORIFICE	Flow Star Engineering Pvt. Ltd.,
142	FLOW ELEMENT - ORIFICE	MICRO PRECISION PRODUCTS PVT. LTD.
143	FLOW ELEMENT - ORIFICE	INSTRUMENTATION ENGINEERS PVT LTD
144	FLOW ELEMENT - ORIFICE	STAR-MECH CONTROLS (I) PVT.LTD.
145	FLOW ELEMENT - ORIFICE	MINCO (INDIA) FLOW ELEMENTS PVT. LTD.
146	FLOW ELEMENT - ORIFICE	DYNAFLUID VALVES AND FLOW CONTROLS (P) LTD.
147	FLOW ELEMENT - NOZZLE	MICRO PRECISION PRODUCTS PVT. LTD.
148	FLOW ELEMENT - NOZZLE	MINCO (INDIA) FLOW ELEMENTS PVT. LTD.
149	FLOW ELEMENT - NOZZLE	HYDROPNEUMATICS PVT. LTD.
150	FLOW ELEMENT - NOZZLE	DYNAFLUID VALVES AND FLOW CONTROLS (P) LTD.
151	FLOW ELEMENT - NOZZLE	STAR-MECH CONTROLS (I) PVT.LTD.
152	FLOW ELEMENT - NOZZLE	INSTRUMENTATION LTD.
153	FLOW ELEMENT - NOZZLE	MINCO (INDIA) PRIVATE LIMITED
154	INSTRUMENT FITTINGS	HP VALVES & FITTINGS INDIA PVT. LTD.
155	INSTRUMENT FITTINGS	Arya Crafts & Engineering Pvt. Ltd.
156	INSTRUMENT FITTINGS	Perfect Instrumentation Control (India) Pvt. Ltd.
157	INSTRUMENT FITTINGS	PRECISION ENGINEERING INDUSTRIES
158	INSTRUMENT FITTINGS	AURA INCORPORATED
159	INSTRUMENT FITTINGS	Comfit & Valve Pvt. Ltd.
160	INSTRUMENT FITTINGS	FLUIDFIT ENGINEERS PVT. LTD.
161	INSTRUMENT FITTINGS	VIKAS INDUSTRIAL PRODUCTS
162	INSTRUMENT FITTINGS	PANAM ENGINEERS
163	INSTRUMENT FITTINGS	Fluid Controls Pvt. Ltd.
164	ELECTROMAGNETIC FLOW METER	V.A Valves
165	ELECTROMAGNETIC FLOW METER	Adept Fluidyne Pvt. Ltd.
166	ELECTROMAGNETIC FLOW METER	Electronet Equipments Pvt Ltd.
167	ELECTROMAGNETIC FLOW METER	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,

SI No.	Package Name	Vendor Name	LOCATION
1	LOCAL CONTROL PANELS	C and S ELECTRIC LTD.	New Delhi
		PYROTECH ELECTRONICS PVT. LTD.	Udaipur
		PROCON INSTRUMENTATION PVT. LTD.	Chennai
		INDUSTRIAL CONTROLS & APPLIANCES PVT LTD	Mumbai
2	ANALYSERS (ALL TYPES)	ABB INDUSTRIES AG	SWITZERLAND.
		ROSEMOUNT ANALYTICAL INC	IRVINE
		ENDRESS + HAUSER INDIA PVT. LTD.	MUMBAI
		HACH LANGE S.A.R.L CH-1222,	VESENAZ
		SWAN Analytische Instrumente AG, CH-8340	Hinwii
		METTLER-TOLEDO INDIA PVT. LTD.,	MUMBAI
		THERMO ORION INC	BEVERLY
3	UPS	EMERSON NETWORK POWER,	AMBERNATH
		EMERSON NETWORK POWER	PUNE
		HITACHI-HIREL,	GANDHINAGAR
		KELTRON,	TRIVANDRUM
		CONSUL NEOWATT POWER SOLUTIONS,	PUNE
5	MOTORISED ACTUATOR	ROTARK	UK
		AUMA	Bengaluru
		WEIR BDK VALVES	Hubli
		LIMITORQUE	Faridabad
6	AIR FILTER REGULATOR	PLACKA	Chennai
		SHAVO-NORGREN	Mumbai
		SCHRADER SCHORILL DUNCAN LTD.	Mumbai
		FAIRCHILD	USA
		SMC PNEUMATICS	Noida
7	SOLENOID VALVE	ASCO	USA
		ROTEX	Vadodra
		SCHRADER	Pune
		AVCON	Mumbai
		HERION-NORGREN	Germany
		IMI-NORGREN	Germany
		JAFFERSON	Argentina

Notes :-

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

2) New subvendor, if proposed by vendor during contract stage shall be subject to BHEL/end user approval without any commercial implication.

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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.

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

2. DEALERS ARE NOT ACCEPTABLE FOR ANY ITEM OF THE PACKAGE. BIDDER SHALL PROCURE ALL ITEMS INCLUDING PLATES, STRUCTURAL, FLANGES; COUNTER FLANGES ETC. FROM APPROVED SUB VENDOR ONLY.
3. THE INSPECTION CATEGORY WILL BE INTIMATED AFTER AWARD OF CONTRACT BY BHEL/CUSTOMER. HOWEVER THE SAME WILL BE ADHERED BY THE BIDDER WITHOUT ANY COMMERCIAL AND DELIVERY IMPLICATION TO BHEL/ CUSTOMER.



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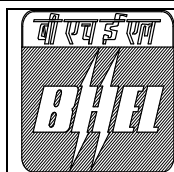
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ANNEXURE III

FUNCTIONAL GUARANTEE AND LIQUIDATED DAMAGES



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

1.00 PERFORMANCE GUARANTEES

General Requirements

- 1.01 The Bidder shall guarantee that the equipment offered shall meet the ratings and performance requirements stipulated for various equipment covered in these specifications.
- 1.02 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.
- 1.03 The Bidder 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 / acceptance test, are listed. The Bidder at site shall conduct the guarantee tests in presence of Purchaser on each unit individually.
- 1.04 All costs associated with the tests including cost associated with the supply, calibration, installation and removal of the test instrumentation shall be included in the contract price.
- 1.05 The performance tests shall be performed using only the normal number of Employer supplied operating staff. Bidder/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.
- 1.06 It shall be responsibility of the Bidder to make the plant ready for the performance guarantee tests. At all times during the performance tests the emission and effluents from the plant shall not exceed the guaranteed emission and effluent limits.
- 1.07 The term "Performance Guarantees" wherever appears in this Section shall have the same meaning and shall be synonymous to "Functional Guarantees".
- 1.08 The term "Performance Tests" wherever appears in this Section shall have the same meaning and shall be synonymous to "Guarantee Test(s)"
- 1.09 The term "TMCR" (Turbine maximum continuous rating) appearing in the Technical Specification shall mean 660 MW electrical power output at generator terminals under 0% cycle make-up and guaranteed optimized condenser pressure unless used in conjunction with a different cycle make up and / or a different condenser pressure.
- 1.10 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 super heater outlet at rated parameters.
- 1.11 Test Instrumentation, Flow Measurement and their Calibration. All instruments required for performance testing shall be of the type and accuracy required by the code prior to the test, the Bidder shall get these instruments calibrated in an independent test Institute approved by the BHEL/customer. All the test instrumentation required for performance tests shall be supplied by the Bidder and shall be retained by him upon satisfactory completion of all such tests at site. All calibration procedures and standards shall be subject to the approval of the BHEL/ customer. The



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protecting tubes, pressure connections and other test connections required for conducting guarantee test shall conform to the relevant codes.

- 1.12 Tools and tackles, thermowell (both screwed and welded) instruments/devices including flow devices, matching flanges, impulse piping & valves etc. and any special equipment, required for the successful completion of the tests, shall be provided by the Bidder free of cost.
- 1.13 The Performance test shall be carried out as per the agreed procedure. The detailed 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 bidder shall submit the test evaluation report of performance test results to customer and BHEL promptly but not later than one month from the date of conductance of performance test. However, preliminary test reports shall be submitted to customer and BHEL after completing each test run.
- 1.14 The P&G test procedures shall be submitted for equipment/ system & subsystem under Bidder'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.
- 1.15 The Bidder shall submit for BHEL/customer approval the detailed Performance Test procedure containing the following:
 - i. Object of the test
 - ii. Various guaranteed parameters & tests as per contract.
 - iii. Method of conductance of test and test code.
 - iv. Duration of test, frequency of readings & number of test runs.
 - v. Method of calculation.
 - vi. Correction calculations & curves.
 - vii. Instrument list consisting of range, accuracy, least count, and location of instruments.
 - viii. Scheme showing measuring points.
 - ix. Sample calculation
 - x. Acceptance criteria.
 - xi. Any other information required for conducting the test. The Performance test shall be carried out as per the agreed procedure.
- 1.16 Test Reports
After the conductance of Performance test, the Bidder shall submit the test evaluation report of Performance test results to BHEL/customer promptly but not later than one month from the date of conductance of Performance test. Preliminary test reports shall be submitted to the BHEL/customer 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 BHEL/customer for approval.
- 1.17 The performance guarantee test will be carried out within three months after the successful completion of Initial Operation of facilities or as per the time frame specified for a particular equipment/ plant/ system in the Technical specifications. Delay in conductance of the test beyond this period will not be normally permitted by the BHEL/customer. In the event of BHEL/customer agreeing to conductance of such tests after three months, for reasons not attributable to the BHEL/customer, as assessed by the BHEL/customer, no factor for ageing shall be considered for computing performance of the equipment. Performance Guarantee Tests on the equipment /systems not covered shall be carried out as per the procedure/test codes specified.

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1.18 In case during performance guarantee test(s) it is found that the equipment/system has failed to meet the guarantees, the bidder shall carry out all necessary modifications and/or replacements to make the equipment/system comply with the guaranteed requirements at no extra cost to BHEL / CUSTOMER and re-conduct the performance guarantee test (s) with BHEL / CUSTOMER's consent. In case the specified performance guarantee (s) are still not met by the Bidder even after modification and/or replacement but are achieved within the acceptable shortfall limit, BHEL / CUSTOMER will accept the equipment/system/plant after levying liquidated damages as mentioned in the specification. However, if, the demonstrated guarantee(s) continue to be beyond the stipulated acceptable short fall limit, even after the modifications/replacements within ninety (90) days or a reasonable period allowed by the BHEL / CUSTOMER, after the tests have been completed, the BHEL / CUSTOMER will have the right to either of the following (at BHEL / CUSTOMER discretion):

a) For Category-I Guarantees

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

OR

Accept the equipment /system/ plant after levying Liquidated Damages. The liquidated damages shall be prorated for the fractional parts of the deficiencies. These 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 bidder 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 bidder 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 BHEL/CUSTOMER. Such damages shall, however be limited to the cost of replacement of the equipments/systems replacement of which shall remove the deficiency so as to achieve the guarantee performance. These parameters / capacities shall be termed as Category-III, guarantees.

2.00 GUARANTEES UNDER CATEGORY I

NIL

3.00 GUARANTEE UNDER CATEGORY –II

NIL

4.00 GUARANTEE UNDER CATEGORY –III

CONDENSATE POLISHING PLANT

Following parameter / capabilities shall be guaranteed by the Bidder for condensate polishing unit which falls under "GUARANTEE UNDER CATEGORY –III" but not be limited to the following:



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a. NORMAL OPERATING CONDITION:

- i. Design Flow of each Service Vessel of Condensate Polishing Plant to be guaranteed.
- ii. Guaranteed service length (Period between two successive regenerations) of each service vessel shall be 10 days (240 hours).
- iii. Bidder shall guarantee the number of hours of operation of each service vessel in hydrogen cycle mode.
- iv. Effluent Quality of Condensate:

With specified Design Flow, influent quality, each CPU service Vessel shall be guaranteed to maintain the effluent quality as specified in technical specification throughout the cycle (i.e. period between two successive regenerations) of 10 days (240 hours). No shortfall in guaranteed effluent quality will be accepted by the BHEL / customer during the service cycle.

- v. Guaranteed chemicals consumption of Acid (33% HCL) & Alkali (48%NaOH) per regeneration.

b. START UP CONDITION

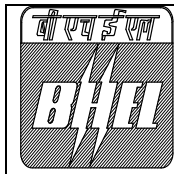
- i. Design Flow of each Service Vessel of Condensate Polishing Plant to be guaranteed.
- ii. With Design Flow, influent quality, each Service vessel shall be guaranteed to maintain the effluent quality as specified in technical specification throughout useful service run of not less than 50 hours (i.e. period between two successive regenerations). No shortfall in guaranteed effluent quality will be accepted by the BHEL / customer during the service cycle.
- iii. Guaranteed chemicals consumption of Acid (33% HCL) & Alkali (48%NaOH) per regeneration.

c. CONDENSER TUBE LEAKAGE CONDITION

- i. Design Flow of each Service Vessel of Condensate Polishing Plant to be guaranteed.
- ii. With Design Flow, influent quality, each Service vessel shall be guaranteed to maintain the effluent quality as specified in technical specification throughout useful service run of not less than 50 hours (i.e. period between two successive regenerations). No shortfall in guaranteed effluent quality will be accepted by the BHEL / customer during the service cycle.
- iii. Guaranteed chemicals consumption of Acid (33% HCL) & Alkali (48%NaOH) per regeneration.

d. Pressure drop across the polisher service vessel (as defined elsewhere) in clean and dirty condition of resin at rated design flow i.e.

- i) At the design flow rate, the pressure drop between inlet and outlet flanges of the polisher Condensate Polisher Mixed Beds with clean resin bed shall not exceed 2.0 bar (g).
- ii) Maximum pressure drop under dirty conditions shall be restricted to about 3.5 bar (g) including the pressure drop across effluent resin traps.



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- e. Vibration & parallel operation of all the pumps and blowers at the rated duty point shall be demonstrated at site.
- f. Noise level of all pumps and blowers at the rated duty point shall be demonstrated at site.
- i) Noise: All the CPU plant pumps and blowers covered under this specification shall perform continuously without exceeding the noise level over the entire range of output and operating frequency specified in the technical specifications.

Noise level measurement shall be carried out using applicable and internationally acceptable standards. The measurement shall be carried out with a calibrated integrating sound level meter meeting the requirement of IEC 651 or BS 5969 or IS 9779.

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

A minimum of 6 points around each equipment shall be covered for measurement. Additional measurement points shall be considered based on the applicable standards and the size of the equipment. The measurement shall be done with slow response on the A – weighting scale. The average of A-weighted sound pressure level measurements expressed in decibels to a reference of 0.0002 micro bar, shall not exceed the guaranteed value.

Corrections for background noise shall be considered in line with the applicable standards. All the necessary data for determining these corrections, in line with the applicable standards, shall be collected during the tests.