

	TITLE: 2X660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-155A-A001	
		SECTION : I	
	TECHNICAL SPECIFICATION FOR CONDENSATE POLISHING UNIT	SUB-SECTION: IA	
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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-412-155A-A001 for condensate polishing unit package of **2X 660 MW ENNORE SEZ STPP**.

The Condensate Polishing Units with a common external regeneration system and associated accessories shall conform to the technical specification (PE-TS-412-155A-A001) for **CONDENSATE POLISHING UNIT** of **2X 660 MW ENNORE SEZ STPP**.

2.0 DESIGN CONDITIONS FOR CONDENSATE POLISHING UNIT

There shall be three service vessels (3X50%) for each 660 MW unit each polishing 50% of the condensate flow corresponding to VWO (valve wide open) condition at 1% make up (Flow through each service vessel indicated in the data sheet) & all HP heaters out of service condition.

3.0 BRIEF DESCRIPTION OF THE SYSTEM

The proposed condensate plant shall treat the entire condensate of the turbine generator of each unit 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 of corresponding units. The resins shall be transferred to and from the common regeneration facility by sluicing through a pipeline hydraulically / hydro pneumatically.

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.

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.

A. SERVICE VESSEL FACILITY

- 1) There shall be three service vessels (3X50%) for each 660 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.



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- 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.
- 6) Rinse water outlet headers from condensate polisher vessels of each installation up to the condenser hot well. Rinse water outlet headers from condensate-polymer 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 from CP System Control Panel of each 660 MW Unit. 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 Mixed Beds / 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.
- 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 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.
- 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 globe type control valve and globe type isolation valves (resilient material seated, to ensure bubble-tight shut off) on the upstream and downstream sides of the control valve.** Either 2X50% capacity valves or 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. 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 twelve (12) 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 condensate outlet header of each TG unit & One no. specific Conductivity Analyzer at outlet of each Condensate polishing Mixed Beds / Condensate Polisher Service vessels.
- 16) One no. cation Conductivity analyser at condensate inlet header, One no. cation Conductivity Analyzer at condensate outlet header of each TG unit & One no. cation Conductivity Analyzer at outlet of each Condensate polishing Mixed Beds / Condensate Polisher Service vessels.
- 17) One no. pH analyser at condensate inlet header for Each TG unit & one no. pH analyser at outlet of each Condensate polishing Mixed Beds / Condensate Polisher Service vessels. Hence total 8 nos. of PH analysers shall be supplied for both TG units service vessel area.
- 18) One no. multichannel sodium analyser to measure process value of each service vessel outlet for



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each TG unit and 1 no. single channel sodium analyser to measure the process value of common inlet for each TG unit. Hence total number of multichannel sodium analysers shall be two & single channel sodium analysers shall be two numbers for both the TG units. However Sodium analysers shall be multi-channel and subject to max 3 channel/stream only.

- 19) One no. multichannel Silica analyser to measure process value of each service vessel outlet for each TG unit and 1 no. single channel silica analyser to measure the process value of common inlet for each TG unit. Hence total number of multichannel silica analyser shall be two & single channel silica analyser shall be two numbers for both the TG units. However silica analysers shall be multi-channel and subject to max 3 channel/stream only.
- 20) One no. chloride analyser at condensate inlet header for Each TG unit & one no. chloride analyser at outlet of each Condensate polishing Mixed Beds / Condensate Polisher Service vessels. Hence total 8 nos. of chloride analyser shall be supplied for both TG units service vessel area.
- 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.
- 24) All butterfly valves MOC used in service vessel area in condensate inline line shall be (body: WCB Disc:CF8M/SS316) and condensate outlet line will be (Body & Disc both: CF8M/SS316).

B. REGENERATION SYSTEM

The regeneration system shall be common to polisher of both the units and shall be external. The CPU regeneration system will be located near DM plant area. Regeneration area shall be considered as low pressure area. Complete regeneration facility as mentioned below shall be in Bidder's scope:

- I. One common facility for regeneration of the resins from the condensate polishers of all the TG units shall be provided by the bidder and consisting of following:
 - 1) One no Resin Separation & Cation Regeneration Vessel.
 - 2) One no Anion resin regeneration vessel.
 - 3) One no Mixed resin storage vessel
 - 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) Interface isolation vessel (if resin separation process calls for). However one additional mixed resin storage vessel along with resin charge, interconnected valves, piping for transfer of resin has to be provided by bidder as mandatory requirement for storage of regenerated resin which will be transferred to the service vessel area during regeneration.
 - 7) The type of vessels indicated above (s.no 1, 2 and 3) shall be as per supplier process requirement.
 - 8) 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 per Single injection.
 - 9) Two (2) nos. (1W+1S) oil free type air blowers with electric motor drives, for supplying all the process air required for cleaning of the 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

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snubber, acoustic hood, relief valve etc.as required and shall be mounted on a single base.

- 10) Two (2) nos. 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).
- 11) All integral pipe works, valves, internals, fittings, hangers, supports and appurtenances etc. for these vessels.
- 12) Two (2) sets of safety equipment comprising PVC protection suits with hoods, rubber boots, face visors and thick PVC gauntlets shall also be provided by bidder. Two numbers personnel water drench shower/safety shower and eye bath in regeneration area shall be provided by the bidder.

II. BULK ACID AND ALKALI UNLOADING AND DOSING FACILITY

The Acid and alkali unloading equipment for regeneration of condensate polishing resins shall preferably be mounted on skid.

- a. One (1) no. hose Station for Transfer of Hydrochloric Acid (30-33% HCl). The hose station shall consist of two (2) sets of hoses each of size 80 mm /NB @ 20 m, provided along with coupling & Diaphragm type isolation valves.
- b. One (1) no. hose Station for Transfer of Alkali (48% NaOH). The hose station shall consist of two (2) sets of hoses each of size 80 mm /NB @ 20 m, provided along with coupling & Diaphragm type isolation valves.
- c. Two (2) nos. Bulk Acid storage tanks complete with integral pipe works, valves, level transmitter, level gauges, fume absorber cum overflow seal pot and all other accessories required. Further each of these bulk acid storage tanks have One spare nozzles of min 65NB size along with one isolation valve for chemical supply up to RO-DM plant by gravity.
- d. Two (2) nos. Bulk Alkali storage tanks complete with integral pipe works, valves, level transmitter, level gauges, CO2 absorber, over flow seal pot and all other accessories required. Further each of these bulk alkali storage tanks have One spare nozzles of min 65NB size along with one isolation valve for chemical supply up to RO-DM plant by gravity.
- e. Two nos. (2X100%) Acid unloading pumps each complete with electrical drive motor and all other accessories as required.
- f. Two nos. (2X100%) Alkali unloading pumps each complete with electrical drive motor and all other accessories as required.

III. ALKALI PREPARATION FACILITY

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 bidder may also supply and install this equipment's independently instead of assembling the skids. Complete facility for preparing alkali solution from alkali lye & flakes shall be included in Bidder's scope. This will consist of the following:

- 1) One number alkali solution preparation tank. The tank shall consist of slow speed agitator driven by motor, carbon dioxide absorber, overflow seal pot, dissolving basket, integral pipe works, valves and all other required accessories. The tank capacity shall be equal to 120% of regeneration requirement of one regeneration.
- 2) 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 heaters shall be sized for

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heating the water from a temperature of 15 to 50 deg. C in 5 hours at the outlet of ejector.

- 3) Two (2) nos. (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 & accessories as required.
- 4) 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 unloading pump /alkali transfer cum recirculation pump (as applicable), and the maximum velocity through the filter for this flow shall not exceed 12 meters/hour. Depth of the filter materials shall not be less than 1 meter.
- 5) One number Carbon trap shall be provided at the outlet line of Activated carbon filter. This carbon trap shall have screen opening of 60 mesh.
- 6) All interconnecting piping, valves and fittings & instrumentation as required to complete the system.

IV. ACID AND ALKALI DOSING SYSTEM

The Acid and alkali dosing equipment for regeneration of condensate polishing resins shall preferably be mounted on skid and shall be in bidder's scope. All the equipment, piping etc. shall be assembled on two structural steel skids one for acid and one alkali dosing equipment. The Acid and Alkali dosing systems shall be skid mounted and shall consist of at least following equipment's:

- 1) Two (02) numbers acid measuring tanks for regeneration complete with fume absorbers, overflow seal pot, integral pipe works, valves, instrumentation and all other accessories required. Each tank capacity shall be equal to 120% of regeneration requirement of one regeneration.
- 2) One (1) no. Alkali measuring (day) tank for regeneration including slow speed agitator driven by motor complete with carbon dioxide absorber, overflow seal pot, integral pipe works, valves, instrumentation and all other accessories required. The tank capacity shall be equal to 120% of regeneration requirement of one regeneration.
- 3) Two (02) numbers (1W+1S) Positive displacement 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.
- 4) Two (02) numbers (1W+1S) Positive displacement 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) 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.
- 6) **2 nos. Non-Nucleonic (Vibration) Type Density Meter/ transmitter shall be provided one (1) in acid dilution line and one (1) in alkali dilution line as per C&I specification as enclosed in sub Sub-section IIC of this technical specification. This transmitter shall be provided in addition to mechanical density indicator in each line.**
- 7) 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.
- 8) 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.

C. NPIT AND NPIT DISPOSAL SYSTEM

- 1) One (1) no. Neutralization Pit of RCC construction (civil work not in bidder's scope) with two (2)



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compartments with acid and alkali resistant lining/tiling along with isolation gates for each compartment shall be provided in the CPU regeneration area. Each section/ compartment shall have capacity to hold 150% of waste water generated from CPU in one regeneration + 120% of waste generated from RO –DM plant in one regeneration (170 m3 considering margin). Dosing of acid and alkali shall also be provided to neutralize effluents of CPU regeneration waste before disposal.

- 2) One (1) no. Acid Measuring Tank for Neutralization- pit complete with fume absorbers, overflow seal pot, integral pipe works, valves, instrumentation & all other accessories as required shall be supplied by bidder.
- 3) One (1) no. Alkali Measuring Tank for neutralization-pit including slow speed agitator driven by motor complete with carbon dioxide absorber, overflow seal pot, integral pipe works, valves, instrumentation and all other accessories as required shall be supplied by bidder.
- 4) Two (2 x 100%) capacity Waste Recirculation / Disposal pumps of horizontal centrifugal type (rubber lined) single stage with priming arrangement (two priming tanks for N-pit waste recirculation / disposal pumps) each complete with electrical drive motor. These pumps shall be of horizontal centrifugal type with priming arrangement and shall be supplied for waste recirculation and disposal to CMB of ETP. The pump shall be designed to pump the total volume of one section/ compartment of the neutralization pit in 2 hours. Proven agitation system like air agitation, venture mixing etc. shall be provided in addition to recirculation from pumps.
- 5) One no pH Analyser at effluent discharge header, shall be in the scope of bidder.
- 6) All interconnecting piping, valves, instrumentation and fittings as required for the N-pit and N-pit disposal system.

Further all interconnecting piping, valves, instrumentation and fittings as required for the complete CPU regeneration system shall be in bidder's scope.

D. PIPING

All the piping as listed below shall be in bidder's scope. The below indicated pipes shall be designed, 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 SA 106 Gr-C (OD 457.2 X 12.7 mm thick)
- 2) Service vessel outlet header shall be SA 106 Gr C (OD 457.2 X 12.7 mm thick)
- 3) Rinse water outlet piping shall be SA 106 Gr-C (OD 168.3 x 7.11 mm). The distance between CPU service vessel to condenser hot well shall be considered as 70 meter for each unit (Total 140 m) and this piping shall be in bidder's scope.
- 4) 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 550m. In addition to that complete resin transfer piping shall be in bidder's scope which shall include the piping inside regeneration area equipments also.
- 5) 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 600 m. In addition to that complete DM Water piping shall be in bidder's scope which shall include the piping inside regeneration area equipments also.
- 6) N-Pit effluent piping from N-Pit to ETP of CMB shall be minimum 150 NB CPVC Sch. 40. The distance between N-Pit and CMB (common monitoring basin) of ETP shall be 750 m and this piping shall be in bidder's scope.
- 7) Piping used for handling alkali (concentrated) and alkali solution shall be CPVC Sch. 40 minimum for complete CPU regeneration area.
- 8) Piping handling acid service shall be CPVC Sch. 40 for complete CPU regeneration area.

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- 9) Piping for air service shall be hot dip galvanized (heavy grade) steel as per IS 1239.
- 10) All piping within each of the above skids/equipment shall be in bidder's scope.
- 11) Similarly DM water piping from each DM water storage tanks inlet nozzle to CPU REGENERATION CUM RESIN TRANSFER PUMPS suction lines along with their isolation valves, piping and flanges shall be in bidder's scope.
- 12) Similarly DM water piping from each CPU REGENERATION CUM RESIN TRANSFER PUMPS discharge recirculation line to both DM water storage tanks recirculation nozzles along with their isolation valves, piping and flanges shall be in bidder's scope.
- 13) 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.
- 14) Service water piping (used for cooling of condensate sample & other activities in regeneration area), piping for gland sealed valve cooling, instrument air piping and service air piping, potable water piping for eye wash & other applications etc. shall be in bidder's scope.
- 15) Similarly, all piping between the external regeneration facility and the skids for chemical dosing and acid/alkali preparation, and acid & alkali storage shall also be designed, supplied, erected and tested by the bidder. These shall include demineralized water piping to the chemical dosing, acid /alkali piping from external bulk storage tanks to respective preparation skids, the alkali preparation 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 skids, etc.
- 16) In addition, any additional piping and associated accessories required to complete the system shall be in bidder's scope.

NOTE: There will be no price implication to BHEL/Customer from bidder's side due to addition / deletion in piping, when the piping quantity increases $\pm 10\%$ from the specified quantity in the technical specification. Layout and routing shall be finalized during detailed engineering. However system shall be designed to take care of any increase or decrease in length of piping.

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

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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, **DDCMIS based** 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. Bulk chemical storage tanks, unloading and transfer pumps shall be located open to sky. Further N-pit shall be located in open area near CPU regeneration area. CPU regeneration cum resin transfer pumps shall be located near DM water Storage tanks and shall have been provided with localised KNOPY arrangement on pump & motor and the same shall be in bidder's scope. Further Bidder to also provide the localized KNOPY arrangement on all pumps & motors which are open to sky.
- 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 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

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- 18) All necessary valves and fittings for the installations with the actuators necessary for their remote operation.
- 19) Embedment plates with lugs shall also be provided by bidder as per system requirement.
- 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.
- 22) Mandatory spares as per attached Annexure-VI of Sub-Section IA to this technical specification.
- 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.
- 24) All Motorized valves with integral starter as per requirement and as indicated in the P&ID.
- 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 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) Wrapping, coating and protection of the entire buried pipe shall be as per IS 10221 or AWWA C 203-93.
- 29) 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.
- 30) 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.
- 31) All other items are also included in scope of supply as specified in other part of the specification.
- 32) Bidder to use analysis given in Sub-Section –IA ANNEXURE –VIII of this technical specification under SALIENT DESIGN INPUTS/ CRITERIA for NORMAL RUN & START-UP OR CONDENSER LEAK CONDITION for design of condensate polishing plant.
- 33) 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 chain pulley block shall be manufactured as per class-II of IS3832 & Electric hoist

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shall be manufactured as per class-II of IS-3938.

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 attached list mentioned elsewhere in the specification.

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

For items weighing 300 kg and above, hoists and trolleys along with monorails shall be provided throughout the plant where crane cannot be utilized. For items weighing less than 1000 kg, manual hoists shall be provided. For items weighing 1000 kg and more, electric hoists (lift & travel) shall be provided. In case the lifting height is more than 10m, electric hoist (lift & travel) shall be provided irrespective of the weight. All hoists shall be provided with trolleys.

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 by the Crane/Hoist.

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: -

- a. Hoisting and CT drive arrangement
- b. All electrical equipment including cables (as per electrical scope matrix) and panels.
- c. PVC insulated shrouded bus bar DSL
- d. Earthing arrangement.
- e. Initial fill of lubricant.
- f. Painting of electric hoist and accessories.
- g. Maintenance Tools & Tackles (as per attached list)
- h. Erection & Commissioning spares
- i. Isolating switch in enclosure at operating floor for disconnecting supply to DSL while maintaining the electric hoist.

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).

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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

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; and
- 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.



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The following shall be provided as minimum requirement:

S-No.	Description	Qty.
1	Complete set of ring spanners (Indicate the sizes offered)	1 Set
2	Complete set of screwdrivers (Indicate the sizes)	1 Set
3.	Adjustable Spanner	1 No.
4.	Insulated plier	1 No.
5.	Grease gun	1 No.
6.	Oil gun	1 No.
7.	Line tester	1 No.

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

5.8 ELECTRICAL REQUIREMENTS

Electrical equipment shall be adequately rated to permit simultaneous operation of any combination of motions of the crane for it duty service.

5.8.1 MOTORS

Motor ratings shall be 25% (at least) over the maximum power requirement. The hoist motors shall be rated to lift 125% of the design load at rated speed.

Motors shall suit the duty class S4, cyclic duration factor 60% and 300 starts per hour and shall be suitable for VVF operation. Motor pull out torque shall not be less than 2.75 times/ rated torque. Motor shall have class F insulation temperature rise limited to class B and enclosures shall conform to the degree of protection IP-55.

All motors shall be capable of the following:

- Operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals.
- Withstand 120% of rated speed for two minutes.
- Current shall not exceed 6 times full load current for creep speed motor.
- Withstanding the stresses imposed if started at 110% rated voltage.
- Start with rated load and accelerate to full speed with 80% rated voltage at motor terminals.
- The locked rotor motor withstand time under hot condition at 110% rated voltage shall be more than motor starting time at minimum permissible voltage by at least 3 seconds for motors upto 20 seconds starting time.
- Maximum torque shall not be below 200% of full load torque.

Each motor more than 30 KW rating shall be provided with space heater. All electrical equipment accessories and wiring shall have tropical protection.

The VVF drive control shall be used for control of each motion. The VVF drive shall be equipped at least with 1024 pulse in card, droop control for synchronization and crane software. The rating of VVF shall be decided considering 250% of full load current of respective drive motor based on in panel rating with derated at 50 Deg C ambient temperature.

The crane(s) shall be furnished complete with all electrical equipment, accessories, like drive motors with VVF drives, conductors, insulators, protective & operating devices, cables, current collectors, all protective devices, anti-collision limit switches, mechanical overload and protection for electrical faults etc.

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5.9 DSL

DSL shall meet the following requirements:

- Shrouded bus bar type.
- Minimum 20% allowance for wear and tear shall be considered during sizing.
- Voltage drop for all conductors and cables/ wires shall be limited to 3% of rated voltage between the main disconnect switch and motor terminals.

5.10 LIMIT SWITCHES

The limit switches shall be totally enclosed type IP-55. Each hoist shall be furnished with two (2) limit switches meeting the following requirements:

- A screw type limit switch with self-resetting features which will act in case of over hoisting.
- A gravity operated hand reset type limit switch as a backup protection against over hoisting. Track type limit switches shall be provided on the bridge and trolley to prevent over travelling in either direction.

Trailing cable shall be 1100 V grade, tinned copper, heat resistant, with EPR insulation and as per Class – 5 of IS-8130. Also should have inner PCP sheath and outer CSP sheath with nylon chord reinforcement & heat resistant, oil resistant and flame retardant heavy duty FRLS type.

5.11 CONTROL & INSTRUMENTATION REQUIREMENTS

Necessary start/stop and emergency controls shall be provided. Automatic reset type limit switches shall be provided to prevent over-travel for-

- Over hoisting and lowering motions of the hook.
- Long travel motion
- Cross travel motion

OPERATING SPEEDS FOR MISCELLANEOUS HOISTS

- Hoist : 3 m/min
- Trolley travel : 6 m/min
- Long travel : 10 m/min
- Creep speed : 10% of full speed (as applicable)
- Crane runway rails : Rails to suit

Notes:

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

6.0 SCOPE OF SUPPLY (ELECTRICAL)

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

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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.

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. 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 IS 10221.
- (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) *During Logic preparation, FAT & commissioning of DDCMIS, bidder shall arrange his concerned personnel at PEM office, BHEL –EDN office & for commissioning of DDCMIS at site, as and when required by customer / BHEL without any delay.*
- (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 operators' personnel on plant operation and maintenance.
- (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.



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(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, SA 106 Gr-C) - Single piping connection near service vessel area in BC bay for unit 1 & unit -2.
- (ii) Service vessel outlet – (OD 457.2 X 12.7 mm thick, SA 106 Gr-C) - Single piping connection near service vessel area in BC bay for unit 1 & unit -2.
- (iii) Rinse water outlet- Rinse water outlet piping (OD 168.3 x 7.11 mm, SA 106 Gr-B) from the service vessel outlet till condenser hot well for each unit is in the 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.
- (vi) If service air required is required by the bidder for hydro pneumatic transfer of resins bidder to provide necessary compressors, valves, piping, fittings, flanges, instruments etc. to meet the system requirement. No service air terminal point shall be provided by BHEL to bidder.
- (vii) Gland sealing valves cooling water supply & analysers rack cooling water supply piping – Service water connection (25 NB) at 5 meter distance from service vessel area for each TG unit. Piping inside service vessel area for each TG unit for mentioned services will be in bidder's scope.

10.2 EXTERNAL REGENERATION AREA

- (i) DM Water Supply –The DM water piping terminal point shall be from outlet nozzles to both DM water storage tanks (DM water storage tanks not in bidder's scope) & for recirculation line terminal point shall be up to the recirculation nozzles to both DM water storage tanks. Piping from these terminal points to the pump suctions (CPU regeneration cum resin transfer pumps) shall be in the scope of bidder.
- (ii) DM Pumps Recirculation Lines – Piping from CPU regeneration cum resin transfer pumps outlet lines to DM water storage tanks recirculation nozzle shall also be in the scope of bidder.
- (iii) Alkali (48% NaOH)- A spare connection of minimum 65 NB size shall be provided with isolation valve, blind flange along with header pipe connection in both alkali storage tanks for withdrawal of alkali for RO-DM plant .
- (iv) Acid (30-33% HCL)- A spare connection of minimum 65 NB size shall be provided with isolation valve, blind flange along with header pipe connection in both Acid storage tanks for drawing acid for RO-DM plant .
- (v) 25 NB Instrument air supply at 5 to 7 kg/cm² (g) – At 5 meter distance from the regeneration building.

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- (vi) 25 NB Service air supply at 5 to 7 kg/cm² (g) - At 5 meter distance from regeneration area. If service air required is more than provided by BHEL, bidder to provide necessary compressors, valves, piping, fittings, flanges, instruments etc. to meet the system requirement.
- (vii) Service water (50 NB) - At 5 meter distance from the CPU regeneration building. However distribution and piping inside CPU regeneration area will be in bidder's scope.
- (viii) Drinking/Potable water (25 NB) - At 5 meter distance from the CPU regeneration building. However distribution and piping inside CPU regeneration area will be in bidder's scope.
- (ix) N-Pit effluent piping (150 NB) from N Pit up to CMB OF ETP shall be in bidder's scope. The piping distance to be considered shall be 750 m.
- (x) RO-DM plant regeneration waste – RO DM plant regeneration waste shall be terminated by the RODM plant bidder near the neutralization pit inlet channel of CPU.
- (xi) In addition to that detailed terminal points shall be as per the P&ID for CPU plant (BHEL Drg. No.: PE-DG-412-155A-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. 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 embedments 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 effluent disposal piping etc.) are in bidder's scope.
- 11.3 Instrument air & service 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 **Supply of ISMB monorail.**
- 11.7 Other exclusions are mentioned in the electrical & C&I parts of this specification.
- 11.8 Service water, Drinking/ potable water & DM water up to terminal points.

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

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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 IIB, 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 data sheet-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 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

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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>

16.0 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:-

16.1 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 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. 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.

16.2 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.

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

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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.

16.3 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.

Notes:

- 1) The Bidder shall indicate the service expectancy period for the spares parts (mandatory) 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 (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 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

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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.

17.0 MISCELLANEOUS 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 (except bulk acid & alkali storage and Neutralisation pit which area kept in open) 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.

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VIII. Bidder to submit BBU during detailed engineering after approval of Basic documents. BBU shall be equal to BOQ for the package and there shall be no price and delivery implication is applicable to BHEL / customer for the same. None of the items supplied for the project as non-billable. Incomplete BBU shall not be review by BHEL. Further during detail engineering breakup of supply prices of condensate polishing unit package in the Billing break up schedule shall be prepared as per below mentioned details:

1.0	THE BREAK UP (%) OF SUPPLY PRICES OF CONDENSATE POLISHING UNIT PACKAGE IN THE BBU SHALL BE IN LINE WITH THE BELOW PROVIDED DETAILS:	
1.1	Lump sum firm price for supply of Atmospheric tanks inclusive of all taxes, duties and other levies as applicable.	8 % of Total Supply Price.
1.2	Lump sum firm price for supply of Pressure Vessels inclusive of all taxes, duties and other levies as applicable.	20% of Total Supply Price.
1.3	Lump sum firm price for supply of Valves inclusive of all taxes, duties and other levies as applicable.	15% of Total Supply Price.
1.4	Lump sum firm price for supply of Instruments & analysers inclusive of all taxes, duties and other levies as applicable.	14% of Total Supply Price.
1.5	Lump sum firm price for supply of Pumps & Blowers with motor inclusive of all taxes, duties and other levies as applicable.	5% of Total Supply Price.
1.6	Lump sum firm price for supply of Piping & Fittings inclusive of all taxes, duties and other levies as applicable.	10% of Total Supply Price.
1.7	Lump sum firm price for supply of Resin media inclusive of all taxes, duties and other levies as applicable.	20% of Total Supply Price.
1.8	Lump sum firm price for supply of agitators, heater, strainers, resin trap, filter nozzle inclusive of all taxes, duties and other levies as applicable.	3% of Total Supply Price.
1.9	Lump sum firm price for supply of Balance items inclusive of all taxes, duties and other levies as applicable.	5% of Total Supply Price.

IX. Any statutory requirement / clearance required for the package from government / local body shall be in bidder's scope.

X. 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.

XI. All the vertical pumps shall be self-lubricating type.

XII. 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.

XIII. 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.



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- XIV. 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.
- XV. 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%
- XVI. 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.
- XVII. 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.
- XVIII. 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.
- XIX. 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.
- XX. 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.
- XXI. 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.
- XXII. 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 & sub - sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under SECTION -III of the specification. 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.

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- XXIII. 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 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.
- XXIV. 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.
- XXV. 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.
- XXVI. 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.
- XXVII. 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.)
- XXVIII. In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.
- XXIX. 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 TAMILNADU GENERATION AND DISTRIBUTION CORPORATION LIMITED (TANGEDCO), HYDERABAD and /or DESEIN (customer's assigned consultant).
- XXX. The equipment covered under this specification shall not dispatch unless the same have been finally inspected, accepted and shipping release issue by BHEL/Customer.
- XXXI. 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.

18.0 MINIMUM IMPORTED ITEMS

- i) Resins.



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TECHNICAL DETAILS OF CONDENSATE POLISHING PLANT

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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) Units of the power station, using deep Mixed Bed Ion exchange Polisher vessels and an external regeneration system. One (1) number of Condensate Polishing Plants (CPP), for each 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 consists 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 each 660 MW unit each polishing 50% of the condensate flow corresponding to VWO (valve wide open) condition at 1% make up (Flow through each service vessel indicated in the data sheet) & all HP heaters out of service condition.
- 2.04.00 The regeneration system shall be external and common to the CPU of all the TG units. 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.
- 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 "START-UP OR CONDENSER 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 the Sea water analysis is exhibited in the Sub-Section IA Annexure VIII of tender specification shall be used with 1.3 COC.
- 2.08.00 Polisher mixed bed / service vessels of each 660 MW Unit shall be located in respective TG hall unit. However the regeneration system shall be common to polisher of both the units and shall be external and in building (except bulk acid & alkali storage facility & N-pit which is in open area). The CPU regeneration system will be located near DM plant area (kindly refer plot plan for the same).
- 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,



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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 suitably selected by the bidder.

3.00.00 SALIENT DESIGN DATA

3.01.00 There shall be three service vessels (3X50%) for each 660 MW unit each polishing 50% of the condensate flow corresponding to VWO (valve wide open) condition at 1% make up & all HP heaters out of service condition (Flow through each service vessel indicated in the data sheet)

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:

(a) NORMAL RUN :

CONTAMINANT	UNIT	INFLUENT	EFFLUENT
Ammonia	ppb	100	---
Total dissolved solids (TDS, ammonia excluded)	ppb	100	< 25
Conductivity (at 25°C)	Micro-mhos/cm	---	< 0.1 (After Cation Column)
Silica – Dissolved (as SiO ₂)	ppb	30	5 (Refer note # 1)
Iron (Dissolved) -as Fe	ppb	50	5
Sodium(as Na)	ppb	10	2
Chloride (as Cl)	ppb	10	2
pH (polisher runs at 25°C with H/OH mode)		8.5	6.8-7.5
Crud (mostly black oxide of iron)	ppb	50	5

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 720 hours (30 days) 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 provide sufficient filtering action to restrict the effluent crud content to less than 5 ppb & same shall be guaranteed.

Under the above operating and design flow through the polisher units, the un-ammoniated resins shall not reach "ammonia break-point" in less than 30 days (720 hrs.) of continuous operation while maintaining the above effluent quality. Whenever specific conductivity starts increasing from 0.1 micro mhos/cm in the effluent, it is deemed that "ammonia break point" is reached. The effluent values indicated above shall be the maximum values.

(b) START-UP OR CONDENSER LEAK CONDITION :

The inlet and outlet quality ionic concentrations for design of CPU exchanger for startup or condenser tube leakage conditions shall be as mentioned below:



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CONTAMINANT	UNIT	INFLUENT	EFFLUENT
Ammonia	ppb	1000	---
Total dissolved solids (TDS, inclusive ammonia)	ppb	2000	---
Conductivity (at 25°C)	Micro-mhos/cm	---	---
Silica – Dissolved (as SiO ₂)	ppb	150	20
Iron (Dissolved) -as Fe	ppb	500	---
Sodium(as Na)	ppb	50	20
Chloride (as Cl)	ppb	300	--
Crud (mostly black oxide of iron)	ppb	500	150

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.

- 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.
- 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 or as flakes. 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 lines steel pipe : 120

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4. 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 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.

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 twelve (12) 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 shall be in the form of spherical beads. Base of the ion-exchange resins shall be a copolymer of styrene and divinyl benzene forming a macro porous or macrorecticular structure. 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.

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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:

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 1.5 parts cation to 1.0 part anion by volume. In case the bidder's process require 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. The CPU Grade resin shall be of uniform particle size quality.

Manufacturer: It is not the intent to pre-select any specific brand name for this application. Resins will be accepted by the BHEL/Customer strictly on their merits. The resins shall be of reputed manufacturer with adequate past record of successful service for not less than 3 years in similar application.

Bidder shall submit all necessary data and information in this regard along with his proposal. Some of these possible resin terms are as follows:

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

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:



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- 1) Each Condensate polisher service unit shall be provided with an automatic bypass system for the condensate polisher on the condensate inlet and outlet headers of the unit with a **Globe type** control valve and **Globe 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) Bidder to provide either 2x50% capacity control valves or 1x100% control valve to achieve proper control under all operating conditions as per Customer/BHEL's approval of Engineering Documents.
- 4) 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.
- 5) The isolation valves shall be provided with geared operators for manual operation. 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.
- 6) 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 position indicator shall be furnished by the bidder as part of this package. 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 freeboards to be are as follows:

- | | | |
|-------|---------------------------------------|--------|
| (i) | Mixed resin Storage vessel | : 50% |
| (ii) | Resin separation vessel | : 100% |
| (iii) | Anion and cation regeneration vessels | : 100% |
| (iv) | Activated carbon filter | : 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).
- 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 of pressure vessels. A minimum thinning allowance of 2 mm shall be considered for the dished ends of pressure vessels.

5.05.08 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

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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 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.

5.05.09 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 12 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	:	Not less than 850 sq.m/gm.
Bulk density	:	Not less than 400 kg/cu.m.
Iodine number	:	850 minimum
Uniformity coefficient	:	1.9 or less
Abrasion number	:	70 minimum
Ash	:	8% maximum

Mean particle diameter shall be about 1.5-1.7 mm with following size distribution:

On 20 mesh	:	Less than 3%
Through 40 mesh	:	Less than 10%
Through 50 mesh	:	Less than 1%

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.

5.05.10 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 (not in bidder's scope). However, provision of suction nozzle & recirculation nozzle for CPU plant DM water requirement, shall be there in BHEL provided each DM water storage tanks (2nos.). Bidder to consider the piping from these suction nozzles to CPU regeneration cum resin transfer pumps and recirculation line piping from the outlet discharge line of these pumps to each DM water storage tanks recirculation nozzle along with pneumatic/electric actuated on –off valves, required flanges, counter flanges, fittings. Further Bidder to consider interlock (trip) of these pumps from the Level transmitter /level switch provided in both the DM water storage tanks necessary arrangement of bringing this Level interlocks from both DM water storage tanks to CPU regeneration cum resin transfer pumps shall be in bidder's scope (i.e. multiplier etc.). These signals shall be also brought by Bidder to **CPU DDCMIS (not in bidder's scope)** for tripping and auto operation of the CPU regeneration cum resin transfer pumps.

5.05.11 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.



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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 lined.

5.05.12 PIPING

1) Bidder shall design, supply and erect the piping between the service units 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.

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 2.3 and 3.0 meters/sec.

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

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 class except the polisher service vessels which shall be ANSI 300 lb class: Flat face flanges shall be used throughout. Nozzle material shall be ASTM-106 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 for piping inside regeneration area & power cycle piping for piping inside service vessel area which is enclosed elsewhere in this specification.

5.05.13 VALVES

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



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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 **Globe** type. **Globe** type Isolation valves (resilient material seated, to ensure bubble-tight shut off) shall be provided on the upstream and downstream sides of the control valve. The end connection type of isolation **Globe** valve on the upstream and downstream sides of the control valve shall be as per DATASHEET –A of condensate polishing unit.

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 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 (**minimum**).

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

5.05.14 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 Div.-I Ed 2010 /IS-2825 or acceptable equivalent international standard.

3) All pressure vessels shall be fabricated from carbon steel plates as per SA-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 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.

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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) Spherical vessels for CPU service vessels are acceptable.

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 of torispherical type.

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 20 cm or 10% of vessel height 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.

5.05.15 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 of torispherical type.

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. 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 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.

5.05.16 VESSEL INTERNALS REQUIREMENTS:

Vessel internal shall meet the following requirements:

1) Inlet water and regenerant distributor: - Hub and internals diffuser splash plate or header and perforated laterals. Material of construction shall be SS-316 except for acid service which will be of Hastelloy-B.

2) Under drains: The under drain system shall be provided 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.

5.05.17 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. Resin trap housing shall be of rubber lined steel construction for regeneration area & Housing MOC shall be SS316 provided at the outlet of each condensate polisher vessel and for internals (cord & screen) shall

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be of JOHNSON SCREENS IRELAND or equivalent (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): Outlet of each Activated Carbon filler on Carbon trap (media trap) shall be provided. MOC of carbon trap Housing shall be SS316 and for internals (cord & screen) MOC shall be SS-316.

6.00.00 OPERATION & CONTROL PHILOSOPHY OF CPU PLANT

The regeneration system shall be external and common to the polisher of both the units. 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.

The control & operation of regeneration area shall be from OWS as well as OWES located in regeneration area. Operation of Service vessel shall be from 1 no. OWS located in each unit of service vessel area.

1 no. GIU (17" LCD/TFT) shall also be provided in regeneration area for the local operation (On/OFF) of CPU regeneration area drives (i.e. pumps, blowers & agitators).

Control of condensate polishing unit shall be DDCMIS (BHEL scope). Bidder to also note that GIU shall be provided by BHEL.

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 by operation of the Control switches on the panel. Control for chemical dosing system and alkali preparation facilities shall be provided in it.
- 6.01.03 'Close-Auto-Open' control facility shall be provided from OWS/control panel for solenoid valves. In 'Auto' position, the valves shall receive close / open command from the Control system.
- 6.01.04 'Stop-Auto-Start' Control facility shall be provided from OWS / control panel for the various drives. In 'Auto' position, the drives shall receive stop/start command from the Control system.
- 6.01.05 On control system failure, it shall be possible to operate the valves by means of manual operation of solenoid valves too.
- 6.01.06 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

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- 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.
- 6.01.07 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.
- 6.01.08 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.
- 6.01.09 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.
- 6.01.10 A mimic shall be provided for the CPP scheme and Regeneration system scheme shall be provided. Status of various vessels, drives, valves etc. shall be indicated by on the mimic.
- 6.01.11 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 interval, the steps should not proceed further, and Alarm shall be provided. Missing criteria, sequence, which is under hold up etc., shall be displayed.
- 6.01.12 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.
- 6.01.13 Wherever standby equipments are provided, it shall be possible to select each of the drive on 'standby' duty.
- 6.01.14 The detailed logic for the sequence and for each of the drive shall be subject to the BHEL/Customer's approval.
- 6.01.15 Start, progress and stop of each of the sequence shall be annunciated.
- 6.01.16 The status of vessels of Condensate Polishing Plants shall be available in all the CPP panels of all TG units 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 Plants of all TG units.

6.02.0 CONDENSATE POLISHER CONTROL SYSTEM

- 6.02.01 Condensate polishing system shall be controlled from DDCMIS (BHEL scope). The control and monitoring of condensate polishing plant is done at two places:

Service vessel: The control & operation of the CPU service vessels shall be done from the 1 no. OWS and remote I/O cum processor panel dedicated for control and operation of CPU's service vessel for Each TG unit. These RIO panel's shall be located in TG hall area near CPU Service vessels for each TG unit and shall be air conditioned. RPU (Remote Processing unit) shall also be provided near service vessel area of each TG unit.

Regeneration system: The control & operation of CPU regeneration system shall be done from 2 nos. (1OWS & 1 OEWS) and redundant processor, Backup Control desk with colored Mimic, Indicators, Ammeters, H.W. Annunciator, P.B. and indication Lamps shall also be provided.

1 no. GIU (BHEL SCOPE) shall also be provided in regeneration area for the local operation (On/OFF) of CPU regeneration area drives (i.e. pumps, blowers & agitators).



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- 6.02.02 Facility to monitor the Condensate Polishing System from the Main control room is not envisaged. However, the status of major parameter shall be sent to the control room for indication purpose only.
- 6.02.03 This CPU DDCMIS shall have interface module for redundant and bi-directional OPC connectivity with main 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.
- 6.02.04 CPU DDCMIS shall be provided with necessary redundant ports & complete hardwares for Auto time synchronization from Master clock time.
- 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 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.
- 6.02.09 Flow transmitters at each CPU service vessel inlet shall be provided for monitoring the performance and accountability.
- 6.02.10 Annunciations for abnormal conditions (as per system requirement) shall be provided in the Control Panel.
- 6.02.11 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.
- 6.02.12 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.
- 6.02.13 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 (with ACDB), 1 x 100% Bypass stabilizer & 1 set of Battery Bank (For 1-hour back-up) in case of UPS rating less than 15 KVA. 2 sets (For 1-hour back-up) in case of UPS rating more than 15 KVA shall be provided.
- 6.02.17 Smart positioners shall be provided for pneumatically controlled valves.
- 6.03.00 CONTROL & OPERATION OF THE CONDENSATE POLISHING UNIT**
- 6.03.01 The regeneration system control system shall be linked with TG control system for data transfer through a two-way link for both information and control.
- 6.03.02 *Each condensate polishing system shall be provided with RIO panel (with processor) that will*



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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:

- Standby (Applicable for where spare service vessel (s) are provided.
- 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.

6.03.03 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.

Each condensate polishing system shall be provided with a RIO panel (with processor) 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:

Each mode or operation is described as below:

6.03.04 STANDBY MODE:

- (1) Among the vessels, any one of the vessels may be selected in this mode.
- (2) Under this mode, the vessel, which was regenerated in previous cycle and filled with regenerated resin, shall be kept ready for next Service cycle.
- (3) The selection of any vessel for Standby mode shall be initiated by operator and there shall be indication about the details such as "Condition of the resin; Whether it is filled with regenerated resin or exhausted resin, whether the standby vessel has undergone rinse cycle or not, date and time of receipt of regenerated resin and completion of rinse cycle etc.

6.03.05 SERVICE MODE:

- (1) 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.
- (2) A differential pressure transmitter installed between the influent and effluent headers will on a high signal cause an annunciator alarm and bypass system shall be initiated as described elsewhere in this section.
- (3) 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.
- (4) 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.
- (5) When the vessel under Service mode is ready for regeneration, the operator shall change the same into "Isolation mode" in the panel. Subsequently the "Standby vessel" shall be

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selected for “Service mode” from the OWS/control panel. The selection shall follow, required sequences such as pressurization of the vessel, checking of the effluent quality and putting the vessel in service on satisfactory effluent quality.

6.03.06 ISOLATION FROM SERVICE:

(1) Normally “Service Vessel” once exhausted shall be isolated from service till the “Resin Transfer” operation is complete. In addition, provision to be kept for isolation of one or all the vessels from service if required by operator from the panel.

(2) 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 **CPU DDCMIS** in the Regeneration Control Panel.

6.03.07 EXHAUSTED RESIN TRANSFER FROM CPU VESSEL TO REGENERATION PLANT:

(1) When a vessel in a service mode needs regeneration as stated above, the resin transfer from the particular vessel to the regeneration plant shall be initiated from the panel of the condensate polishing plant.

(2) 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.

(3) The transfer of resin from the service vessel shall include operations such as 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 hotwell.

(4) The sequence of “Resin Transfer” operation from CPU service vessel to regeneration plant and from regeneration plant to CPU vessel shall be initiated from service vessel area as well as regeneration area panel.

(5) The completion of the operation shall be exhibited in the control panels.

6.03.08 RESIN TRANSFER FROM REGENERATION PLANT TO CPU VESSEL:

(1) When the regeneration is completed in the regeneration plant, the resin shall be transferred to the empty service vessel of Condensate Polishing plant.

(2) This shall be initiated by the operator from the control panel of condensate polishing plant of the unit from which resin was transferred to the regeneration plant in previous service. Provision shall also be kept to transfer the regenerated resin to any of the empty vessel of the CPP of any of the TG unit if required.

(3) The transfer of resin from the regeneration plant shall include operations such as hydraulic/Hydro-pneumatic transfer of the resin and the complete drain down of the water.

(4) The sequence shall be initiated from the panel of CPP and shall be controlled in the regeneration Control Panel.

(5) The completion of resin transfer operation shall be exhibited in both the Control panels.

6.03.09 RINSE RECYCLE MODE:

(1) After transfer of regenerated resin from the regeneration plant to the empty condensate



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polisher vessel, this rinse cycle shall be initiated from the Control system of the respective unit so that the vessel may be rinsed and kept ready for next service cycle.

(2) The rinse recycle shall be manually initiated in full automatic sequence. This sequence shall include the rinse down step using condensate at the desired flow rate until the unit effluent quality is acceptable for boiler feed water. Prior to rinsing, the resin shall be given air scrub by means of air blowers provided near the CPP.

(3) The effluent quality shall be determined by conductivity monitoring of the rinse water outlet, which is returned to the condenser hotwell for recycle.

(4) Panel mounted cation conductivity indicator shall be interlocked to prevent advancing of the automatic sequence until the rinse down is complete.

(5) Cation conductivity values shall be monitored and interlocked to prevent advancing of the automatic sequence until the rinse down is complete.

(6) The completion of rinse operation shall be annunciated in the panel so that the rinsed vessel may be selected for "Standby mode" or "Service mode" as per requirement.

6.04.00 EXTERNAL REGENERATION CONTROL SYSTEM

6.04.01 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.

6.04.02 Manually initiated automatic sequences shall be provided for transferring resin from a vessel to the remote common facility for physical cleaning, separation and chemical regeneration and for returning fresh resin to the service vessel(s). Control for chemical dosing system and alkali preparation facility shall also be provided in it.

6.04.03 Physical cleaning of the resin shall consist of three steps, drain to level, air scrub and rinse. The air scrub and rinse steps are of short duration, approximately 1 and 2 to 3 minutes respective time. However the program will allow the operator to increase or decrease the number of times the sequence is repeated to meet the requirements existing at that time.

6.04.04 The chemical regeneration is a many step sequence. Regeneration shall include hydraulic reclassification of the resins and the transfer of the resins to the respective regeneration vessels shall be hydraulically/ hydro-pneumatically. The Bidder may include a layer of inert, intermediate density resin to achieve a better separation of the cation and anion resins, improve resin regeneration, and reduce leakage. The separated resins are then back washed, cation & anion resin shall be regenerated with hydrochloric acid and sodium hydroxide solutions respectively and then rinsed. Following the rinse step the resins shall be given an air scrub followed by 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. The quality of this discharge will determine if the regeneration has been effective. If the quality is not satisfactory the regeneration sequence must be repeated. If satisfactory, the mixed resin is transferred to the resin storage vessel.

6.04.05 A resin mixing and final rinse may occur in the resin storage vessel provided that the system design will permit direct return of the resins to the resin separation vessel in the event of an unsatisfactory regeneration.

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- 6.04.06 Upon satisfactory completion of regeneration, the status shall be annunciated audio-visually in the regeneration system OWS/control panel and as well as in the Main Plant Control System. This repeat annunciation in the CPP OWS/panel shall facilitate the operator to initiate resin transfer operation from the regeneration plant to the desired vessel of the Unit in which the service vessel is empty.
- 6.04.07 Upon resin transfer operation from regeneration plant as described by the operator from the I Control System, the regeneration plant shall be ready to receive next batch of exhausted resin from any of the CPP. The status of regeneration plant (Whether ready to receive resin for regeneration or under regeneration etc.) shall be available in the Control System of CPP.
- 6.04.08 Demineralized water shall be used throughout the regeneration process for backwashing, diluting the regenerant, rinsing and resin transfer.
- 6.04.09 A conical bottom hopper having a water ejector will be used for resin make-up.
- 6.04.10 The complete detail of the regeneration system shall be supplier specific and 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 shall be provided during detail engineering.
- 6.04.11 It shall be possible to operate the Regeneration Plant in Auto/Semi-Auto/Manual mode.
- 6.04.12 Following operations shall be possible from the Regeneration Control Panel.
- Complete Regeneration.
 - Resin Transfer from CPU vessel to Regeneration Plant.
 - 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.
- 6.04.13 In 'Auto' mode, once the sequence has been initiated, it shall proceed from step to step automatically.
- 6.04.14 In 'Semi-auto' mode each step shall be performed only after initiation by the operator.
- 6.04.15 In 'Manual' mode complete operation shall be by the operator by operation of the Control switches on the panel.
- 6.04.16 '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 **DDCMIS**.
- 6.04.17 '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 **DDCMIS**.
- 6.04.18 On **CPU DDCMIS** failure, it shall be possible to operate the valves by means of manual operation of solenoid valves also.
- 6.04.19 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.
- 6.04.20 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.
- 6.04.21 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 on the front of the panel.

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- 6.04.22 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.
- 6.04.23 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.
- 6.04.24 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.
- 6.04.25 wherever standby equipments are provided, it shall be possible to select each of the drive on 'standby' duty.
- 6.04.26 Start, progress and stop of each of the sequence shall be annunciated in all the control panels.
- 6.04.27 At any time only one of the sequence shall be in progress.

6.05.00 INTERLOCKS

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:

- 6.05.01 Service vessels shall be taken back in service, only after they have been pressurized.
- 6.05.02 Service vessels can be taken up for resin transfer only after they have been completely isolated from the condensate system and depressurized.
- 6.05.03 Resin can be transferred to and from only one service vessel at a time.
- 6.05.04 Resin transfer between the service and the regeneration skids shall be permitted only when the receiving vessel is initially empty.
- 6.05.05 Regeneration sequence can commence, only when the level in the waste neutralization pit is low enough to receive the entire waste quantity of waste water from the regeneration operation.
- 6.05.06 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.
- 6.05.07 It shall be possible for the operator to extend the timing of a 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.
- 6.05.08 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 override for this shall also be provided.
- 6.05.09 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.

- 6.05.10 adequate diluent water flow shall be established before starting of the ejectors/ dosing pumps for acid and alkali.
- 6.05.11 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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S. No.	DESCRIPTION
1.	NOT APPLICABLE
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8.	NOT APPLICABLE
9.	INSTRUMENT INTALLATION DIAGRAM
10.	NOT APPLICABLE
11.	NOT APPLICABLE

LIST
OF
C&I DOCUMENTS/
DELIVERABLES

LIST OF VENDOR DELIVERABLES FOR C&I FOR CPU SYSTEM			
SI.No.	DRAWING NO.	DRAWING/DOCUMENT TITLE	CATEGORY
1	PE-V0-412-155-I901	CONTROL & OPERATIONAL WRITE-UP FOR THE SYSTEM	A
2	PE-V0-412-155-I902	CONTROL SCHEME/LOGIC DIAGRAM(TO BE IMPLEMENTED IN DCS)	A
3	PE-V0-412-155-I903	HMI PICTURES/PLANT SCHEMATICS	I
4	PE-V0-412-155-I904	INSTRUMENT SCHEDULE with set points	A
5	PE-V0-412-155-I905	GROUPING AND TERMINATION	A
6	PE-V0-412-155-I906	I/O LIST (ANALOG & BINARY)	A
7	PE-V0-412-155-I907	DRIVE LIST/SOLENOID/ACTUATOR VALVE LIST WITH LOCATION DATA	A
8	PE-V0-412-155-I908	DATASHEETS FOR INSTRUMENTS, JBs,Analysers etc.along with catalogue	A
9	PE-V0-412-155-I909	INSTRUMENT HOOK-UP DRAWING	A
10	PE-V0-412-155-I910	QUALITY PLANS/CHECK LISTS (For all applicable instruments)	A
11	PE-V0-412-155-I911	CABLE SCHEDULE & INTERCONNECTION	I
12	PE-V0-412-155-I912	ANNUNCIATION & SOE LIST	A
NOTES: 1. ANY OTHER DOCUMENT DECIDED DURING DETAILED ENGINEERING SHALL BE PROVIDED BY BIDDER WITHOUT ANY COMMERCIAL/TECHNICAL IMPLICATION. 2. CONTRACTOR TO SUBMIT REUSABLE DATABASE FORMATS IN BHEL/CUSTOMER APPROVED FORMATS LIKE MS EXCEL,MS ACCESS OF DOCUMENTS LIKE INSTRUMENT SCHEDULE, I/O LIST, DRIVE LIST,FIELD JB TERMINATIONS, CABLE SCHEDULE & INTERCONNECTION, etc. SOFT COPY OF FORMATS SHALL BE PROVIDED TO SUCCESSFUL BIDDERS.			

ACTUATORS

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR		SPECIFICATION NO.: PE-DG-412-145-I902	
			VOLUME II B	
			SECTION D	
			REV. NO. 02	DATE: 28.03.17
			SHEET 2	4
Data Sheet A & B				
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
GENERAL*	* PROJECT	2x 660 MW ENNORE SUPERCRITICAL TPP		
	OFFER REFERENCE			
	* TAG NO. SERVICE			
	* DUTY	☐ ON / OFF ☐ INCHING		
	* LINE SIZE (inlet/outlet): MATERIAL			
	* VALVE TYPE	☐ GLOBE ☐ GATE ☐ REG. GLOBE ☐ BUTTERFLY		
	* OPENING / CLOSING TIME			
	* WORKING PRESSURE			
	AMBIENT CONDITION	SHALL BE SUITABLE FOR CONTINUOUS OPERATION UNDER AN AMBIENT TEMP. OF 0-55 DEG C AND RELATIVE HUMIDITY OF 0-95%		
	VALVE SEAT TEST PRESS	BIDDER TO SPECIFY		
	REQUIRED VALVE TORQUE	BIDDER TO SPECIFY		
	ACTUATOR RATED TORQUE	BIDDER TO SPECIFY		
CONSTRUCTION AND SIZING	CONSTRUCTION	TOTALLY ENCLOSED, WEATHER PROOF, IP:68		
	MECHANICAL POSITION INDICATOR	TO BE PROVIDED FOR 0-100% TRAVEL		
	BEARINGS	DOUBLE SHIELDED, GREASE LUBRICATED ANTI-FRICTION.		
	GEAR TRAIN FOR LIMIT SWITCH/TORQUE SWITCH OPERATION	METAL (NOT FIBRE GEARS). SELF-LOCKING TO PREVENT DRIFT UNDER TORQUE SWITCH SPRING PRESSURE WHEN MOTOR IS DE-ENERGIZED.		
	SIZING	OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 85% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER. FOR INCHING SERVICE - 150 STARTS/HR MINIMUM & FOR REGULATING SERVICE - 600 STARTS/HR MINIMUM.		
HANDWHEEL	* REQUIRED	☒ YES ☐ NO		
	* ORIENTATION	☐ TOP MOUNTED ☐ SIDE MOUNTED		
	*TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION.			
ELECTRIC ACTUATOR	ACTUATOR MAKE/MODEL	BIDDER TO SPECIFY		
	MOTOR MAKE / MODEL / TYPE / RATING (KW)	BIDDER TO SPECIFY		
	@ MOTOR TYPE	SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SIX TIMES THE RATED CURRENT- INCLUSIVE OF I.S. TOLERANCE		
	ACTUATOR APPLICABLE WIRING DIAGRAM	☐ ENCLOSED (BIDDER TO CONFIRM) A: ☐ DRG. NO. 3-V-MISC-24227 R00 B: ☐ DRG. NO. 3-V-MISC-24550 R00 C: ☐ DRG. NO. 3-V-MISC-24283 R00 D: ☐ DRG. NO. 4-V-MISC-90271 R11 E: ☐ For Thyristor based Integral starter, Bidder/Vendor to furnish wiring diagram		
	COLOUR SHADE	☐ BLUE (RAL 5012) ☐		
	PAINT TYPE (## Refer Notes)	☐ ENAMEL ☒ EPOXY ☐		
	SHAFT RPM	BIDDER TO SPECIFY		
	OLR SET VALUE	BIDDER TO SPECIFY		
	@ STARTING / FULL LOAD CURRENT	BIDDER TO SPECIFY		
	NO. OF REV FOR FULL TRAVEL	BIDDER TO SPECIFY		
	@ PWR SUPP TO MTR / STARTER	415V, 3PH, AC		
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER ☐ 230 V ☐ 110 V		

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Data Sheet A & B				
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
	@ ENCLOSURE CLASS OF MOTOR	☒ IP 68 ☐ FLAME PROOF		
	@ INSULATION CLASS	CLASS-F TEMP. RISE LIMITED TO CLASS-B		
	@ WINDING TEMP PROTECTION	☒ THERMOSTAT (3 Nos., 1 IN EACH PHASE) ☐ -----		
	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED		
INTEGRAL STARTER	INTEGRAL STARTER	☒ REQUIRED ☐ NOT REQUIRED		
	TYPE OF SWITCHING DEVICE	☒ CONTACTORS ☐ THYRISTORS		
	TYPE	☒ CONVENTIONAL ☐ SMART (NON-INTRUSIVE)		
	STEP DOWN CONT. TRANSFORMER	☒ REQUIRED		
	OPEN / CLOSE PB	☒ REQUIRED ☐ NOT REQUIRED		
	STOP PB	☒ REQUIRED ☐ NOT REQUIRED		
	INDICATING LAMPS	☒ REQUIRED ☐ NOT REQUIRED		
	LOCAL REMOTE S/S	☒ REQUIRED ☐ NOT REQUIRED		
	STATUS CONTACTS FOR MONITORING	☒ REQUIRED ☐ NOT REQUIRED		
	INTEGRAL STARTER DISTURBED SIGNAL	REQUIRED (MOTOR THERMOSTAT TRIP, O/L RELAY OPERATED, CONT./POWER SUPPLY FAILED, PHASE LOSS, S/S IN LOCAL or OFF MODE, STOP PB OPTD, TORQUE OPEN/CLOSE CUTOFF)		
INTERPOSING RELAY/OPTO COUPLER (Applicable for integral Starter)	TYPE OF ISOLATING DEVICE	☐ INTERPOSING RELAY ☐ OPTO COUPLER ☐ EITHER		
	QUANTITY	☒ 2 NOs. ☐ 3 Nos. *		
	DRIVING VOLTAGE	☒ 20.5 – 24V DC ☐ _____ V DC		
	DRIVING CURRENT	☒ 125mA MAX ☐ _____ mA MAX		
	LOAD RESISTANCE	☒ > 192 ohms - <25 k ohms ☐ > _____ ohms - < _____ ohms		
TORQUE SWITCH (Not Applicable for Smart Actuator) (\$\$ Refer Notes)	MFR & MODEL NO.	BIDDER TO SPECIFY		
	OPEN / CLOSE	☒ 1 No. ☐ 2Nos. / ☒ 1 No. ☐ 2Nos		
	CONTACT TYPE	2 NO + 2 NC		
	RATING	5A 240V AC AND 0.5A 220V DC		
	CALIBRATED KNOBS(OPEN&CLOSE TS)	REQUIRED FOR SETTING DESIRED TORQUE		
	ACCURACY	+3% OF SET VALUE		
LIMIT SWITCH (Not Applicable for Smart Actuator) (\$\$ Refer Notes)	MFR & MODEL NO.	BIDDER TO SPECIFY		
	OPEN : INT : CLOSE	☐ 1 No ☒ 2 Nos.	2 Nos. (ADJ.)	☐ 1 No. ☒ 2Nos.
	CONTACT TYPE	2 NO + 2 NC		
	RATING (AC / DC)	5A 240V AC AND 0.5A 220V DC		

*For inching type drives IPR 3 Nos. to be considered for inching operation.





SPECIFICATION FOR MOTORISED VALVE ACTUATOR

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SHEET

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=

4

Data Sheet A & B

DATA SHEET-A
(TO BE FILLED BY PURCHASER)

DATA SHEET-B
(TO BE FILLED-UP BY BIDDER)

POSITION TRANSMITTER	POSITION TRANSMITTER (For inching duty & other specific applications)	☒ REQUIRED ☐ NOT REQUIRED	
	MFR & MODEL NO.	BIDDER TO SPECIFY	
	TYPE	☐ ELECTRONIC (2 WIRE) R/I CONVERTER ☒ ELECTRONIC (2 WIRE) CONTACTLESS	
	SUPPLY	☒ 24V DC ☐	
	OUTPUT	☒ 4-20mA	
	ACCURACY	± 1% FS	
SPACE HEATER	@SPACE HEATER	REQUIRED	
	@ POWER SUPPLY (NON INTEGRAL)	230V AC, 1 PH., 50 Hz	
	@ POWER SUPPLY (INTEGRAL) BI	BIDDER TO SPECIFY	
	@ RATING		
TERMINAL BOX	ACTUATOR/MOTOR TERMINAL BOX	REQUIRED	
	ENCL CLASS ACTUATOR/MOTOR T.B.	@ ☒ IP 68 @ ☐	
	@ EARTHING TERMINAL	REQUIRED	
	PLUG & SOCKET (9 PIN) (FOR COMM, LS/TS FEED BACK, PoT)	☐ REQUIRED ☒ NOT REQUIRED ☐ ☐ 2 NOS. ☐	
CABLE GLANDS	@ POWER CABLE GLAND	SIZE: suitable for 3Cx2.5sq mm Cu	
	@ SPACE HEATER CABLE GLAND	SIZE:-	
	OTHER CONTROL CABLE GLANDS	QUANTITY & SIZE: Cable gland suitable for 8Px0.5 sq mm & 2P x 0.5 sq mm cable.	
WEIGHT	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY	_____ Kg.

NOTES:

- SCOPE:** DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY.
- CODES & STANDARDS:** DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATIONAL STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH:
IS-9334, IS-2147, IS-2148, IS-325, IS-2959, IS-4691 AND IS-4722
- ACTUATOR SHALL HAVE HARDWIRED CONTACTS FOR FOLLOWING SIGNALS (a) ACTUATOR IN LOCAL MODE (b) ACTUATOR IN REMOTE MODE
- BIDDER TO ENSURE AVAILABILITY OF SPARE 1NO + 1NC LIMIT SWITCH & TORQUE SWITCH.
- SS TAG NAME PLATE SHALL BE PROVIDED.
- TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C.
- CABLE GLANDS OF DOUBLE COMPRESSION TYPE, Ni PLATED BRASS MATERIAL SHALL BE PROVIDED.
- THE TORQUE SWITCHES SHALL BE PROVIDED WITH MECHANICAL LATCHING DEVICE TO PREVENT OPERATION WHEN UNSEATING FROM THE END POSITIONS. THE LATCHING DEVICE SHALL UNLATCH AS SOON AS THE VALVE LEAVES THE END POSITION. IF SUCH PROVISION IS NOT POSSIBLE, THE TORQUE SWITCHES SHALL BE BYPASSED BY END-POSITION LIMIT SWITCHES WHICH OPENS ON VALVE LEAVING END POSITION. THESE LIMIT SWITCHES ARE ADDITIONAL TO THE NUMBER OF LIMIT SWITCHES SPECIFIED ELSEWHERE.
- THE MOTOR SHALL OPERATE SATISFACTORILY UNDER THE +/- 10% SUPPLY VOLTAGE VARIATION AT RATED FREQUENCY, -5% TO +3% VARIATION IN FREQUENCY AT RATED SUPPLY VOLTAGE, SIMULTANEOUS VARIATION IN VOLTAGE & FREQUENCY THE SUM OF ABSOLUTE PERCENTAGE NOT EXCEEDING 10%.
- THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING.
- LOCAL DIGITAL POSITION INDICATOR SHALL BE PROVIDED FOR INCHING DUTY DRIVES.
- COMMANDS SHALL BE LATCHED AT INTEGRAL STARTER END.
- SWITCHES SHALL BE TERMINATED IN JB MOUNTED ON ACTUATOR.
- ACTUATORS FOR HAZARDOUS AREA SHALL BE CERTIFIED FLAME PROOF FOR ZONES 1 & 2.

\$\$ TORQUE SWITCH & LIMIT SWITCH SHALL ACT INDEPENDENT OF EACH OTHER. TANDEM OPERATION IS NOT ACCEPTABLE.

EPOXY PAINT IS RECOMMENDED FOR COASTAL AREAS.

NOTES* = TO BE FILLED BY MPL (LEAD AGENCY). @ = TO BE FILLED BY ES

FIELD & MEASURING INSTRUMENTS

CHAPTER-3**FIELD AND MEASURING INSTRUMENTS****3.00.00 FIELD & MEASURING INSTRUMENTS (PRIMARY & SECONDARY INSTRUMENTS)****3.01.00 GENERAL REQUIREMENTS**

3.01.01 Instruments, control devices and other equipment accessories covered under this specification shall be furnished in accordance with I&C specification sheets and drawings enclosed herewith and the requirements of all applicable clauses of this specification.

3.01.03 The instrumentation/control equipment and accessories shall be from the latest proven design for which the performance and high availability have been demonstrated by a considerable record of successful operation in power station service for similar applications. The bidder shall furnish sufficient evidence to fully satisfy the Owner in this regard.

3.01.04 For plug in type instruments, The plug & sockets shall be polarized to prevent wrong connections and have facility for secure coupling in plug-in position to prevent loose connections.
Signal/Electrical connection shall be screwed connection with double compression type Nickel-plated brass cable glands for Explosion proof area, Flame proof area and high vibration prone area.

3.01.05 Every instrument requiring power supply shall be provided with a pair of easily replaceable glass cartridge fuse of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus.

3.01.06 All field instruments shall be weatherproof, drip tight, dust tight and splash proof suitable for use under outdoor ambient conditions prevalent in the subject plant. All field-mounted instruments shall be mounted in suitable locations where maximum accessibility for maintenance is achieved. The enclosures of all electronic instruments shall conform to IP-65 unless otherwise specified (Explosion proof for NEC article 500, class 1, Division 1 area & flame proof) and an anti corrosive paint shall be applied to the field mounted enclosures / instruments. All the field instruments shall also be provided with SS tag nameplate and double compression type Nickel-plated brass cable gland. Gaskets, Fasteners, Counter and mating flange shall also be included wherever required with the field instruments.

3.02.00 Following minimum requirement of field instruments shall be fulfilled by Bidder (In addition, Redundancy criteria for field instruments shall be as specified else where in specification): -



- iii. Level Transmitters (Type as per Owner approval) for open sump/tank/bunker/vessel/heaters.
- iv. Stand pipes on both side of tank for all level instruments (LT, LS & LG).
- v. Flow elements with flow transmitter & Flow meter for flow measurement of as decided by owner
- vi. Pressure gauges and temp. Gauges at inlet and outlet of each heat exchanger and cooler.
- vii. DPG, DPT & DPS across the filters/strainers.
- viii. Tapping points/test points shall be provided.
- x. All Thermocouples & RTDs shall be Duplex.
- xi. All Field Instruments used in acid or alkaline atmosphere shall be with standard Anti corrosion coating i.e. the combination of Polyurethane and epoxy resin baked coating (ANSI/ISA-71.04).
- xii. All primary instruments installed at "Minus level or Floor" shall be with protection class of IP 68.
- xiii. Transmitters (all type) for monitoring & controls purpose.



- xvii All field mounted push button, selector switch etc. shall be as per IEC or NEMA 4X protection.
- xviii All limit switch shall be conform to IEC-60947-5-1.
- xxi. Temp. Transmitters are envisaged with RTD & Thermocouples for monitoring services/application only. However any RTD & Thermocouples are used for control, interlock & protection application, same shall be directly wired to DDCMIS/DCS/PLC using instrumentation & Extension cables respectively.
- xxiii. Contacts less, electronic 2-wire position transmitters shall be provided for all inching type motorised valve and dampers.
- xxvii. Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application. For HFO, LFO Applications, SS capillary with thin wafer element with ANSI RF flanged ends are to be provided. For hazardous area, explosions proof enclosure as described in NEC article 500 shall be provided.

FIELD INSTRUMENTS SHALL BE SUPPLIED & OFFERED AS PER DATA SHEETS SPECIFIED BELOW:



2 x 660 MW ENNORE SEZ Supercritical Thermal Power
Project at Ash Dyke of NCTPS
Spec. No. CE/C/P&E/EE/E/OT.No.03/2013-14



3.03.00 TRANSMITTERS, SWITCHES, GAUGES AND PANEL MOUNTED INSTRUMENTS**3.03.01 Pressure, Differential Pressure, DP type Level and Flow Transmitters (PT, DPT, LT & FT)**

Smart Transmitters of the electronic type shall be furnished.

Transmitters shall be equipped with mounting brackets suitable for a mounting in transmitter enclosures.

In general, Transmitters are envisaged to be grouped at several places as to be decided during detailed engg. stage. For this purpose, suitable enclosures complete with all tubing, fittings, purge meters, loop cable trays etc. shall be provided.

Type/Construction	:	Sealed capacitance/ Inductance/ Silicon resonance type
Material		
- Body	:	Die cast Aluminum with epoxy coating for air & flue gas SS316 for other services
- Diaphragm	:	316 SS
- Measurement element	:	Teflon seal
- Valves	:	Carbon steel for non-corrosive Applications SS316 for corrosive applications.
Output signal	:	4 to 20 m Amp. DC (Two wires) HART Compatible
Local Indicator	:	LCD indicator (5 digit) with scale of Engg. unit
Overall Accuracy	:	$\pm 0.04\%$ or better of Span for BTG package $\pm 0.065\%$ or better of Span for BOP packages $\pm 0.2\%$ or better of span for remote seal type transmitter.
Turn down ratio	:	100:1 in general
Stability	:	$\pm 0.15\%$ of URL for 5 years.
Response time	:	150 msec.
Power supply	:	24V DC nominal
Drive capability	:	600 Ohms nominal
Enclosure Class	:	IP-65 (Explosion proof for NEC Class-1, Division 1 area)
Span and Zero	:	Locally adjustable, non-interacting



Zero suppression / elevation : At least 100% of Span

Connection

- Process : 1. Half (1/2) inch NPT (F)
Quarter (1/4) inch NPT
with/without oval flanges

- Electrical : Suitable for Plug in type connection (Both side of transmitter), unused entry with blind plug.

Accessories

- For Absolute Pressure Transmitters: Two (2) valve SS316 manifold

- For Gauge & Vacuum pressure transmitter : Three (3) valve SS316 manifold

- For DP, level & flow transmitter : Five (5) valve SS316 manifold

- For oil and corrosive liquids : Separator diaphragm seals

- For all transmitters : Mounting bracket

Manifold should not be mounted on the transmitter, Manifold shall be non integral and standalone type. Snubbers/Pulsation dampners shall be used where the process media is unstable for measurement such as the discharge of a pump. Over range protection shall be used where necessary. The coil syphons & condensate pots shall be used for steam services. Transmitters shall be provided with suitable drain & vent points.

3.03.02 PRESSURE SWITCHES (PS) & DIFFERENTIAL PRESSURE SWITCHES (DPS)

Applicable Standards : IS3624 - 1966/ISA-RP-8.1 except as modified in spec.

Type/Construction : Bourdon/Sealed Diaphragm Piston
Actuated preferable. Indicators with contacts are not acceptable.

Materials

- Bellows : 316 SS

- Bourdon tube : 316 SS

- Movement : 316 SS

- Encloser : Die-cast aluminum with stoved enamel black finish. Epoxy coating shall be provided for corrosive atmosphere.

- Protective Diaphragm : Teflon



Accuracy	:	$\pm$ One (1) percent or better
Repeatability	:	$\pm$ 0.5(half) percent or better
Setting & Differential	:	Adjustable
Contact		
- Number	:	DPDT /2 SPDT
- Type	:	Auto reset with internal Adjustable snap action micro switch
- Rating	:	5 Amp, 240V AC / 0.2 Amp, 220V DC
Connection - instrument	:	Half (1/2) inch NPT Male Process
Electrical	:	Suitable for Plug in type connection. All the switches are internally connected and brought to the surface with Amphenol male/female connection. Cabling need not terminated inside the switch. Cable ends are to be soldered in connector and to be inserted for easy maintenance.
- Over range protection	:	One Fifty (150) percent of full scale
Enclosure Class	:	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)
Accessories		
- 3 / 5 valve manifold	:	As applicable for all switches
- Self cleaning type pulsation dampners/Snubber (Material SS316)	:	Pump and compressor discharge lines
- Syphon	:	For all steam lines
- Protective separating diaphragm	:	For fuel oil & corrosive liquid lines.
Mounting	:	Local (in LIE/LIR for BTG package).

3.03.03 PRESSURE & DIFFERENTIAL PRESSURE GAUGES (PG & DPG)

Applicable standard	:	IS:3602-1966, IS/3624, ASME B 40.1
Type/Construction	:	
-760 mm to 1.0Kg/cm ²	:	Bellows/Diaphragm
-Above1.0Kg/cm ²	:	Bourdon Tube
- Suction side of pumps	:	Compound gauge
Materials		
- Bourdon tube	:	316 SS
- Bellows	:	316 SS
- Movement	:	316 SS
- Case	:	SS 316/ Die-cast aluminum with stoved enamel black finish. Epoxy coating



		shall be provided for corrosive atmosphere.
- Protective Diaphragm	:	Teflon
Dial size	:	150mm with shatter proof glass
Scale Details	:	Graduations in black lines on white dial, on white dial, 270 Deg. pointer deflection scale provided with glass cover. Smallest scale division shall be one (1) percent of full scale value or smaller. Pointer stop for all gauges.
Accuracy	:	$\pm$ One (1) percent or better
Connection - Instrument Process	:	1/2 inch NPT Male Bottom
Mounting	:	Local
	:	1/2 inch NPT Male (Back entry) mounted on local gauge board.
Enclosure Class	:	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)

Accessories

- 3 way needle valve/manifolds	:	For all gauges
- Self cleaning type	:	Pump and compressor discharge lines
Pulsation dampener/snubber (S316)	:	
- Syphon	:	For all steam lines
- Protective separating	:	For fuel oil and corrosive liquid lines

Other particulars

- External Zero adjustment	:	For all gauges
- Safety device	:	
Ranges 5 to 20 Kg/cm ²	:	Rubber blow out disc with open front construction.
Ranges above 20 Kg/cm ²	:	Neoprene safety diaphragm at the back with solid front construction.
- Over range protection	:	One Fifty (150) percent of full scale

Other Requirments

	:	Movement mechanism shall be glycerin filled for oil services & vibration prone area.
	:	For Fuel oil & corrosive liquid lines diaphragm type sensors required. Armored capillary of 10 M for Fuel oil & Corrosive liquid service.



- : Contact type pressure gauges are not acceptable for interlock & protection.
- : For condensate storage tank the pressure gauge in terms of 0-10000 mm wc or suitable range having **dial size of 300mm or bigger size** shall be provided.

3.03.04 TEMPERATURE TRANSMITTERS

Type	:	SMART type configurable from control room through HART protocol (HMS System).
Display type	:	Indicating type (5 digit LCD Display),
Accuracy	:	$\pm 0.10\%$,
Ambient temperature error	:	0.1% per 10°C change
Output	:	4-20 mA DC (2 wire system) HART compatible signals for analogue monitoring inputs to the distributed control system (DDCMIS), DCS & PLC.
Protection class	:	NEMA 4/IP66 or equivalent degree of protection for enclosure/ (Explosion/Flame proof for NEC Class-1, Division 1 area)/ flame proof (IEC-79.1, Part I). As applicable).
Material of accessories	:	SS316.
Stability	:	$\pm 0.1\%$ or ± 0.1 deg C of reading (whichever is great) for 2 years in case of RTD inputs and for 1 year in case of Thermocouples inputs.
Operating Voltage	:	16 – 48 V DC
Calibration	:	as per NIST monograph 125 for T/C & European Curve Alpha = 0.00385 for RTD .
Ref. Junction compensation	:	Provided
Span/zero adjustment	:	Locally adjustable, Non interacting
Auto calibration	:	Provided
Burn out protection upscale	:	Provided
Input - output isolation	:	Provided
Circuit ungrounded	:	Provided

Any RTD & Thermocouples shall be directly wired to DDCMIS/DCS/PLC for metal temperature application, bearing & winding temp application only.

The Temperature transmitter shall accept Universal dual inputs of all types of thermocouples & RTD, 0-5V input signals etc.



Temp. Transmitter shall be extremely stable against Ambient temp variation, The accuracy figure shall be inclusive of effect due to ambient temperature variation

3.03.05 RESISTANCE TEMPERATURE SENSORS WITH THERMOWELLS

Applicable Standard	:	ASME PTC 19.3 - Latest Revision DIN EN 60751:1996, BS EN/IEC60751:2008
Element	:	Platinum, R0=100 ohm 4-wire Duplex for Process Temp. Measurement Platinum, R0=100 ohm 3-wire Duplex for Bearing & Winding Temp. Measurement
Sheath Material/ Insulation	:	316SS/Compacted Magnesium Oxide
Sheath O D	:	8 MM
- Gauge	:	18 AWG
Terminals	:	Spring loaded high temperature ceramic base with silver plated brass for high vibrating locations.
Calibration	:	As per DIN Standard – 43760, Class A
Head	:	Hex Head, Die Cast Aluminum (Screwed) with galvanized SS chain
Response Time	:	6-10 Sec bare & 30 Sec. With protective sheath/thermowell
Accuracy	:	± 0.35 degree C or Class-A whichever is better.
Electrical connection	:	Gold plated Plug in type. Double entry – one unused entry with blind plug
Enclosure Class	:	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)

THERMOWELL

Applicable Standard	:	ASME PTC 19.3 TW - 2010
- Construction	:	Tapered drilled from Bar stock (Straight for Air & Gas systems)
- Material	:	- 316 SS/F11/F22/F91 - water and steam Services depending upon process parameters. - Inconel for air & flue gas services For furnace zone, impervious ceramic protecting tube of suitable material along



with Incoloy supporting tubes and adjustable flanges.

For Mill classifier outlet long life solid sintered tungsten carbide material or better of high abrasion resistance.

Bidder shall provide calculation for thermowell as per ASME – PTC-19.3 2010. "All Thermowells in high velocity steam service shall be checked for Strouhal's frequency limit to arrive at a safer size and design of Thermowells".

- Process Connection	:	(i) M 33 x 2 (ii) SS316 Flanged, for Air & Gas systems, with mating flanges, fasteners, gaskets etc.
- Extension	:	Threaded union (SS316) 1/2" NPT (F) with two nipples of SS 316 having 1/2"NPT(M) threads at both ends
Immersion length	:	Within ± 10 mm of center line of pipe and as per ASME – PTC-19.3 - 2010
Extension neck length	:	Minimum 100 mm above insulation of pipe and Minimum 160 mm when there is no insulation on pipe.
IBR Certification	:	For high pressure service, Steam Temp., Fuel oil temp. measurement as per IBR rules and regulations
Note	:	Extension /Compensating/paired cable exposed to atmosphere in the conventional method melts away due to high temperature at the top of mill or due to coal burning. Hence The terminals of temperature sensors shall not be at the top of mills itself. The temperature sensors wires are to be laid up to JB though SS tube of required diameter and the head shall be placed nearer to the JB.

~~3.03.06 THERMOCOUPLES WITH THERMOWELLS~~

Applicable standard	:	ASME PTC 19.3- Latest Revision ANSI-MC 96.1 – 1982, IEC 584-2
Element	:	Duplex
- Sheath	:	8 MM OD
- Sheath Material	:	316 SS
- Spring Loaded	:	Yes
- Nipple/Union	:	Yes
- Packed connector	:	Compacted magnesium Oxide ungrounded



with two nipples of SS 316 having 1/2"NPT(M) threads at both ends

Thermowell : To suit Temp. switch with same design criteria as specified for RTDs.
Electrical : Suitable for Plug in type.

All the switches are internally connected and brought to the surface with Amphenol male/female connection. Cabling need not terminated inside the switch. Cable ends are to be soldered in connector and to be inserted for easy maintenance.

Other Particulars

- Capillary length : As per requirement (min 10 meters)
- Immersion Length : Within + ten (10) mm of center line of pipe with adjustable nuts.
- Extension neck length : Minimum 50 mm above insulation of pipe /As per approved hookup drawings.
- Packing glands : Yes
IBR Certification : For high pressure service, Steam Temp, Fuel oil temp. measurement as per IBR rules and regulations
N.B : Switches designed for cross ambient operation shall be used in applications where the ambient temperature will approximate or exceed the switch set point.

3.03.09 TEMPERATURE GAUGES (TG)

Applicable standard : IS : 3602,BS:5235 ISA:RP:8.1 except as modified in this specification

Type/Construction

- Thermometer : Industrial type, Gas in Filled type with separable thermowell
- Thermowell : Bar stock

Material

- Bulb : 316 SS
- Capillary : Armoured SS (Applicable for capillary Type)
- Casing : SS 316/ Die-cast aluminum with stoved enamel black finish. Epoxy coating



		shall be provided for corrosive atmosphere
Dial Size	:	150mm with shatter proof glass
Scale Details	:	270 degree dial rotation/deflection. Graduations in black lines on white dial provided with glass cover. Smallest scale division shall be one (1) percent of full scale value or smaller .Pointer stop for all gauges
Accuracy	:	$\pm$ One (1) percent or better
Response time	:	Maximum 15 seconds without thermowell and 30 seconds with thermowell
Connection		
- Pipe	:	M33 x 2
- Thermowell	:	To suit instrument with same design criteria specified for RTDs.
- Process Connection	:	(i) M 33 x 2 (ii) SS316 Flanged, for Air & Gas systems, with mating flanges, fasteners, gaskets etc.
- Extension	:	Threaded union (SS316) 1/2" NPT (F) with two nipples of SS 316 having 1/2"NPT(M) threads at both ends
Other Particulars		
- Capillary length	:	5Meters/10 Meters as required
- Immersion Length	:	Within + ten (10) mm of center line of pipe with adjustable nuts.
- Extension neck length	:	Minimum 50 mm above insulation of pipe /As per approved hookup drawings.
- Stop at Maximum value	:	For all gauges of scale
- Pointer	:	Externally adjustable
	:	In general, Contact type Temp. gauges are not acceptable for interlock & protection.
		Contact type Temp. gauges are acceptable for interlock & protection in case of bearing temp. only.
- Over range protection	:	150 percent (%) of full scale
Enclosure Class	:	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)
IBR Certification	:	For high pressure service, Steam



Temp., Fuel oil temp. measurement
as per IBR rules and regulations

3.03.10 TEST THERMOWELLS (TW)

Applicable Standard	:	ASME PTC 19.3 TW - 2010
Type/Construction	:	Machined from Bar Stock
Material	:	316 SS/F11/F22/F91
Connection	:	
- Pipe	:	M33 x 2
- Test Instrument	:	To suit test instruments
Accessories	:	Plug with chain
IBR Certification	:	For high pressure service, Steam Temp., Fuel oil temp. measurement as per IBR rules and regulations Bidder shall provide calculation for thermowell as per ASME – PTC- 19.3 TW - 2010.

Test wells shall be provided on main steam, reheat steam, extraction steam, feed water, condensate, spray water lines and other piping as required to meet ASME test requirements.

3.03.11 DIRECT MOUNTED LEVEL TRANSMITTERS (LT)

Displacer type level transmitter shall not be used in the process anywhere in the plant.

3.03.12 Ultrasonic Level Transmitter (for Water sump/Tank level, Raw water reservoir level, Cooling water fore bay level measurements)

Principle of Operation	:	Detection of reflected ultrasonic pulse
Measuring Ranges	:	Up to 30 meters (typical)
Signal Processing	:	Microprocessor Controlled Signal Processing
Operating Freq.	:	10 KHz to 50 KHz (typical)
Display	:	Head mounted alpha-numeric back lit LCD/LED
Calibration & Configuration	:	Accessible from front of panel & HART calibrator.
Diagnosis	:	On-line
Status	:	For power, Hi / Lo / V. Hi / V. Lo- level indication, fault etc.
Construction	:	Plug-on board
Power supply	:	240 V AC 50 Hz / 24V DC
Signal Output	:	4-20 mA DC with HART (isolated) - 600 Ohm load.
Hysteresis	:	Fully adjustable preferred
Output contacts	:	2SPDT Potential free changeover contacts @ 8A 230V AC.
Accuracy & Repeatability	:	± 0.25% of span or better
Resolution	:	± 0.1% of span
Temperature Compensation: To be provided with Transducer.		



Operating temp.	:	Transmitter-50 deg C and Sensor – 80 deg C
MOC Sensor	:	Body- PVDF and Face – Polyurethane
Humidity	:	1% to 95% non condensing.
Enclosure	:	IP-67 Epoxy painted die cast Aluminum or SS316L housing.
Cable Connection	:	3/4" ET
Mounting	:	2" – 4" NPT or flanged
Accessories	:	Cable gland, prefab cable, mounting accessories like EPDM seal, SS316 flanged etc.
		Additional separate local display unit with large Alphanumeric back light LCD/LED & to be provided for the applications which will be decided during detailed engineering.

3.03.13 CAPACITANCE TYPE LEVEL TRANSMITTER

The total system shall consist of capacitance probe, pre-amplifier and transmitter

Type	:	Capacitance type
Probe	:	a) Rod or suspended electrode. b) Rope type probes may be used only where required probe length is greater than 3 meters
Probe Mounting	:	Stainless steel 1-1/2 ANSI RF Flange / 3/4" NPT (M)
Material of construction	:	316 SS
Insulation	:	PTFE Part/Full as per service.
Transmitter	:	The transmitter shall receive output of the preamplifier and convert it into 4-20 mA DC output signal.
Accuracy	:	± 1% of Full scale
Repeatability	:	± 0.5 % of Full scale
Load	:	Min 600 Ohms
Enclosure	:	Powder/Epoxy coated Die cast aluminum. with neoprene gasket conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).
Ambient temperature	:	0-60 °C.
Mounting	:	Wall / Surface
Supply voltage	:	240V AC, 50Hz / 24V DC
Response time	:	100 m sec or better
Cable connection	:	3/4" ET
Accessories	:	Counter flange, Cable gland, prefab cable if any
Preferable features	:	Alarm output contacts with adjustable set point facility

3.03.14 GUIDED WAVE RADAR/RADAR LEVEL TRANSMITTER

Type	:	Guided wave Radar (Contact type)/Radar (Non contact type) as finalized by owner.
Application	:	For Turbine Lube oil tank, HFO & LDO tank level,



		Condenser Hotwell, LP heaters, CBD tank level, Stator water expansion level, and other Low pressure, Vacuum vessels.
Environment Class	:	Highly abrasive with Gases and Fumes
Orientation	:	Vertical
Probe Type	:	Flexible Single lead with chuck
Probe Material	:	SS 316L
Connection Size & Type	:	2" Flanged ANSI 300 lb SS316L material
Connection material	:	SS 316L
Accuracy	:	+/- 5 mm
Resolution	:	± 1 mm
Type (Transmitter)	:	SMART, 2 Wire
Operating Principle	:	Time Domain Reflectometry
Output	:	4-20 mA, DC with HART protocol and 600 Ω output load.
Electrical Connection	:	1/2" NPT
Enclosure Class	:	IP-65 or better (Explosion/Flame proof for NEC Class-1, Division 1 area)
Electrical Power	:	11-42 V DC
Housing material	:	Die Cast Aluminum
Vent & Drain Plug material	:	SS
Side Flange Material	:	SS
Local Display	:	Provided (LCD Digital)
Units of Measurement	:	Length M
Electromagnetic compatibility:	:	EN-61326

3.03.15 3 D TYPE ACOUSTIC WAVE LEVEL TRANSMITTER

Type	:	Acoustic Wave Level Transmitter (3 D type)
Application	:	Coal and Ash Bunker Level, Volume & Mass.
Temperature compensation	:	Required for high temp applications
Operating Principle	:	Non - Intrusive acoustic wave transmission & Reflection
Frequency Range	:	3 – 10 KHz
Accuracy	:	+/- 0.25 % for even surface & $\pm$ 0.5% for uneven surface.
Resolution	:	1 mm
Output	:	4-20mA DC with HART
Display Unit:		
Type	:	Head mounted LCD Display with Engg. Units
Location	:	Suitable location at bunker / Silo operating floor area
Protection Class	:	IP 65 or better// flame proof (IEC-79.1, Part I) As applicable).
Material Of construction:		



~~D. Application : Ash Silos~~

3.03.18

LEVEL INDICATORS (Gauge Glass) (LI)

Type/Construction	:	a) Reflex b) Tubular (For tanks open to atmosphere only)
Material:		
a) Glass	:	Tempered borosilicate resistant to thermal shock
b) Case	:	Carbon steel
c) Integral cocks and	:	i) Forged carbon steel with drain valves stainless steel internals ii) Rubber lined corrosion resistant 316 stainless steel (for Demineralised and Osmosis water service)
d) Fittings	:	i) Forged carbon steel ii) Rubber lined 316 steel/PVC for corrosive liquids Demineralised and Osmosis water service) iii) 304 Stainless Steel for non-corrosive liquids
e) Packing	:	Teflon
Dial size/scale	:	150 mm /1.5 Meters maximum length with
Scale details	:	Aluminum/SS316 scale Graduated in mmwc
Connection	:	25 Nb/40 Nb ANSI Flanged
Accessories	:	a) Integral cocks b) Drain valves c) Bolts, nuts and gaskets d) Illuminating lamps as required e) Periscope as required
Tests	:	Tested at two hundred (200) percent of the maximum process pressure
Other details	:	For larger lengths, additional gauge glasses shall be provided with minimum of 50 mm overlap.

3.03.19

FLOAT & BOARD TYPE LEVEL GAUGE

Type of Instrument	:	Mechanical Type (Float Operated)
Service/ Application	:	As per service requirement
Measuring Range	:	as per requirement
Material Specification		
a) Float Material	:	SS316 having 2 nos. Guide wires
b) Float Wire Pulley	:	Shall comprise of 2 nos. Cast Aluminum Pulley housing Assembly with SS 304 pulley and pulley shaft. Steel ball bearings shall be provided in pulley housing for easier float movement. Float wire material shall be



SS316L. Between 2 pulleys, 1" NB G.I. short pipe with tentative length as per P&ID

- | | | |
|--|---|--|
| c) Guide wire Assembly | : | CS chamber with spring and adjuster having 1" Class 150 ANSI RF MS flange. Guide wire rope shall be SS316L. |
| d) Counter Weight | : | MS counter – weight with Aluminum Pointer and Brass assembly Pull Chain. |
| e) Scale | : | SS 316/Aluminum material in mm with 1 % accuracy. |
| Nozzle Details | : | For float wire pulley assembly, one tapping and for guide wire assembly two tapping at the top of the tank; Size 1" NB (Top Mounting Type) |
| Process Connection | : | Flanged as per ANSI B 16.5 to suit 1" NB nozzle (Nozzle length - 150 mm for float wire, 100 mm for guide wire) |
| Accessories (to be supplied with the instrument) | | |
| a) Counter flange | : | All mating Flanges, Nozzle |
| b) Mounting Accessories | : | All mounting accessories |
| c) Tag Plate | : | To be provided (material SS316) |

3.03.20**MASS FLOW METER****Sensor**

- | | | |
|---------------------------------|---|--|
| Measuring Principle | : | Coriolis Mass flow. |
| Primary Element | : | Flow Tube of 316SS or better |
| Heating Arrangement | : | Integral with Flow meter. |
| Temperature Control For Heating | : | To be provided. |
| Process Connection | : | ANSI RF Flanged and rating as per process requirement. |
| Drain | : | Self-draining facility |
| Accessories | : | Counter flanges, Mounting nuts, bolts, gaskets etc. |

Transmitter

- | | | |
|-------------------------|---|---|
| Measured quantities | : | Mass Flow rate, Total Mass Flow, Density, Temperature as minimum. |
| Input Signal Processing | : | Digital Processing. |
| Display | : | Digital Display (LCD). |
| Output | : | 2 Nos. isolated output of 4-20mA DC selectable from four measured quantities. |
| Load | : | < 750 ohms. |
| Power supply | : | 240V AC, 50 Hz. From UPS |
| Accuracy | : | 0.15% of measured value for Liquid
0.5% of measured value for Gas |
| Repeatability | : | 0.05% |
| Housing | : | IP 65 (Explosion proof for NEC Class-1, Division 1 area) |
| Hazardous duty Version | : | FM Standards. |



Output Signal	:	Pulse
Material of Construction	:	AISI 316
Sensor Seal	:	PTFE / higher based on temperature
Flow range	:	As required.
Linearity	:	0.25% or better.
Repeatability	:	0.02% or better.
Ambient temperature	:	50 deg C
Mounting	:	On-Line mounting with flanges of stainless steel.
Enclosure	:	IP 65
Accessories	:	Nuts, bolts, gaskets etc.
Transmitter		
Electronics	:	Solid State
Power Supply	:	240V AC, 50Hz. UPS
Input	:	Input from Sensor
Display	:	4 1/2 digit LCD
Output	:	Isolated 4-20mA DC HART
Measuring Accuracy	:	0.5% of full scale range
Totalized Value	:	Required
Housing	:	IP-65 (Explosion proof for NEC Class-1, Division 1 area)
Nameplate	:	Tag number, service engraved in stainless steel tag plate
Accessories	:	Clamping strip, bracket, prefab cable etc. Special tool kit for calibration/ configuration .

3.03.23 Flow Transmitter (Ultrasonic)

Type	:	ULTRA SONIC, 2-wired
Sensing element	:	Non-contact
Output	:	4-20mA with HART Protocol
Accuracy	:	± 0.1% FS
Supply	:	24 V DC
Enclosure class	:	IP-65
Transmitter		
Mounting	:	On Nozzle
Mounting position	:	Top mounted
Housing	:	Plastic
Display	:	Head mounted LCD Display and remote LCD display
Process connection	:	NPT/Flanged
Electrical connection :	:	NPT
Turn Down ratio	:	1:100
Measuring range	:	Adjustable (as per process requirement)
Totaliser	:	Required
Accessories	:	As per process requirement Additional separate local display unit with large Alphanumeric back light LCD/LED & to be provided for the applications which will be decided during



- b) Nuts, bolts, gaskets, mesh etc.
Special tool kit for calibration/configuration.

3.03.25 Electromagnetic Flow meter

Electromagnetic flow meters shall have separate transmitter having accuracy $\pm 0.2\%$ with zero stability feature, suitable for process medium with ≤ 5 micron Siemens conductivity, flanges material SS-316, electrode & measuring tube material SS-316, liner material Teflon and enclosure IP-66, local digital display configurable as totaliser, 4-20 mA output signal HART compatible with zero and span field adjustable. Application – DM Water and for other application as decided by owner.

3.03.26 FLOW GAUGES (FG)

- Type/Construction :
- a) On-line type Rotameter for 50 Nb and below lines
 - b) Bypass type Rotameter for above 50 Nb lines.

Material

- For On-line type

- Metering Tube : Borosilicate glass
Float : 316 SS
Packing : Teflon
End fittings : 304 SS

-For Bypass type

- Metering Tube : Borosilicate glass
Float : 316 SS
Packing : Teflon
End Fittings : 304 SS
Orifice Plate : 316 SS
Carrier ring : 304 SS
Flanges & Mating flanges : Same as pipe material, 200 lbs ANSI - RF
- Impulse pipe : Same as pipe material
- Fittings : 2000 ANSI, SW ends to match with pipe material.
- Dial Size/Scale length : 250 mm
Scale Details : Direct reading type engraved on detachable Aluminum scale
- Accuracy : $\pm$ Two (2) percent
Reproducibility : Half (1/2) percent
Rangeability : 1:10
Connection : SCRD NPT



Accessories	:	a) Isolating valves (for Bypass type only)
		b) Bolts, Nuts and Gaskets as required
Tests	:	Shall be tested at two hundred (200) percent of the maximum process pressure

3.03.27 SIGHT FLOW GLASS INDICATORS

Type/Construction	:	Flapper type.
Materials	:	
Body	:	Carbon steel/SS316 as per process requirement
Glass	:	Toughened Borosilicate
Gaskets	:	Neoprene
Bolts & nuts	:	SS
Flappers / Rotating Wheel	:	316 SS
Flappers / Rotating Wheel holder	:	304 SS
Process Connection	:	SW (Socket Welded)
Accessories	:	Scale, Bolts, Nuts, Cover plates and Gaskets as required
Tests	:	Tested at two hundred (200) percent of the maximum process pressure.

3.03.28 SOLID FLOWMETER

Type	:	Online Impact type Microprocessor Based
Measuring Principle	:	The system measurement is basically pertains to the measurement of horizontal deflection using LVDT, created by the impact of solid flow upon online sensing plate. The horizontal deflection being proportional to the impact forces, LVDT convert this horizontal movement into electrical signal. The inbuilt integrator convert this signal into time based flow rate indication & provide totalized flow also.
Sensing plate	:	316 SS
Sensing head	:	Sensing mechanism shall be mounted outside the process flow line.
Enclosure	:	316 SS
Enclosure protection	:	IP 67 class
Accuracy	:	+/-1%
Repeatability	:	+/- 0.2%
Drift	:	Both zero & span $\pm$ 2% / month
Output	:	4-20mA DC isolated, load 600 ohm (min)
Digital communication	:	yes, (HART) facility
Power supply	:	240 V AC, 50Hz. UPS
Ambient condition	:	Temperature -60 ^o C, RH-95% Environment – Highly Dusty



Accessories : Shall be complete with all the accessories including digital display for flow rate, integral vents, baffles for air separation, etc. which ever required for satisfactory operation.

Note:-

1. The above on line flow meter shall not create any obstruction on flow.
2. User's list shall be submitted to support on proven satisfactory performance for similar process application.

3.03.29

Instrument Air System

The instrument Air Supply System for various pneumatic Control & Instrumentation devices like pneumatic actuators, power cylinders, I/P converters, pneumatically operated valves etc. shall be complete in all respect with necessary Air Filter Regulators, valves, piping/tubing etc.. Each pneumatic instrument shall have an individual air shut off valve. The pressure-regulating valve shall be equipped with an internal filter, a 50 mm pressure gauge and a built in filter-housing blow down valve.

Filter shall be of minimum 5-micron size & sintered bronze material.

On collection of water in the drains of instrument air lines, mechanical automatic drains and periodically solenoid operated drains (with electronic timer - 15m, 30m, 60m and 2 Hours & Timing adjustable) are to be provided.

For mechanical type & Electrical type, the locations to be provided in the instrument air lines of boiler area, Chimney area, turbine area etc., shall be decided during detailed Engineering.

Bulk header nearby the crowded applications shall be provided and from this bulk header individual air lines with necessary isolation valves are laid to the application.

These bulk header are to be provided with **mechanical / electronic based automatic Drains**.

Individual moisture separator for O₂ analyzer or vital application shall be provided nearby the instrument so as to enhance the cell life or the performance of vital final control elements.

3.03.30

Air Filter Regulator (AFR)

Constant bleed type AFR with an accuracy of ± 1.0 % inlet pressure range of 5-8 kg/ cm² and suitable spring ranges (AFR) for use with positioners in control valves, control damper, E/P converters and shut off valves for phosphor bronze filter element; Filtering particles above five microns. Weather and water proof enclosure. Material of accessories will be SS316.

Air filter regulators shall be provided in the :

- (a) Air supply line to valve positioners / power cylinders
- (b) Air supply line to electric to pneumatic converters.



- (c) Air supply line to pneumatic interlocked block valves.
- (d) For each instrument rack, field instruments enclosure for purging.

3.03.31 Electro-Pneumatic Convertors (E/P)

Two wire type E/P convertors with an accuracy of $\pm 0.25\%$ accepting 4-20 mA dc signals from control system and converting to 0.2 to 1 kg/cm² air pressure to operate valve positioner of all final control elements; Housed in cast aluminum casing (with polyurethane paint); NEMA 4 or equivalent degree of protection for enclosure. Material of accessories will be SS. E/P convertors shall have fail freeze (stay put) feature also. Process connection shall be 1/4" NPT (F) and Electrical connection shall be 1/2" NPT (F). Zero/span adjustment facility shall be provided. The E to P convertors shall **retain the pneumatic signal (last value) even in failure of control signal** and shall have **self volume boosters**. Necessary air lock devices and pressure switches for air pressure low alarming shall be provided.

3.03.32 Solenoid Valves

Solenoid valves shall be provided with control valves / pneumatic control valves hooked up with process interlock requirements and where direct tripping is involved. The number of ways for solenoid valve shall be provided as indicated below:

- (a) Two (2) way solenoid valves shall be provided, where process line of less than 50 mm with low pressure and temperature application.
- (b) Three (3) way solenoid valve shall be provided commonly, where the pressure is admitted or exhausted from a diaphragm valve or single acting cylinder, e.g, Pneumatic operated spray water block valve.
- (c) Four (4) way solenoid valve shall be provided for operating double acting cylinders, e.g, Pneumatically operated on-off type dampers.
- (d) For operation of the fuel oil corner nozzle valves, fuel oil trip valves etc., **double coil solenoid valve** (latch coil & relatch coil) shall be adopted.
Single coil usage requires always power and loss of power leads to closure of above valves resulting the unit trip or loss of generation.
- (e) Solenoid Valve coils shall be Class-H high-temperature or Class-F construction as applicable and shall be designed for continuous duty. Three-way solenoid valves shall be designed for universal operation so that the supply air may be connected to any port. Solenoid enclosures shall be NEMA-4)/ (Explosion proof for NEC Class-1, Division 1 area)/ flame proof (IEC-79.1, Part I) As applicable). Body material of solenoid valve shall be Die Cast Aluminum or SS316.
- (f) All solenoid shall be with varister, LED indication, surge suppress diode and circuits.

3.03.33 Power Cylinders (Pneumatic)

Mounting Type	:	a) Fixed position mounting (End mounting).
	:	b) Trunnion mounting
Control Signal	:	0.2 to 1 Kg/Sq. cm. from I/P converter for modulating purposes. 24V/48VDC operated solenoid valve operating on pneumatic line.



		The Pilot solenoid will have separate coils for open closing purpose.
Supply Air	:	0-7 Kg / Cm ² .
Selection	:	Based upon thrust / torque, stroke length, angular movement, full-scale travel time, repeatability, space factor etc. Provision for air-to-open and air-to-close operation.
Casing	:	IP-65.
Accessories (as required)	:	a) Air lock relay b) Hand wheel. c) Air filter regulator with gauge. d) Volume Booster. e) Limit Switches. f) Positioner with Input, Output and supply pressure gauges. g) Pilot Solenoid Valve (Double Coil type) h) Position Transmitter (4-20 mA DC linear output, LVDT or non contact type).
Fail-safe operation	:	Stay put, open or close position on pneumatic / electrical power supply failure as per process safety criteria.
Repeatability	:	Better than 0.5% of full travel.
Hysteresis	:	Less than 1% of full travel.

3.03.34 Nucleonic Type Density Meter (For Ash Handling Plant):-

Type	:	Nuclear type radiation
Application	:	Abrasive Slurries & Corrosive Chemicals
Accuracy	:	< 1% of Span
Orientation	:	As per requirement.
System Type	:	Radiation Source & Scintillation Detector
Meter Material	:	SS 316L/ Aluminium with PVC coating
Connection material	:	SS 316L
Compensation	:	Temp. Compensation required
Type (Transmitter)	:	SMART, 2 Wire HART based
Operating Principle	:	As the density increase, the lower the radiation field at detector and vice versa
Output	:	With photomultiplier, 4-20 mA, DC
Electrical Connection	:	½" NPT
Enclosure Class	:	IP 66
Local Display	:	Provided
Accessories	:	Radiation Survey Meter and all erection/installation hardware

3.03.35 Non - Nucleonic (Vibration) Type Density Meter (For DM & AHP Plant):-

Application	:	Liquid Density measurement
Detector	:	



- | | | | |
|----|----------------------|---|-------------------------------|
| 1. | Orientation | : | As per requirement. |
| 2. | Case Material | : | SS 316/ Cast Aluminium alloy |
| 3. | Wetted part material | : | SS 316 |
| 4. | Operating Principle | : | Vibration Density measurement |

Convertor

- | | | | |
|----|-----------------------|---|---|
| 1. | Output | : | 4-20 mA DC isolated. |
| 2. | Electrical Connection | : | ½" NPT |
| 3. | Enclosure Class | : | IP 65 |
| 4. | Local Display | : | Digital 5 digit, density display with temp. compensation. |
| 5. | Accuracy | : | +/- 1% |
| 6. | Response time | : | < 1 minute. |
| 7. | Power Supply | : | 240 V AC, +/- 10%, 50 Hz. From UPS |

3.03.36**PULL CORD SWITCH**

- | | | |
|-----------------------|---|---|
| Type | : | Addressable Type |
| Body | : | Cast Iron |
| Contact rating | : | Continuous 10 Amp, Breaking 2 Amp. (240 V AC) |
| No. of contact | : | 2 NO + 2 NC |
| Reset facility | : | Manual Reset |
| Type of enclosure | : | Die Cast Aluminum |
| Degree of protection | : | Flame proof/Explosion proof for NEC class 1, Division 1 area |
| Local trip indication | : | Required |
| Accessories | : | <ol style="list-style-type: none"> 1. Canopy over lever of pull Cord switch. 2. Linking of switches through a single cable for each section. 3. Each pull cord switch shall be provided with red LED indication lamp for prominent visible indication of tripping. 4. "One number indicator panel which shall display the exact number of safety switches (pull cord and belt sway switches) operated in a loop of conveyor. It shall also monitor the condition of field cable connecting the switches in series & generate signal if field cable is found broken or short. The indicator panel shall display the operated switch number. The same indication shall also be available in CHP PLC operator station. |

3.03.37**BELT SWAY SWITCH**

- Failure Diagnostics
- Long Term Stability
- Fast Response
- IP 66 / NEMA4X Protection
- Supplied with Calibration Certificate Traceable to National & International Humidity Standards
- Sensor protection with sintered filter
- Local LCD Display for Dew Point

3.03.42

Junction Boxes

v.	Type	:	Flame proof/weather proof
vi.	Enclosure	:	IP-65/Explosion/Flame Proof as per area classification.
vii.	Material	:	FRP with protective Coating
viii.	Cable entry	:	Bottom or Side
ix.	Cable glands	:	Double compression type – Nickel plated brass with PVC hoods.
x.	Mounting	:	Indoor/Outdoor
xi.	No. of terminals	:	As required with standardization with 20% spare of each size & type.
xii.	Terminals	:	Phoenix/Wago (screw less cage clamp type spring loaded)
xiii.	Grounding	:	Two terminals for body and shield ground
xiv.	Door	:	Hinged, lockable type.
xi.	Suitable mounting clamps and other accessories shall be in scope of bidder.		
xii	The brackets, bolts, nuts, screws, glands, lugs required for erection shall be of brass, included in bidder scope of supply. High voltage & insulation resistance test shall also be conducted.		
Xiii	M6 Ni plated Brass earthing stud shall be provided (external 2 nos. internal 1 no.)		
xiv	Gasket (Normal)- Neoprene thickness 6.0 mm		

3.03.43

Interposing Relays (IPR)

Electro magnetic type IPRs with modular design, plug-in type connections, suitable for channel/DIN rail mounting in cabinets; coil rating 24V D.C; 2 set of silver plated change over contacts rated for 0.5A 220 V DC/8 A 240 V AC. Free wheeling diode across relay copper coil and self reset type status LED indicator flag (electronic) shall be provided. Manual forcing/override facility is required. The test voltage for relay shall not be less than 4 KV with operating temperature from –20 deg. C to 60 deg. C. The relay shall have the necessary approvals like V0 inflammability class in accordance with UL94”, IEC60664/IEC60664A/DIN VDE 0110. Facility to stimulate IPR manually shall be provided. The VA burden of relays shall be suitable to match the capacity of output modules. Interposing relay & sockets for mounting the interposing relay shall be of same make only.

~~3.03.44~~~~**RECORDERS (CHARTLESS)**~~

Type	:	Micro-processor based, Digital TFT display type
- No. of Channels	:	Forty Eight (48) point).



Input	:	110 V PT Volts
Output	:	4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	$\pm 0.25\%$

3.03.57 TRANSDUCERS FOR POWER FACTOR

Input	:	PT (110V)
Output	:	4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	$\pm 0.25\%$

3.03.58 TRANSDUCERS FOR MVAR

Input	:	CT & PT (110V/1A)
Output	:	4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	$\pm 0.25\%$

3.03.59 DIFFERENTIAL FREQUENCY TRANSDUCERS (FOR SYNCHRONIZATION)

Input	:	110 V PT
Output	:	4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	$\pm 0.25\%$

3.03.60 DIFFERENTIAL VOLT TRANSDUCERS (FOR SYNCHRONIZATION)

Input	:	System voltage
Output	:	4-20 mA with 500 impedance
Mounting	:	Back rail
Accuracy	:	$\pm 0.25\%$

3.03.61 PUSH BUTTONS (PB)/ ILPBs FOR ON/OFF, OPEN/CLOSE, START/STOP

Type	:	Momentary/Miniaturised Suitable for mosaic grid 24x48 Mm with 2 PB and 3 coloured LED.
------	---	--

Contact Configuration	:	2 NO + 2 NC
Contact Material	:	Hard Silver Alloy
Contact Rating	:	500V / 10 A
Insulation Voltage	:	2 KV for 1 minute between

terminals and earth

Lamp Rating :-

a) Voltage	:	240 V AC
b) Watt	:	2 Watt (approx.)

Colour



- Red – ON/Start/Open ILPB
- Green – OFF/Stop/Close ILPB
- Red - energized, running, Start, valve open LED/Lamp
- Green - de-energized, stopped, valve closed LED/Lamp
- Light yellow - abnormal, discrepancy LED/Lamp
- Red – OFF/Stop/Close PB
- Green – ON/Start/Open PB
- Red** - Emergency trip push buttons with red flap / hinged Transperent arylc cover.

- 3.03.62 PUSH BUTTON FOR Control DESK:** **Momentary mosaic grid mounted**
24x48 mm size, single PB 18x40 mm
Colours for DESK RELEASE - Yellow,
Desk Lamp test - Blue, Desk Ack - Green
- 3.03.63 PUSH BUTTON FOR SEQUENCE START/RELEASE :** Momentary (Miniaturised) suitable
for mosaic grid 24x48 mm
3 PB + 5 LED
- 3.03.64 PUSH BUTTON FOR ANNUNCIATION**
- Contacts
- Number & Type : As per requirement
 - Breaking capacity : 1 Amp, 220V DC
10 Amp, 600V AC
- Different colours for Accept/Ack - Green, reset Grey, Lamp test – Blue, System Test – Yellow & Audio Ack - Black.

3.03.65	<u>BELT WEIGHING SYSTEM</u>
3.03.65.1	General
	The mechanical design and constructional features for belt weigher has been described under mechanical section, hence not repeated here, Similarly motor specifications for the same has been covered under electrical specification, hence not repeated here.
	The belt weighing system shall have its own local control panel to be located in electrical equipment room. The local panel shall include: (a) Local flow rate indication (b) Integrated flow rate indications (c) System alarm annunciation (d) Local Calibration facility (e) Power on/off All these above display shall be backlit LCD type with 12mm character height. NI Cd Battery back up (60 minutes backup) shall be provided for the measurement system. (a)Application : Bulk material, Powder material (b)Drive Protection : Reverse Polarity, Communication failure



5.11.00 Technical Specifications of Conductivity Analyser

- | | | |
|----|---------------------|---|
| a) | Applicable standard | ASME PTC 19.11-1970 except as modified in this specification. |
| b) | Type: | |
| | i) Cell | Flow through type/ removable type (withdraw able with sealing valve) |
| | ii) Monitors | Electronic (Microprocessor based) indicating type with multi range facility |
| c) | Material : | |
| | i) Cell | Epoxy resin/SS316 |
| | ii) Electrode | Platinised/SS316 |
| | iii) Monitors body | Carbon steel/Aluminum/Polycarbonate |
| d) | Monitor output | |
| | i) | 4-20 mA D.C. with HART protocol spare out put |
| | ii) | 4-20mA DC with HART protocol for DDCMIS
Output load : 500Ω |
| e) | Power supply | 240V, AC, 50 Hz from UPS |
| f) | Accuracy | ± 1% of full scale span |
| g) | Stability | ± 1% of full scale per month
non-cumulative |
| h) | Repeatability | ± 0.3% of span |



- i) Annunciation contacts from monitors
 - i) Number 2SPDT
 - ii) Type Snap action micro switch
 - iii) Rating 5 amp, 240 V, 0.2 Amp, 220V DC
- j) Connection:
 - i) Cell
 - On line/pipe mounted
(ON LINE in sample table)
1/4 (Quarter) inch NPT (F) SCRD for
on-line type and Three quarter (3/4) inch NPT (M)
SCRD for pipe mounted.
 - ii) Monitors flush panel mounting
- k) Electrical Half (1/2) inch NPT (F) SCRD
- l) Accessories
 - i) Automatic temperature compensation in the range 0-100°C
 - ii) Ammonia (NH₃) removal equipment.
 - iii) Sample coolers
 - iv) Flow and pressure regulators
 - v) SS316 impulse tubing and fittings
 - vi) Isolation & drain valves as required
 - vii) Other accessories as required
 - viii) Adequate length of cables for connecting coils to monitors
 - ix) Sample rate set valves
 - x) Alarm settings and Alarm indications on monitor.
- m) Other particulars Cell shall be suitable for maximum pressure of 7 kg/cm² and maximum temp. of 100°C
- n) Response time ≤ 3 seconds



5.12.00 Technical Specification of pH Cell and Transmitters

- | | | |
|----|--------------------------------------|--|
| a) | Applicable Standard | pH electrodes shall conform to IS: 6804-1972 except as modified in this specification |
| b) | Type: | |
| | i) Cell | Measuring and Reference Electrode Combination with Flow through type (SS316/Polypropylene flow chambers) for power plant's steam & water application. Sensor shall not be affected by flow variation. Sensor shall be designed for power plant applications. |
| | ii) Monitors | Electronic (microprocessor based) indicating type with adjustable range facility. |
| c) | Material: | |
| | i) Measuring & reference | Toughened sensitive |
| | ii) Electrode | pH glass |
| | iii) Monitor body | Carbon steel/Aluminum/Polycarbonate |
| d) | Monitor output | |
| | i) | 4-20 mAmp D.C. with HART protocol spare out put |
| | ii) | 4-20mA DC with HART protocol for DDCMIS
Output load : 500Ω |
| e) | Power supply | 240V AC, 50 Hz from UPS |
| f) | Accuracy/repeatability | + 0.03 pH/+0.02PH |
| g) | Resolution | + 0.01 pH or 1 mV. 1C |
| h) | Stability | 0.02 pH per week |
| i) | Annunciation contacts from monitors: | |



- | | | | |
|----|-------------|---|--|
| | i) | Number | 2 SPDT 'Hi' and 'Lo' |
| | ii) | Type | Snap action micro switch |
| | iii) | Rating | 5 amp, 240V AC, 0.2 Amp, 220V DC |
| j) | Connection: | | |
| | i) | Process | One-quarter (1/4)inch NPT(F) SCRD
ON-LINE |
| | ii) | Electrical | Half (1/2) inch NPT(F) SCRD |
| k) | Mounting: | | |
| | i) | Cell | Pipe Mounted |
| | ii) | Monitors | Flush panel mounting |
| l) | Accessories | | |
| | i) | Automatic temperature compensation with fast response integral temperature sensors in the range 0-100°C | |
| | ii) | Co-axial cable as required | |
| | iii) | Sample coolers | |
| | iv) | low and pressure regulators | |
| | v) | Standard pH solutions | |
| | vi) | SS316 impulse tubing and fittings | |
| | vii) | Isolation & drain valves as required | |
| | viii) | Electrode holders | |
| | ix) | Other accessories as required | |
| | x) | Sample rate set valves | |
| | xi) | Alarm settings and indications on monitor. | |
| | xii) | RFI/EMI shielded, weather and corrosion proof casing | |

5.14.00 Technical Specification of Silica Analyzer (SI OX)

- | | | |
|----|---------------------|---|
| a) | Applicable standard | ASME PTC 19.11-197 except as modified in this specification |
| b) | Type | Multi Channel (max of each Three channel)
Colorimetric Analyzer (with auto reagent shut off feature in case of sample loss or power loss) built in phosphate inhibition feature. Micro processor based. |
| c) | Material: | |
| | i) Case | Die cast aluminum |
| d) | Cycle/Response Time | Twelve (12) minutes Maximum |
| e) | Analysers output | i) 4 to 20 m Amp DC for spare output
ii) 4 to 20 m Amp DC Isolated output for DCS/PLC |
| f) | Power supply | 240V AC, 50 Hz from UPS |
| g) | Accuracy | $\pm 1\%$ of span |
| h) | Repeatability | $\pm 2\%$ of full scale |
| i) | Sensitivity | 0.2 micrograms/liter |
| j) | Connection: | |
| | i) Process | Quarter (1/4) inch NPT(F) SCRD |
| | ii) Electrical | Half (1/2) inch NPT (F) SCRD |
| k) | Ranges | As per sample stream detail table |



- | | | |
|----|------------------------|--|
| l) | Mounting | Flush |
| m) | Annunciation contacts: | |
| | i) Number | 2 SPDT |
| | ii) Type | Snap action micro switch |
| | iii) Rating | 5 amp 240V AC 0.2 Amp 220V DC |
| n) | Accessories | |
| | i) | Automatic temperature compensation between 5 to 50 deg C |
| | ii) | Automatic zeroing provision |
| | iii) | SS316 tubing & vessels |
| | iv) | All chemical reagents for 12 months operation of the analyzer |
| | v) | Sample rate set values |
| | vi) | Comprehensive diagnostic and alarm features. |
| | vii) | Auto sampling facility with necessary valves & solenoids in the sample lines shall be provided. |

5.16.00 Technical Specification of Sodium Ion Analyzer

- | | | |
|----|------|---|
| i) | Type | Microprocessor based Continuous flow through sample type with sodium responsive |
|----|------|---|



		electrode and reference electrode having pH adjustment facility (Max 3 streams)
ii)	Case material	Die-cast aluminum/SS/Polycarbonate
iii)	Analyzer power supply	240V AC, 50 Hz from UPS
iv)	Analyzer output	i) 4-20 mA DC for spare output ii) 4-20 mA DC isolated output for DDCMIS
v)	Accuracy	Better than $\pm 5\%$ of full scale
vi)	Response Time	6 minutes. max
vii)	Sensitivity	0.1 ppb
viii)	Annunciation contacts:	
	- Number	2 SPDT
	- Type	Snap action microswitch
	- Rating	5A 240V AC, 0.2A, 220V DC
	- Mounting	Flush
ix)	Terminal points	All components piped & wired to terminal points
x)	Accessories	i) Flow regulator ii) Flow gauges iii) Sample rate set valves iv) Other accessories as required to make the system complete v) Chemical reagents as applicable for 12 months consumption

5.18.00 Technical Specification of Chloride Analyzer

- | | | |
|-------|------------------------|--|
| i) | Type | Microprocessor based Continuous flow through sample type. |
| ii) | Analyzer power supply | 240V AC, 50 Hz, Single Phase from UPS |
| iii) | Analyzer output | i) 4-20 mA, DC spare output
ii) 4-20 mA, DC isolated output for DDCMIS |
| iv) | Accuracy | Better than ± 10 % of full scale |
| v) | Sensitivity | Better than 1 ppm |
| vi) | Range | As per Requirements. |
| vii) | Annunciation contacts: | |
| | - Number | As per schedule, 2 SPDT |
| | - Type | Snap action micro switch |
| | - Rating | 5A, 240V AC, 0.2A, 220V DC |
| | - Mounting | Flush |
| viii) | Terminal points | All components piped & wired to terminal points |
| ix) | Accessories | i) Flow regulator
ii) Flow gauges
iii) Sample rate set valves
iv) Other accessories as required to make the system complete |

5.19.00 Technical Specification of Chlorine Analyzer

- | | | |
|------|------------------------|---|
| i) | Type | Microprocessor based Continuous flow through sample type with automatic temperature compensation. |
| ii) | Analyzer power supply | 240V AC, 50 Hz, Single Phase from UPS |
| iii) | Analyzer output | i) 4-20 mA, DC spare output
ii) 4-20 mA, DC isolated output for DDCMIS |
| iv) | Accuracy | 0.005 mg/ltr. or 1% of range. |
| v) | Sensitivity | 0.001 mg/ltr. (1 ppb) |
| vi) | Range | As per schedule. |
| vii) | Annunciation contacts: | |
| | - Number | As per schedule, 2 SPDT |



	-	Type	Snap action micro switch
	-	Rating	5A, 240V AC, 0.2A, 220V DC
	-	Mounting	Flush
viii)		Terminal points	All components piped & wired to terminal points
ix)		Accessories	i) Flow regulator ii) Flow gauges iii) Sample rate set valves iv) Other accessories as required to make the system complete

5.20.00 Technical Specification of Residual Chlorine Analyser

SENSOR

Method	:	Amperometric
Electrodes	:	Gold Cathode/Silver Anode
Cell Material	:	PVC
Electrolyte	:	Potassium Bromide

TRANSMITTER

Type	:	Microprocessor Based with self diagnostic features
Transmitter Output	:	4 – 20 mA
Enclosure Protection	:	IP65
Enclosure Material	:	Polyester coated Al.
Electrical Connection	:	½" NPT (F)
Mounting	:	FIELD
Display Type	:	LCD
Display Details	:	4 digit backlit LCD matrix
Diagnostics	:	Required
Meter Range	:	0-1 mg/l
Resolution	:	0.01 ppm
Area Classification	:	SAFE
Electromagnetic Compatibility	:	BUILT – IN
Temp. Compensator	:	AUTO – BUILT – IN
Temp. Compensating element	:	PT100



CHAPTER-12**FLOW ELEMENTS**

12.00.00 This specification covers the design, material, construction features, manufacture, inspection and testing at the VENDOR'S/SUB-VENDOR'S WORKS and delivery to site of Flow Elements.

The equipment furnished to this specification shall conform exactly to the requirements herein, unless modified by the respective Data Sheet of the equipment.

12.01.00 The design, material, construction features, manufacture, inspection and testing of flow elements shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. The equipment shall also conform to the latest applicable standards. Nothing in this specification shall be construed to relieve the Bidder of this responsibility.

12.02.00 Technical Requirement

316SS long radius, weld in flow nozzles with D and D/2 pressure tapings; 316SS flow orifice plate assembly with flange tap connections; β ratio of 0.4 to 0.7. Element material of SS 316. The material of Flow nozzle shall be A182F91, where pipe material is A335P91. The material of all type of accessories will be SS316. End connections for flow elements will be butt welded except orifice plate on condensate return line to CST, which will be flanged. The accuracy of the flow element shall be $\pm 0.5\%$ or better.

Standards

The flow elements (Orifice plates) shall be designed in accordance with ASME PTC – 19.5 (Pt – II), ISA RP3.2, 1960 or BS 1042/ISO 5167.

The flow elements (Flow Nozzles) shall be designed in accordance with ASME PTC – 19.5 (Pt – II), or BS 1042/ISO 5167.

Construction and installation of flow nozzles and orifices shall conform to the requirements of ASME Performance Test Code PTC-19.5 as mentioned above and discharge coefficients shall be predicted in accordance with data published in ASME Research Report on Fluid Meters.

Flow nozzles shall be provided for critical measurements where weld-in construction is required. Flow nozzles shall be made with quater, triple or dual sets of pressure taps installed in the pipe wall where required considering spare one set of pressure tap. Installation of flow nozzles and pressure taps shall be made in the pipe fabricator's shop.

Anubars shall be used where pressure loss is critical and/or conditions permit their reliable installation.

Concentric orifice plates shall only be provided for other flow measurements where flanged construction and higher pressure losses are acceptable. Orifice plates shall be



made of stainless steel. Orifice flanges shall be of the raised face weld neck type with dual sets of taps. Thickness of Orifice plate shall be 3 mm for pipe diameter up to 300 mm and 6 mm for pipe diameter above 300 mm.

Coriolis principle based mass flow meters shall be used for flow (mass & volume) measurement of liquid fuel.

Aerofoil/ Venturi tubes shall be provided for Air flow measurement.

Flow element shall be accompanied by IBR certification. Hydraulic test pressure shall be considered 1.5 times of design pressure at normal temperature.

SS nameplate to flow elements shall include Tag no/ KKS No./SI. No./ Body Material/Beta ratio/line size & thickness/ direction of flow.

BIDDER to ensure that maximum pressure drop/loss shall be limited to 30% of Differential Pressure for flow Nozzle & 60% of DP for Orifice plate.



12.05.00 PERFORMANCE

The Bidder shall submit type test certificate from a recognized test house certifying evaluation of construction standard, accuracy of calibration.

12.06.00 TESTS AND INSPECTION

All equipment components shall be individually tested to ensure correct functioning. Following tests shall also be conducted:

- a) Calibration test
- b) Dimensional check
- c) Material test

Wet calibration shall be carried out as on each size and design of flow element as per ASME PTC or BS 1042/ISO 5167. The other tests shall conform to ASME-PTC 19.5. The Bidder shall submit the reports for all the tests carried out for Owner's review and records. The functional test shall also be witnessed by owner as per approved QAP.



CHAPTER-11**CONTROL VALVES WITH ACTUATORS****11.00.00 CONTROL VALVES, ACTUATORS AND ACCESSORIES****11.01.00 GENERAL REQUIREMENTS**

11.01.01 This section covers the design and construction requirements of Control Valves, their Actuators and Accessories. Except as otherwise specified herein, the Control Valves and accessory equipment furnished under this specification shall be designed, constructed and tested in accordance with the latest applicable requirements of code for Pressure Piping ANSI B31.1, the ASME Boiler and pressure vessel code, Indian Boiler Regulation (IBR) and other standards referenced herein as well as in accordance with all applicable requirements of the "Federal Occupational Safety and Health Standards, USA", or acceptable equal standards.

11.01.02 The design of Control Valves shall comply with relevant codes and standards, account for relevant design criteria viz. environmental conditions, power and air supply, established reliability (reliability target and life expectancy), design of enclosures as specified in Sections earlier.

11.01.03 All Control Valves and accessories furnished under the Section shall be of Owner approved make, fully meeting the qualifying requirements.

11.01.04 Each control valve station shall be provided with pneumatic bypass control valve or Inching type motorised bypass valve as per process requirement and subject to owner approval. In addition each control valve shall also have upstream motorised valve. Downstream motorised valve shall also be provided as per process requirement and as finalized during detailed engineering.

11.02.00 CONTROL VALVE CONSTRUCTION AND SIZING**11.02.01 General**

1. Valve Construction shall be in accordance with the requirements specified herein. (Bidder to also refer NIT drawing # 114-18-0100).
2. The design of all valve bodies shall conform to the requirements of ANSI (USA) for dimensions, material thickness and material specification for their respective pressure classes.
3. The valve sizing shall be suitable for obtaining maximum operating conditions with valve opening at approximately 80% of total travel. Valves shall be open not less than 15 % of full opening for minimum flow condition and shall be capable of handling at least 120% of the required maximum flow at full open condition. Actual pressure drop is indicated in the specification sheets. Permissible pressure drop shall be calculated and



used by the Bidder for sizing calculations. Valve sizing shall be in compliance with the latest edition of ISA Handbook on control valves, ISA standards "ANSI/ISA-75.01.01, Flow Equations for Sizing of Control Valves" with due consideration for the measures to avoid choked flow. Bidder shall ensure that the valve outlet velocity does not exceed 8 meters/second for liquid services, 150 m/second for steam services and 50% of sonic velocity for flashing services by selecting proper body size for the required Cv.

4. a. The Bidder shall provide valves designed to prevent cavitations, wire drawing, flashing on the downstream side of valve and in downstream piping, when operating through full range under the specified conditions.

For cavitating services, valves with anti cavitation trims shall be offered. This shall ensure cavitation prevention by multiple stages of pressure drops. Detailed calculations shall be furnished by bidder to establish cavitations occurrence or otherwise for various process conditions each service wise.

For flashing services such as heater drains, control valve design shall be specially effected to ensure suitability for the adverse high pressure drops and minimise its detrimental effects on control valve parts.

Bidder shall furnish detailed catalogue, calculations, write ups to establish compliance to these stipulations with the selection of each valve. No price implications during engineering stage would be admissible to comply with these stipulations and intents of specification.

- b. The Liquid pressure recovery factor (FL) shall be 0.995 or better for severe flashing/cavitation services.
 - c. The Liquid pressure recovery factor (FL) shall be 0.985 or better for low flashing/cavitation services.
5. Each valve shall be designed for tight shut-off against pressure, the valves shall have maximum permissible leakage rate as per ISA RP 39.6 Leakage Class IV (0.01% of rated valve capacity) or specified other wise.

~~Control Valves for Application such as HP/LP heaters emergency level control, SH spray & RH Spray control, Emergency makeup to Hotwell, Deaerator drain to condenser hotwell & heavy oil heating, HFO & LDO and Pressurizing control system, condenser normal make up control valve shall have permissible leakage rate as per leakage class V (ANSI/FCI).~~

~~All SH/RH block valves, shut off valve of LDO & HFO and BEP recirculation valve shall have leakage class MSS-SP-61.~~



6. The valve design shall take into account noise abatement considerations. The design objective will be to limit the generation of valve induced noise to 85 dBA at 1 Meter from the valve surface under actual operating conditions. The noise abatement shall be obtained by valve body and trim design and piping arrangement and not by the use of silencers.
7. The Bidder shall be responsible for proper sizing of the valve and selection of appropriate model and materials of constructions for meeting the operating requirements specified herein and details subsequently furnished during the detailed engineering stage.
8. The valve travel time shall be less than 10 second for non critical services valves.
9. Rangeability should be 50 to 1 (min.) for non critical services valves.
10. Control Valve's Linearity, Hysteresis, Accuracy shall be $\leq \pm 1\%$ and Sensitivity shall be $\leq \pm 0.5\%$.

Bidder shall furnish the Control Valve data sheets and sizing calculations with the proposal which will be subjected to owner approval during detailed engineering. The bidder shall furnish all valves as per Owner approved data sheets and drawings.

11.02.02 **Valve Construction**

1. All valves shall be of globe body design and straightway pattern. Straightway pattern valves shall be either single or double ported as specified. Double ported and single ported valves shall have high lift cage guided plugs, unless otherwise specified.
2. Where specified, valves with cage guided plugs and quick change trim shall be supplied. The quick change trim shall consist of a cage and seat ring clamped in the valve body by the valve bonnet and sealed with a spiral wound stainless steel asbestos gasket. The trim shall be removable through the top after bonnet removal without any cutting or welding of the valve. Where applicable, plugs shall be designed to include pressure balancing for cage guided valves.
3. Direct acting and self-contained pilot type valves may have low lift plugs.
4. Cast iron valves are not acceptable.
5. Bonnet joints for all control valves shall be of the flanged and bolted type or other construction acceptable to the Owner. Bonnet joints shall be designed for easy disassembly and for assurance of correct valve stem alignment. Bonnet joints of the internal threaded or union type will not be acceptable.
6. Plugs shall be of one-piece construction either cast, forged, or machined from solid bar stock. Plugs shall be screwed and pinned to valve stems or shall be integral with the valve stems.



7. When Teflon packing is used, the lower valve stem which passes through the stuffing box shall be polished to at least 2×10^{-4} millimeters r.m.s.
8. Valves gland packing shall normally be Teflon on liquid and gas services up to 100 kg/cm^2 and 230 Deg.C Teflon impregnated asbestos shall be used above 230 Deg.C and graphite impregnated asbestos with lubrication shall be used for steam services.
9. All valves shall be arranged so that the plugs may be removed from the valve bodies from the bonnet side.
10. Each valve shall have an arrow permanently fixed on the valve body to indicate the correct direction of flow.
11. Each valve shall have a stainless steel name plate permanently fastened to the yoke which shall be visible when the valve is in service. The name plate shall include
 - a. Tag No. and Valve Serial No.
 - b. Body material, size and pressure rating
 - c. Trim material, size characteristics
 - d. Action on air failure
 - e. Spring range
 - f. Stem travel
 - g. Valve action, etc.

11.02.03

Valve Materials

1. Valve material shall be as specified in Supplier's approved Control Valve Specification sheets. The following table defines abbreviations used for valve materials:

S.No.	Abbreviations	Description
a	BR	Bronze ASTM B 61
b	CS	Carbon Steel Forged - ASTM A 105 Cast - ASTM A 216 Grade WCC
c	1- ¼ CR	1-1/4 % Chromium Alloy Steel Forged – ASTM A 182 Grade F11 Cast – ASTM A 217 Grade WC6
d	2- ¼ CR	2-1/4 % Chromium Alloy Steel Forged – ASTM A 182 Grade F22 Cast – ASTM A 217 Grade WC9
e	5 CR	5% Chromium Alloy Steel Forged – ASTM A 182 Grade



		F5 Cast – ASTM A 217 Grade C5
f.	SS	Stainless Steel AISI Type 316 ASTMA 351 Grade CF8M

2. Body material shall be selected by the Bidder to be compatible with the nature of the fluid, service conditions, and piping material to which it is welded and shall be subjected to Owner approval. In general, cast or forged carbon steel bodies shall be provided for non-corrosive process applications up to 275 Deg.C. Alloy Steel castings shall be provided when the media is non-corrosive and the temperature exceeds 275 Deg.C and is within 550 Deg.C. Stainless Steel of suitable grade shall be provided when media is corrosive and the temperature is below 300 Deg.C.

Sr. No.	Service	Body Material
1.	Non Corrosive, Non Flashing, and non cavitations service for process temp. up to 275 deg. C like Aux. steam flow to Deaerator, Cond. Flow to deaerator, Fuel Oil, Atomising steam service etc.	Cast Carbon Steel ASTM A216 Gr. WCB/WCC
2.	Non Corrosive, Non Flashing, and non cavitations service for process temp. above 275 deg. C. and up to 550 deg. C. and for CRH flow to Deaerator.	Cast Alloy Steel ASTM A217 Gr. WC9
3.	Severe Flashing/ cavitations service like Feed Control Valve, Spray Control valves, LP/HP heater emergency level control valve, HP BP spray control valve, Deaerator Overflow control valve etc.	Cast Alloy Steel ASTM A217 Gr. WC9
4.	Low Flashing/ cavitations service like LP/HP heater normal level control & Condensate/feed water below 275 deg. C.	Cast Alloy Steel ASTM A217 Gr. WC6
5.	DM Water Application (Condenser Hotwell normal & Emergency make up etc.)	Cast type 316 Stainless Steel ASTM A351 Gr. CF8M

3. Unless otherwise specified, all control valves shall have stems, guide bushings, plugs, seat rings, stem lock pins, stuffing box parts, and other trim, all made of stainless steel. Valve guide posts and bushings shall be stellite faced for valves where specified. Stellite faced guide posts and bushings shall be differential hardened. For applications involving high pressure drop as also for flashing and cavitation services, trim material shall be properly chosen to ensure required degree of hard facing (such as 17-4 PH SS) so as to avoid erosion.

Sr. No.	Service	Trim Material
1.	Non Corrosive, Non Flashing, and non cavitations service for process temp. up to 275 deg. C. like Aux. steam flow to Deaerator, Cond. Flow to deaerator, Fuel Oil, Atomising steam service etc.	SS316 Stellite
2.	Non Corrosive, Non Flashing, and non cavitations service for process temp. above 275 deg. C. and up	SS316 Stellite



	to 550 deg. C. and for CRH flow to Deaerator.	
3.	Severe Flashing/ cavitations service like Feed Control Valve, Spray Control valves, LP/HP heater emergency level control valve, HP BP spray control valve, Deaerator Overflow control valve etc.	440 SS
4.	Low Flashing/ cavitations service like LP/HP heater normal level control & Condensate/feed water below 275 deg. C.	17-4 PH SS
5.	DM Water Application (Condenser Hotwell normal & Emergency make up etc.)	17-4 PH SS

4. Where stellite facing is not specified, hardened stainless steel shall be furnished for all surfaces subject to wear.
5. Manufacturer recommended materials for cage guided valves may be substituted for materials specified provided they satisfy the specified service conditions. Also where substitutions are made, the manufacturer shall guarantee performance of recommended materials to be equal to or better than the specified materials for conditions specified.

Bidder may offer valve with body and trim material better than the specified material and in such case, bidder shall furnish the comparisons of properties including cavitations resistance, corrosion resistance, temp. resistance, erosion resistance, hardness etc. of the offered material vis a vis specified material for owner approval.

11.02.04 **End Preparation**

1. Valve body ends shall be butt-welded type.
2. Flanged ends shall be of a pressure class equal or greater in pressure-temperature rating to the body design pressure and temperature indicated on the control valve. Unless otherwise specified, steel flanges shall be raised face type. Flanged ends for valves shall be in accordance with ANSI B 16.5.
3. Welded end for control valves where specified shall be socket-weld per ANSI B 16.11 for control valves of sizes 50 mm (2") and below and Butt welded connections per ANSI B16.25 for control valves 65 mm (2-1/2") and above. The end preparation for butt welded control valves shall be matched to the corresponding details for the piping on which the valve is installed.
4. All end preparations shall be as per Owners requirements indicated during Contract stage.

11.02.05 **Miscellaneous Parts**

1. Extension bonnets shall be used on all valves when the maximum temperature of the flowing fluid is greater than 275 deg. C or when specifically required in the control valve.
2. Stem travel indicators shall be provided on all valves.



11.03.00 VALVE OPERATIONS

- 11.03.01 All control valves shall be furnished with pneumatic spring opposed diaphragm, spring less diaphragm, or piston operators as specified herein.
- 11.03.02 The bidder shall be responsible for proper selection and sizing of valve operators in accordance with the pressure drop and maximum shut-off pressures.
- 11.03.03 Valve operators and stems shall be adequate to handle the unbalanced forces occurring under the specified flow conditions or the maximum differential pressure specified. An adequate allowance of stem force, at least 0.15 kg/sq. cm per linear millimeter of seating surface, shall be provided in the selection of the operator to assure tight seating unless otherwise specified. The operators shall be designed to produce the required stem force with supply air pressure of 3.5 kg/sq. cm maximum unless otherwise specified.
- 11.03.04 Diaphragms shall be moulded synthetic rubber and diaphragm housing shall be of pressed steel construction. Diaphragms shall not be fabricated of natural rubber.
- 11.03.05 Piston operators shall use cast pistons and cylinders with O-ring seals. Operators shall be supplied with name plates which indicate the diaphragm air pressure at full open and full closed positions. for single seated valves the pressures shall be listed for maximum differential and for zero differential across the valve.
- 11.03.06 Pistons and cylinders shall be cast aluminum. Piston rod and extension shall be chrome plated stainless steel. Cylinder seal bushings shall be brass and seal rings shall be nitrile. Yoke shall be cast iron.
- 11.03.07 Valve operators shall be capable of operating at 60 °C continuously.

11.04.00 CONTROL VALVE ACCESSORIES & DEVICES

The following accessory equipment shall be provided for control valves:

- 11.04.01 **Air Locks:** Air locks shall be designed to shut off the diaphragm loading air line if the supply air pressure to the associated pilot or Positioner fails. Air locks shall be of the automatic reset type and shall be furnished with alarms.
- 11.04.02 **Hand Wheels:** Hand Wheels shall be provided. Hand wheels shall be side mounted unless specified to be top mounted. However the mounting shall be as decided during engineering to offer maximum accessibility.
- 11.04.03 **Limit Switches:** Each control Valves shall be provided with limit switches for monitoring of end position in DDCMIS/DCS/PLC. Switches shall have not less than two normally open and two normally closed contacts in both open and close directions. Electrical rating of the limit switch contacts shall be 240V AC, 5 amp or 220V DC, 0.5 amp. Limit switches should be National Acme Co., or Honeywell micro switch type or Owner approved equal. The enclosures of the limit switches



shall be as per NEMA-4 Standard. Limit switches shall be constructed to withstand the temperatures encountered in the actual service. Explosion proof construction shall be furnished where required by applicable code or these specifications. Limit switches shall be factory mounted on the valves with provisions for adjusting the mounting. The Bidder shall stroke the valves to check limit switch operation prior to shipment.

Limit/micro switches can be offered as an integral part of Smart valve positioner.

- 11.04.04 **Smart Valve Positioner:** Control valve actuators for modulating and throttling services shall be provided with HART protocol based smart electro pneumatic valve Positioner to ensure accuracy & repeatability of response. The valve Positioner shall be designed suitable for vibration and service conditions of a steam electric power station.

The Positioner shall have the following features:

- a) Shall provide a pneumatic output signal of range 0.2 to 1.0 kg/cm² or as desired for the actuator.
- b) Shall have integral type position transmitter, input & output gauges, local keypad, display, 4-20 mA input and 4-20 mA output for position indication in DDCMIS/CCR/PLC.
- c) Shall be suitable for direct mounting on control valve assembly both for rotary & linear valves.
- d) Shall be capable of functioning under hot, humid & vibrating conditions.
- e) Shall have dust tight, corrosion resistant & weather proof IP 65 metal casing.
- f) Shall be operated at signal range of 4-20 mA for full travel of the valve. Split range operation in few case may be required. This facility shall also be available in positioner.
- g) Shall have in built mechanical position indicator.
- h) Shall have fail safe & fail freeze function as per loop process requirement.
- i) Shall have in built auto tune facility.

- 11.04.05 **Solenoid Valves:** Solenoid Valve will be provided for the following

- i. **ON / OFF Duty type Control Valve**
- ii. For over-riding the controller signal with Modulating type Control valves.
- iii. For control valve stay put position requirement on controller signal failure with Modulating type Control valves.
- iv. For construction and detailed specification of Solenoid valve, Chapter 3, Vol. V shall be referred by bidder.

- 11.04.06 **Diffusers :** Diffusers shall be provided as per service application requirements. The diffuser shall be designed to reduce the pressure drop across the control valve below the critical value and reduce the sound pressure level. Details of the diffusers shall be submitted.



11.04.07 **External Volume Chambers:** External volume chambers with adjustable bleed valves shall be provided for Control Valve. Volume chambers shall be furnished, mounted on the control valve yoke assembly.

11.04.08 **Position Transmitters:** Position transmitters shall be provided for control valves as a part of smart positioner. The signal shall be 4-20 mA DC range, 24 V DC. For non smart positioners applications and power cylinders, contact less position transmitter shall be provided by bidder.

11.04.09 **Tubing and Air Sets:** All pneumatic tubing required to interconnect devices assembled together shall be furnished complete with each control valve. The tubing shall be fully annealed soft temper copper tubing conforming to ASTM B68 to B75 (USA). Swage lock flare less tubing fittings shall be used for tubing connections (Swage lock or approved equal).

Each device requiring an air supply shall be equipped with a combination filter-regulator. Devices mounted together on a valve yoke may be served by a single regulator, provided the supply pressure is satisfactory and the regulator capacity is not exceeded. Filter-regulators shall be mounted on the device served.

Filter- regulators shall be suitable for a 10 kg/sq. cm maximum inlet pressure. Filter-regulators shall have built-in housing blow down valves and a 2 inch pressure gauge. The filter shall be of size not more than 5 microns and shall be made of sintered bronze.

11.04.10 **Pressure Switch**

Pressure switch suitable for the above the pneumatic system shall be provided. The contact rating shall be 2 A for 240 AC, .2 A, 220 VDC 2 SPDT Contact. Enclosure IP 65.

11.04.11 **I/P Converter**

For non smart positioners applications and power cylinders i/p converters shall be required and owner approval shall be obtained for the use of i/p converter for such applications.

Electro-pneumatic, outdoor type, field mounted Linear. 4-20 MA DC input and 0.2 – 1.0 kg/Cm² output. Die cast aluminum casing with IP65 or equivalent enclosure class. Accuracy of $\pm 0.5\%$ of span or better and repeatability of $\pm 0.5\%$ of span or better will be provided. Easily accessible span and zero adjustment will be provided I/P converter shall be provided with all accessories and erection hardware. The I to P converters shall retain the pneumatic signal (last value) even in failure of control signal and shall have self volume boosters.

11.04.12 **Separate moisture separator unit** for ensuring dryness of air entering I/P as well as the power cylinder is to be supplied **with each control valve and control damper.**

11.05.00 **FOR FOLLOWING CRITICAL APPLICATION SPECIAL CONTROL VALVES ARE REQUIRED.:**



- iv. **Back up panel system** shall be designed for handling ~~the situation in clause 2.12.00 for failure of HMI.~~
- v. **For electrical layout, complete backup panel with mosaic** shall have to be provided for complete on/off operations with necessary meters, DDU's, synchroscope etc. as specified elsewhere in specification.
- iv. Control panel cum desk with HW annunciation windows, ILPBs, Ammeters, PBs, voltmeters, indicators, mimic, recorders etc. shall be provided as per Annexure A – Control System Philosophy for BOP packages. Profile/Overall GA of backup control panel cum desk for BOP packages shall be same as indicated in drawing no. 114-05-0105 attached with NIT.

2.06.00**PROTECTION, CLASS OF CABINETS / PANELS, ENCLOSURES ETC.**

- a) All panels, desks cabinets, consoles & enclosures furnished at least comply with the requirements of protection classes as indicated below.
 - 1. In-door Air-conditioned (A.C.) areas - IP32/42 (min.)
 - 2. In-door Non A.C. areas:
 - (a) Ventilated enclosures - IP42
 - (b) Non Ventilated. IP 54
 - 3. Out-door IP55 / IP65
(As per the requirement)
- b) Distribution boxes, junction boxes, cold junction compensation boxes, terminal boxes and all other field mounted equipment to be furnished as per this specification shall have weather protection conforming to IP 65.
- c) The design of panels, cabinets, enclosures and packaging density of components mounted therein shall be such that the temperature rise does not exceed 10 deg. C above the ambient under the worst conditions.
- d) The panels housing electronic hardware shall be provided with flame and smoke detectors by bidder.
- e) Enclosures for peripheral equipments like printers, etc. shall take care of noise and shall ensure minimum possible noise disturb to the working personnel.

2.06.01

Guards, barriers and access doors, covers of plates shall be marked to indicate the hazard, which may occur upon removal of such devices. Danger or caution signs shall be used to warn of specific hazards such as voltage or current. The marking shall be permanently affixed to the equipment.

2.07.00**~~System Documentation~~**

6.15.00 Local Instrument Racks & Enclosure

Transmitters and switches located in the field shall be grouped together and shall be installed in the enclosure (closed transmitter racks) in case of outdoor area such as Boiler area etc. And in open type Rack in case of covered area. Racks shall be factory prefabricated & painted and complete with internal tubing, manifold valve, isolation valves, integral junction boxes with outside access door, illumination etc. Racks used for furnace, flue gas and air application shall be provided with intermittent & continuous air purging.

6.15.01 Closed Type Instruments/Transmitter Racks

- (a) Required number of Instruments/transmitter racks shall be furnished to house transmitters, switches and converters by grouping them suitably, area- wise / function-wise.
- (b) The Transmitter enclosure shall be constructed of 3 mm thick steel plate. The enclosures shall preferably be of modular construction and with two end plate assembly bolted to the frame.
- (c) The enclosure shall approximately be 1200 milimeters wide, 1000 milimeters deep and 2200 milimeters high to allow easy access to the internals. Racks shall be reinforced as required to ensure true surfaces and to provide adequate support for instruments and equipment mounted therein. Double interlocking doors with three point locking arrangement shall be provided and shall be arranged for maximum possible access to the interior. Center posts or any member which would reduce access shall not be provided.
- (d) Doors shall have concealed quick removal type pinned hinges and locking handles. Doors locks shall accept the same key all over the plant. Neoprene material Gaskets shall be used between all mating sections to achieve dust proof enclosure rating for the modules and a IP-65 waterproof and dust tight rating on the terminal boxes. All Enclosures shall have access doors on front side.
- (e) Bulkheads, especially designed to provide isolation from process line vibration shall be installed on modular bulk head plates of the transmitter enclosures to meet the process sensing line connection requirements. Removable top and bottom plates shall be furnished.
- (f) All internal wirings and/or data bus connections, if any, between the transmitters and terminal junction box shall run through flexible dust tight conduits connected to the terminal box hub. No exposed wirings within transmitter racks, both open and closed type, is admissible.
- (g) All racks shall have a common closed drain trough to connect transmitter drain points to a common header after suitable pressure breaking. Covered funnels shall be used for saturated liquid and steam service, where as, open funnels may be used for cold liquid services. The trough shall be suitably sloped and shall have one end flanged and extending beyond the rack for connection to plant drain header.
- (h) Vibration dampeners shall be installed for supporting each enclosure. The loading at each corner of the enclosure shall be determined by actual test weighting when construction is complete to determine the correct length of each dampener for proper loading of the dampener in accordance with owner's recommendations.
- (i) **Service Power and Lighting**



- (i) Each enclosure shall be provided with universal type power receptacle, light fixture & LED lamps with wire guard and lighting switch etc. Lighting switches shall be door actuated & mounted inside the panel. Outlet box, switch box and device covers shall be of galvanized stamped steel. Light switches and power receptacles shall be installed inside the enclosure on the wall near the latch side of the enclosure door. Light fixtures shall be installed on the ceilings of the enclosures.
 - (ii) Power Supplies for miscellaneous devices shall be provided with 2P MCB located within the enclosures. MCB shall be mounted in Fuse blocks. Nameplates shall be furnished above the MCB blocks, identifying the devices being served.
- (j) Control Air
- (i) A control air supply header shall be furnished in each enclosure having pneumatic devices. The header shall be 25 MM NB brass header stock drilled and tapped for 8 millimeter valves.
 - (ii) A valve with double compression end fittings shall be installed in each tap. Not less than three spare connections shall be furnished in each enclosure. The air header shall originate at a bulkhead penetration or fitting located in one of the bulkhead plates. Each pneumatic instrument shall have individual air shut-off valve.
 - (iii) Pressure reduction shall be achieved by air filter regulator sets. One filter regulator shall be furnished for each group of components making a system.
- (k) Service Air
- A 15 mm NB service air header shall be furnished in each enclosure housing draft and coal mill instruments. The header shall be furnished complete with a pressure regulating valve, pressure gauge and valve quick disconnect connections. A hose for connecting each header to the draft instrument line four way valve shall be furnished. The hose shall be self-storing nylon tubing having a burst pressure 15 Kg/Sq. cm. The service air header shall originate at a bulkhead penetration or fitting located on one of the bulkhead plates.
- (l) Power supplies
- Bidder shall supply all required transformers, regulators and other power supply equipment to adapt sources of power to the requirements of the enclosure mounted equipment. This shall include but not be limited to internal instrument illumination transformers. The circuits shall be separately isolated with MCBs.
- (m) Equipment Installation
- Special attention shall be given in the piping layout to avoid air traps in liquid filled piping, or water pockets in piping.
- (n) Impulse piping/tubing



- (i) Transmitter enclosures shall be complete with impulse piping & tubing, valves from enclosure bulkhead connection to all instruments and necessary drain / blow down connections. The type ,size, material and pressure class of pipes/ tubes, fittings, valves etc. Shall be suitable for the intended applications.
 - (ii) Blow down piping / tubing may be shared, but individual instrument piping/ tubing and valves shall be furnished. Piping/ Tubing material within enclosures shall conform to the application requirements. The final flexible connection to each instrument shall be fabricated with a double offset so that it may readily be disconnected to permit "in situ" calibration of the instrument.
 - (iii) Bulkhead connection shall be used when instrument piping/tubing enters the enclosure. For instruments lines which enter through the bottom of the enclosure, the primary process line from the instrument valve shall be neatly installed, anchored and terminated at approximately 150 millimeters above the floor of the enclosure. The enclosure shall have a removable, gasketed floor plate to provide an effective seal around the incoming field primary process line. An angle shall be installed 600 millimeters above the floor, running the length of the enclosure for anchoring of incoming field process lines.
 - (iv) Pulsation dampeners shall be furnished wherever required.
 - (v) Drain pots shall be furnished for instruments measuring flue gas parameters and vacuum.
 - (vi) All liquid filled blow down lines, except those measuring vacuum shall be connected to a header extended through one end of the enclosure and turned downward for directing the blow down into drain. Gas filled lines and lines equipped with drain pots shall not be connected to the blowdown header. The connection between the blowdown valve and blow down header shall be constructed so that it can be removed to permit the connection of test instruments to the blow down valves.
 - (vii) The draft instrument line four-way valves shall be installed so that the quick disconnect fitting is readily accessible for connection with the service air hose.
 - (viii) Pipe and stainless steel tube welding shall comply with the provisions of the latest applicable ANSI code for Pressure piping.
 - (ix) Instrument piping and tubing shall be hydrostatically tested at one and one-half times the maximum system pressure for that instrument except for low pressure and vacuum measurement the test pressure will be as per piping standard.
- (o) Instrument tubing
- (i) Pneumatic tubing shall be installed in a neat workmanlike. It shall be supported frequently enough that it does not shake when subjected to vibration. All tubes which enter or leave the enclosure shall be terminated on bulkhead fittings in the bulkhead plate.
 - (ii) Pneumatic tubing material shall be 6mm OD brass/ 316 stainless steel tubing, unless otherwise specified. Flareless tubing fittings shall be used for tubing connections smaller than one inch. Tubing shall be stretched before installation to assure straightness. Special tools shall be used for all



bending and forming operations. Tubing shall be carefully handled to avoid flat spots, kinks, and short bends. All piping and tubing shall be air blown after erection and before attachment to equipment at either end.

6.15.02 Open Type Transmitter Racks

- (a) Open type transmitter racks may be provided for mounting Transmitters, switches, gauges, converters and other accessories in rooms, buildings and closed areas like the power house building.
- (b) The open type racks may be shop or site fabricated. Transmitters, switches, converters and transducers of enclosure class IP-65 or better can be directly mounted on open racks. However, enclosures not conforming to the above protection standard shall have to be housed in enclosures conforming to the above protection standard shall have to be housed in enclosures conforming to IP-65 class prior to mounting them on open structures.
- (c) Racks shall be constructed on structural members of adequate strength and rigidity to ensure proper support to the mounted instruments and equipment. Racks shall be of welded construction throughout. Major load-bearing posts shall be suitably supported by gusset plates or moment members. Suitable fenders grill shall be welded to the end-posts of the rack to outline a boundary beyond which no mounted equipment shall project to protect instrument from accidental contact during personnel movement. Each rack shall be provided with a canopy (sheet thickness of 3 mm) to protect the instrument from dripping water or falling objects.
- (d) For Operational convenience, the open type racks shall be used for mounting pressure and temperature gauges and switches and the local operating stations for electrical drives in the vicinity. Gauges mounted in racks shall be bottom connected and secured by double lock nuts. All gauges shall be located within 1500 mm from the floor for easy readability.
- (e) The structural design shall be such that no item shall interfere with maintenance and removal of instrument, equipment and their accessories.
- (f) Service Power and lighting
 - (i) Each rack shall be provided with Universal type power receptacle, LED lamp light fixture with wire guard and lighting switch etc. Outlet box, switch box and device covers shall be galvanized stamped steel. Light fixtures shall be installed on the canopy of the rack.
 - (ii) Power supply for respectacles and lighting shall be arranged. Power supplies for miscellaneous devices shall be provided with 2P MCB located within the rack JB. MCBs shall be mounted in blocks. MCB ratings will given on electrical schemetic diagrams. Nameplates shall be furnished above the MCB blocks, identifying the devices being served.
- (g) Control Air
Same as for closed type transmitter rack. Refer 6.15.01 (j) above



- (h) Service Air
Same as for closed type transmitter rack. Refer 6.15.01 (k) above
- (i) Power Supplies
Same as for closed type transmitter rack. Refer 6.15.01 (l) above
- (j) Equipment installation

Contractor shall prepare rack fabrication and piping drawings indicating the layout of each instrument. The drawings shall clearly indicate contractor's piping arrangement for sharing of process connections between two or more instruments. Special attention shall be given in the piping layout to avoid air traps in liquid filled piping or water pockets in piping intended to be dry.

- (k) Impulse Piping/Tubing
Same as for closed type transmitter rack. Refer 6.15.01 (n) above
- (l) Instrument Tubing
Same as for closed type transmitter rack. Refer 6.15.01 (o) above

6.15.03**Wiring of the Racks**

- (a) A fully enclosed IP 65 type junction box shall be provided in each rack for housing the terminal blocks connectors, power supply fuses and other electrical accessories, as required.
- (b) Junction boxes for modular enclosures shall be fabricated externally on one end of each enclosure assembly to accept field wiring/cabling through the top or bottom of the junction box. A hinged door shall give access to the interior of the junction box.
- (c) All electrical connections between instruments and the junction box terminal blocks shall be made. In addition all utility wiring for lighting and service power shall be installed.
- (d) All wiring used within the enclosures shall conform to NEC/ IEC standards. All wiring shall run through flexible or rigid conduits and shall be terminated at suitable terminal blocks. Sufficient clearance shall be provided for all control and instrument leads and all incoming and outgoing leads shall be connected to terminal blocks suitably located for connecting external circuits.
- (e) High impedance circuits shall be connected using shielded or coaxial wire suitable for the service.
- (f) Conduits shall be supported properly at regular intervals with suitable conduit clamps.
- (g) Wire shall be neatly arranged and routed/laid in PVC trough/tray.

6.15.04

In general, local Instrument enclosures & racks shall be designed considering above cl no. 6.04.00 to 6.14.00 and chapter 9, Vol. V.



APPLICABLE CODES AND STANDARDS

1.08.00 CODES AND STANDARDS

1.08.01 All equipments, system and service covered under this specification shall comply with the requirements of the latest statutes regulations and safety codes as applicable in the locality where the equipments/systems will be installed. The Bidder shall fully acquaint himself with these requirements and shall ensure compliance with them.

The equipments, systems and services furnished as per this specification shall conform to the codes and standards mentioned in Cl. no. 1.08.02 of this Section. However in the event of any conflict between the requirements of two standards or between the requirements of any standard and this specification, the more stringent requirements shall apply unless confirmed otherwise by the Owner in writing. The decision of the Owner shall be final and binding in all such cases.

The Bidder's scope of supply shall include some items such as thermowells, and other in-line devices for main steam, hot reheat, cold reheat, feed water system falling under the purview of Indian Boiler Regulation (IBR) Act. It shall be the responsibility of the Bidder to obtain the necessary approval of the concerned Inspecting Authority/Chief Inspector of Boilers for the design and design calculations and manufacturing and erection procedures as called for under the IBR act for all items requiring such certifications.

The requirements of statutory authorities (e.g. MOEF, Inspectors of factories, IBR, TAC, BEE, CPCB/TNPCB etc) with regards to various plants areas like Main plant, Fuel oil plant/system, Chlorination Plant, Fire Fighting system, Emission Measurement, Ambient Air Monitoring system etc. shall be complied, even if not actually spelt out.

1.08.02 Reference Codes and Standards

The design, manufacture, inspection, testing, site calibration and installation of all equipment and systems covered under this specification shall conform to the latest editions of codes and standards mentioned below and all other applicable ANSI,



ASME, IEEE, NEC, NEMA, ISA, DIN, VDE, NFPA, IEC, EIA, TIA and Indian Standards and their equivalents. Bidder to note that in no case, OEM/manufacturers own standards shall be accepted.

1.08.02.01 Temperature Measurement

1. Performance Test Code for temperature measurement ASME PTC 19.3 (1974 – R 1998)
2. Temperature measurement - Thermocouples ANSI-MC 96.1 – 1982, IEC 584
3. Temperature measurement by electrical resistance thermometers - IS-2806.
4. Thermometer-element-platinum resistance-IS-2848, IEC 751/DIN 43760
5. RTD Design Code – DIN EN 60751:1996, BS EN 60751 : 2008
6. Thermowell Design Code – ASME PTC 19.3 TW – 2010

1.08.02.02 Pressure Measurement

1. Performance Test Code for pressure measurement - ASME PTC 19.2 (2010)
2. Bourdon tube pressure and vacuum gauges - IS 3624, IS 3602, ASME B 40.1

1.08.02.03 Electronic measuring Instruments & Control hardware

1. Automatic null balancing electrical measuring instruments - ANSI C 39.4 (Rev. 1973), IS 9319
2. Safety requirements for electrical and electronic measuring and controlling instrumentation - ANSI C 39.5 - 1974.
3. Compatibility of analog signals for electronic industrial process instruments - ISA-S 50.1:ANSI MC 12.1 - 1975.
4. Dynamic response testing of process control instrumentation - ANSI MC 4.1 (1975): ISA-S26 (1968).
5. Surge withstand capability (SWC) tests - ANSI C 37.90A (1974) IEEE Std. 472 (1974). IEC – 255.4.
6. Printed circuit boards - IPC TM-650, IEC 326 C
7. General requirements and tests for printed wiring boards - IS 7405 (Part-I) - 1973
8. Edge socket connectors - IEC 130-11.
9. Requirements and methods of testing of wire wrap terminations DIN 41611 Part-2.
10. Dimensions of attachment plugs & receptacles ANSI C73-1973.
11. Direct acting Electrical Indicating Instruments: IS-1248-1968.

1.08.02.04 Instrument Switches and Contacts

1. Contact rating - AC services NEMA ICS Part-2 125, A600
2. Contact rating - DC services NEMA ICS Part-2-125, N600.



1.08.02.08 Control Valves

1. Control Valve sizing - Incompressible fluids - ISA S39.2 - 1972.
2. Control valve sizing - Compressible fluids - ISA S39.3 - 1973, ISA S39.4 - 1974.
3. Face to face dimensions of control valves - ANSI B16.10
- 1) ISA Hand book of control valves - ISBN B1047-087664-234-2.
- 2) Valves - flanged, threaded and welding end : ANSI B 16.34(2009)
- 3) Casting : ASTM A 216 / A 351 (2008)
- 4) Welded end connection : As per ASME boiler and pressure vessel code / ANSI.B 16.34(2009), B16.25 (2009), B 16.11(2009).
- 5) Defect removal: ANSI B 16.34 2009.
- 6) Cleaning : ASTM A 380 2006.
- 7) CV test : As per ISA procedure S 75.02 (2008).
- 8) Control Valve seat leakage : ANSI/FCI 70.2

1.08.02.09 Enclosures

1. Types of enclosures - NEMA Std. ICS-6-110.15 through 110.22 (Type 4 to 13).
2. Racks, panels, and associated equipment - EIA: RS-310-B (ANSI C83.9 - 1972)
3. Protection Class for Enclosure, Cabinets, Control Panels and Desks - IS-13947-1962.

1.08.02.10 Apparatus, enclosures and installation practices in hazardous areas

1. Classification of hazardous area - NFPA Art. 500, Vol.70-1984.
2. Electrical Instruments in hazardous dust locations - ISA-RP 12.11
3. Intrinsically safe apparatus - NFPA Art.493 Vol.4.1978
4. Purged and pressurized enclosure for electrical equipment in hazardous location - NFPA Art. 496 1982.



1.08.02.12 Annunciators

1. Specifications and guides for the use of general purpose annunciators - ISA RP 18.1-1979.
2. Surge withstand capability tests - ANSI C.37.90a - 1974 and IEEE std. 472-1974

1.08.02.13 Interlocks, Protections

1. Relays and relay system associated with electric power apparatus - IEEE std.3.13.
2. Surge withstand capability tests - ANSI C.37.90a - 1974 and IEEE Std. 472 - 1974.
3. General requirements & tests for switching devices for control and auxiliary circuits including contactor relays - IS-6875 (Part-I) 1973.
4. Turbine water damage prevention - ASME - TDP-1980.
5. Boiler safety interlocks - NFPA Section 85B, 85D, 85E, 85F, 85G.

1.08.02.14 Process Connection and Piping:

1. Codes for pressure piping power piping ANSI B31.1
2. Seamless carbon steel pipe ASTM A-106.
3. Forged and Rolled Alloy steel pipe flanges, forged fittings, valves and parts - ASTM A-182.
4. Material for socket welded fittings - ASTM A-105.
5. Seamless ferrite alloy steel pipe - ASTM A-335.
6. Pipe fittings of wrought carbon steel and alloy steel - ASTM A-234.
7. Composition bronze or metal castings - ASTM B-62.
8. Seamless copper tube, bright annealed ASTM B-168.
9. Seamless copper tube - ASTM B-75.
10. Dimensions of fittings - ANSI B-16.11
11. Valves flanged and butt welding ends - ANSI B16.34.
12. Nomenclature for Instrument tube fittings ISA-RP-42.1 - 1982.

1.08.02.15 Instrument Tubing

1. Seamless carbon steel pipe - ASTM - A106.
2. Material for socket weld fittings - ASTM - A105.
3. Dimensions of fittings - ANSI B16.11
4. Code for pressure piping, welding, hydrostatic testing - ANSI B31.1.

1.08.02.16 Cables

1. Thermocouple extension wires/cables - ANSI C 96.1 - 1982.
2. Colour coding of single or multi-pair cables – VDE 0815



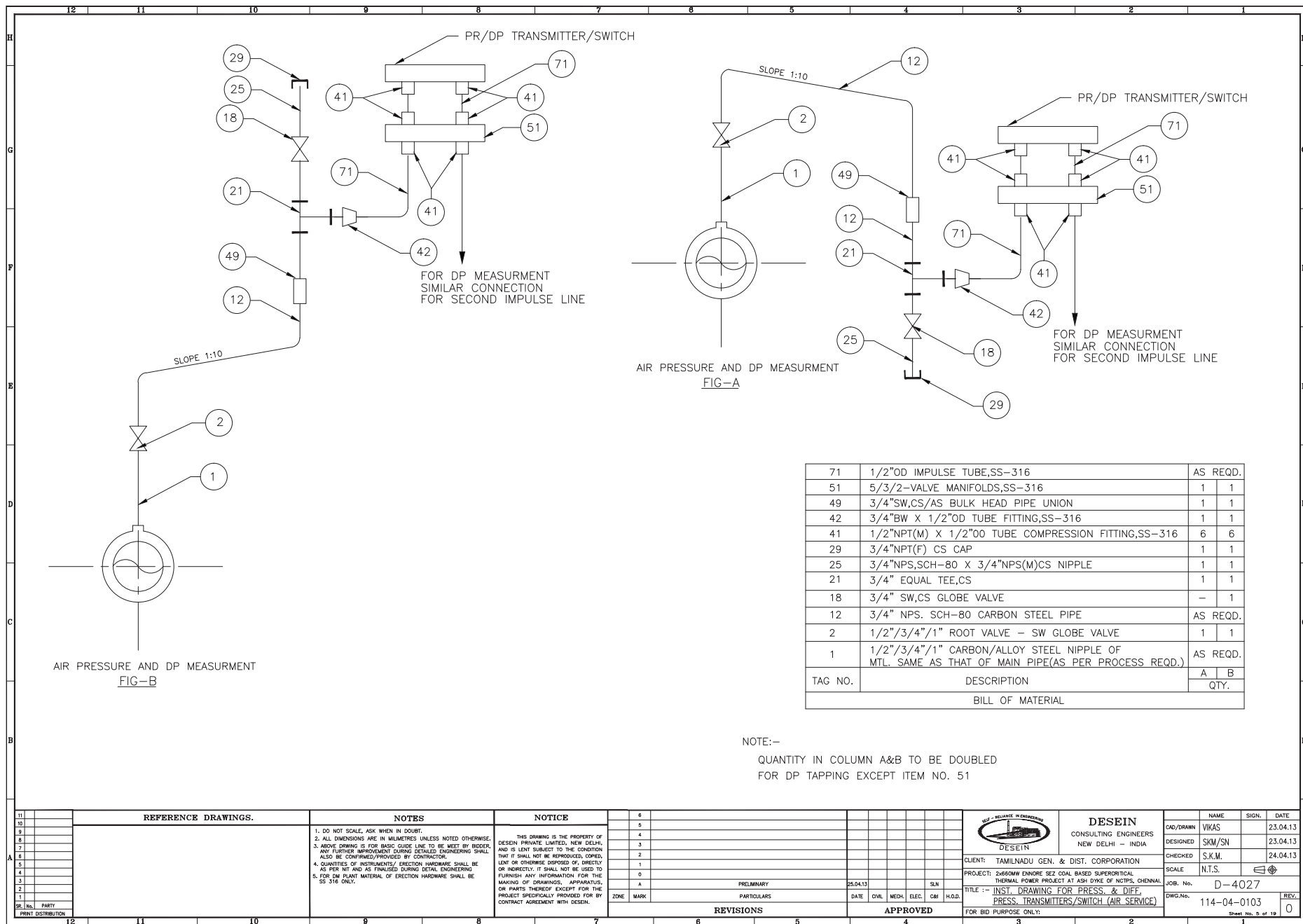
3. Guide for design and installation of cable systems in power generating stations (insulation, jacket materials) - IEEE Std. 422 - 1977.
4. Requirements of vertical tray flame test - IEEE 383 - 1974.
5. Standard specification for tinned soft or annealed copper wire for electrical purpose - ASTM B-33 - 81.
6. Oxygen index and temperature index test - ASTM D-2863.
7. Smoke generation test - ASTM D-2843 and ASTM E-662.
8. Acid gas generation test - IEC-754-1.
9. Swedish chimney test - SEN - 4241475 (F3)
10. Instrumentation cables and internal wiring IS-1554 (Part-I, 1976) and IS-5831(1984).
11. Standard for Control, Thermocouple Extension and Instrumentation cable - NEMA WC57-2004 (IECA S-73-532, Rev. 2, 2004)□
12. PVC insulated (heavy duty) Electric cables for working voltages upto and including 1100V - IS:1554 (Part-I)
13. Conductors for insulated electric cables and flexible cords. - IS:8130
14. PVC insulation and sheath of electric cables - IS:5831
15. Mild steel wires, strips and tapes top armoring cables - IS:3975
16. Water Immersion Test - VDE 0815
17. Drums for electric cables - IS : 1048

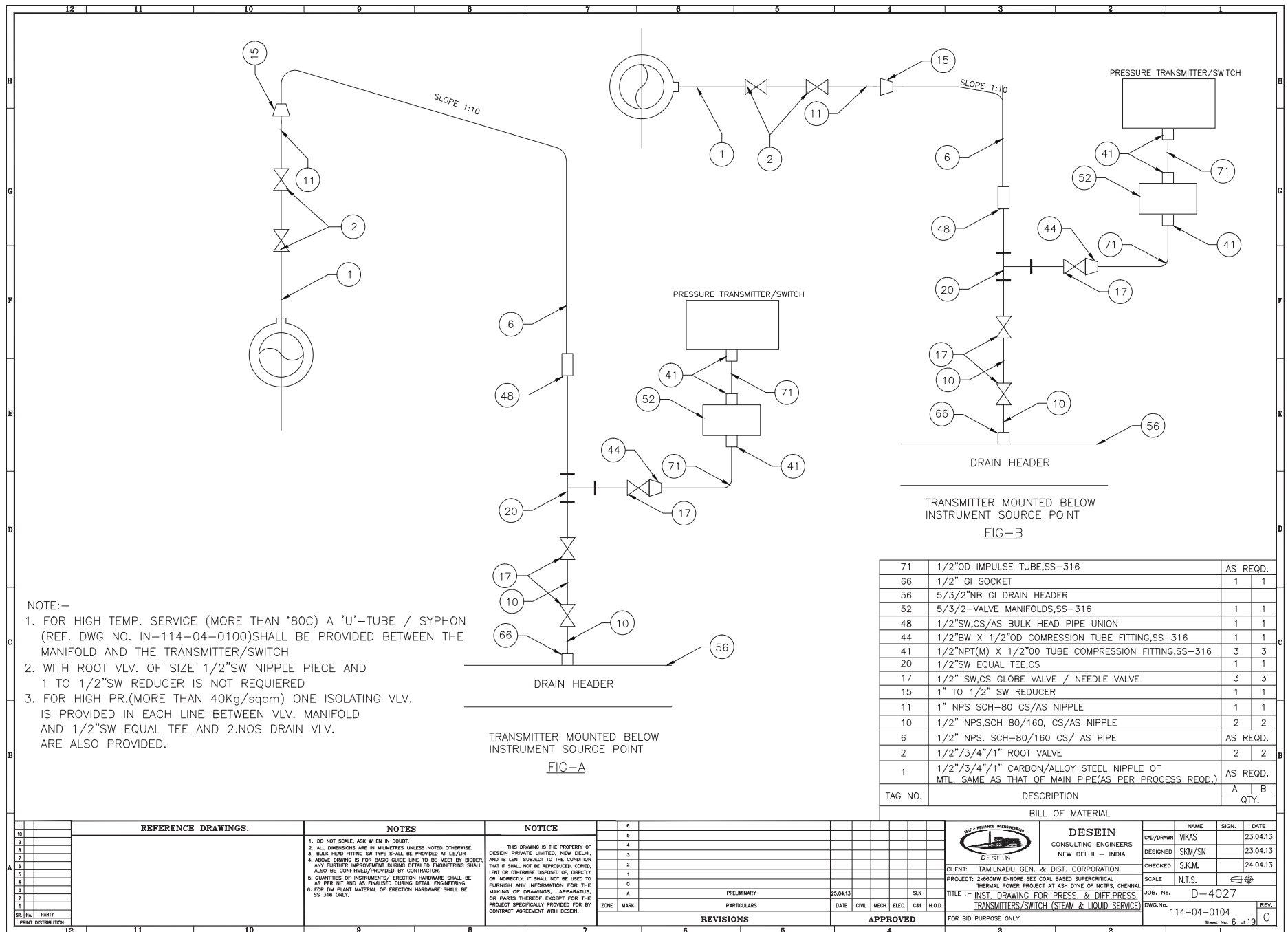
1.08.02.18 Flow measurement

1. ASME Performance Test Code PTC-19.5 (2004), ISA RP3.2
2. BS 1042
3. ISO 5167

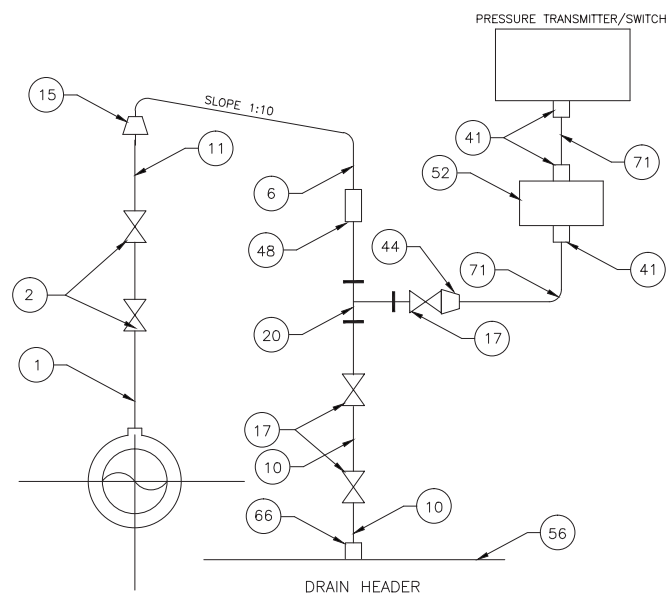


INSTRUMENT INSTALLATION DIAGRAM





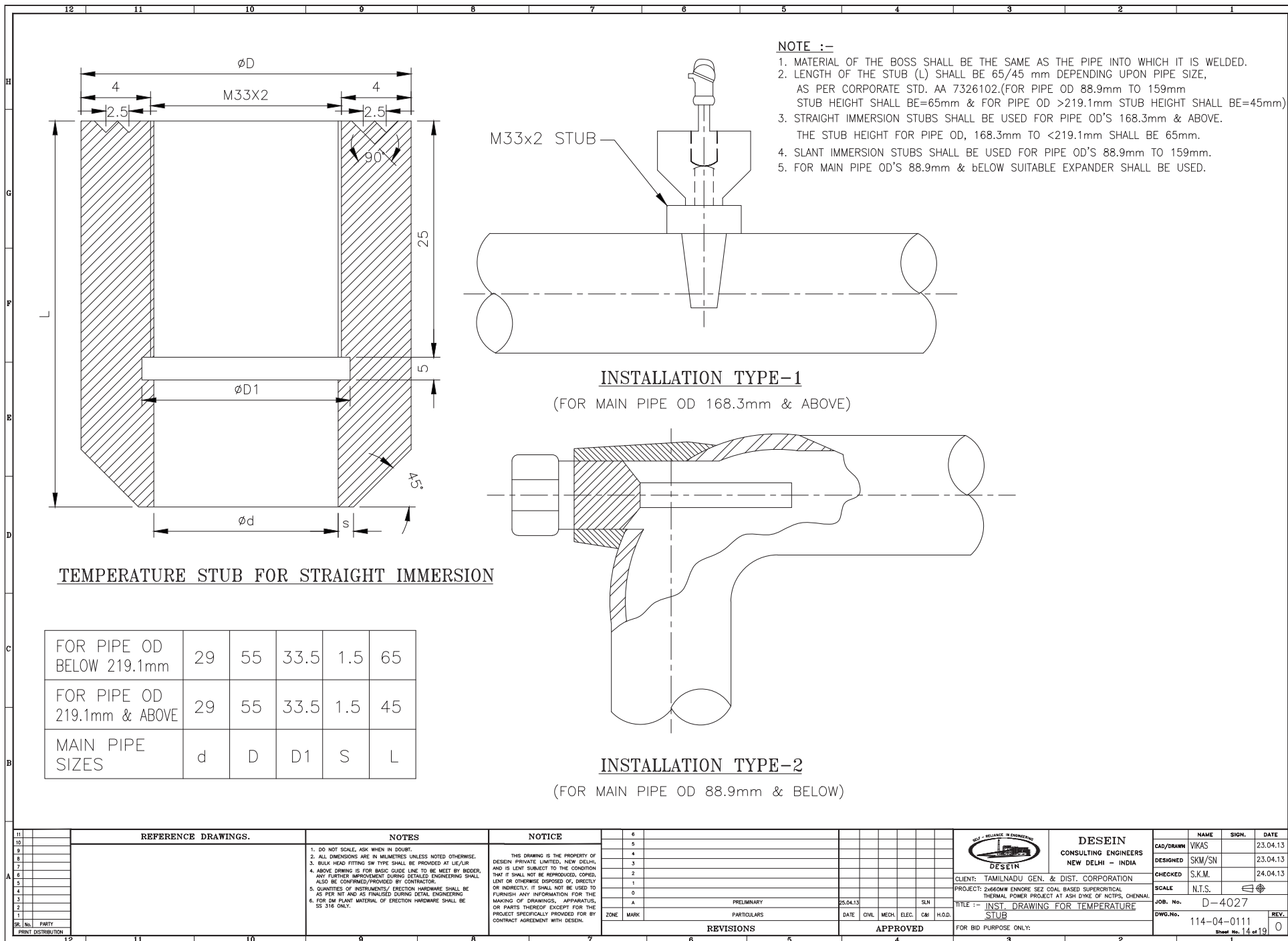
1. FOR HIGH TEMP. SERVICE (MORE THAN *80C) A 'U'-TUBE / SYPHON (REF. DWG NO. IN-114-04-0100) SHALL BE PROVIDED BETWEEN THE MANIFOLD AND THE TRANSMITTER/SWITCH
2. WITH ROOT VLV. OF SIZE 1/2"SW NIPPLE PIECE AND 1 TO 1/2"SW REDUCER IS NOT REQUIRED
3. FOR HIGH PR.(MORE THAN 40Kg/sqcm) ONE ISOLATING VLV. IS PROVIDED IN EACH LINE BETWEEN VLV. MANIFOLD AND 1/2"SW EQUAL TEE AND 2.NOS DRAIN VLV. ARE ALSO PROVIDED.



TRANSMITTER MOUNTED ABOVE
INSTRUMENT SOURCE POINT
FIG-C

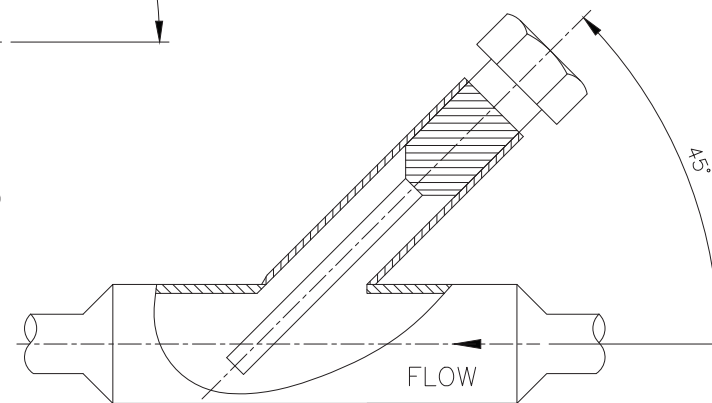
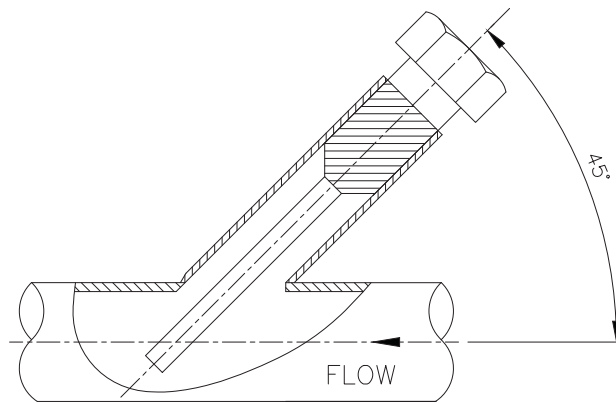
71	1/2"OD IMPULSE TUBE,SS-316	AS REQD.	
66	1/2" GI SOCKET	1	1
56	2"NB GI DRAIN HEADER		
52	5/3/2-VALVE MANIFOLDS,SS-316	1	1
48	1/2"SW,CS/AS BULK HEAD PIPE UNION	1	1
44	1/2"BW X 1/2"OD COMPRESSION TUBE FITTING,SS-316	1	1
41	1/2"NPT(M) X 1/2"OD TUBE COMPRESSION FITTING,SS-316	3	3
20	1/2"SW EQUAL TEE,CS	1	1
17	1/2" SW,CS GLOBE VALVE / NEEDLE VALVE	3	3
15	1" TO 1/2" SW REDUCER	1	1
11	1" NPS SCH-80 CS/AS NIPPLE	1	1
10	1/2" NPS,SCH 80/160, CS/AS NIPPLE	2	2
6	1/2" NPS. SCH-80/160 CS/ AS PIPE	AS REQD.	
2	1/2"/3/4"/1" ROOT VALVE	2	2
1	1/2"/3/4"/1" CARBON/ALLOY STEEL NIPPLE OF MTL. SAME AS THAT OF MAIN PIPE(AS PER PROCESS REQD.)	AS REQD.	
TAG NO.	DESCRIPTION	C	D
		QTY.	

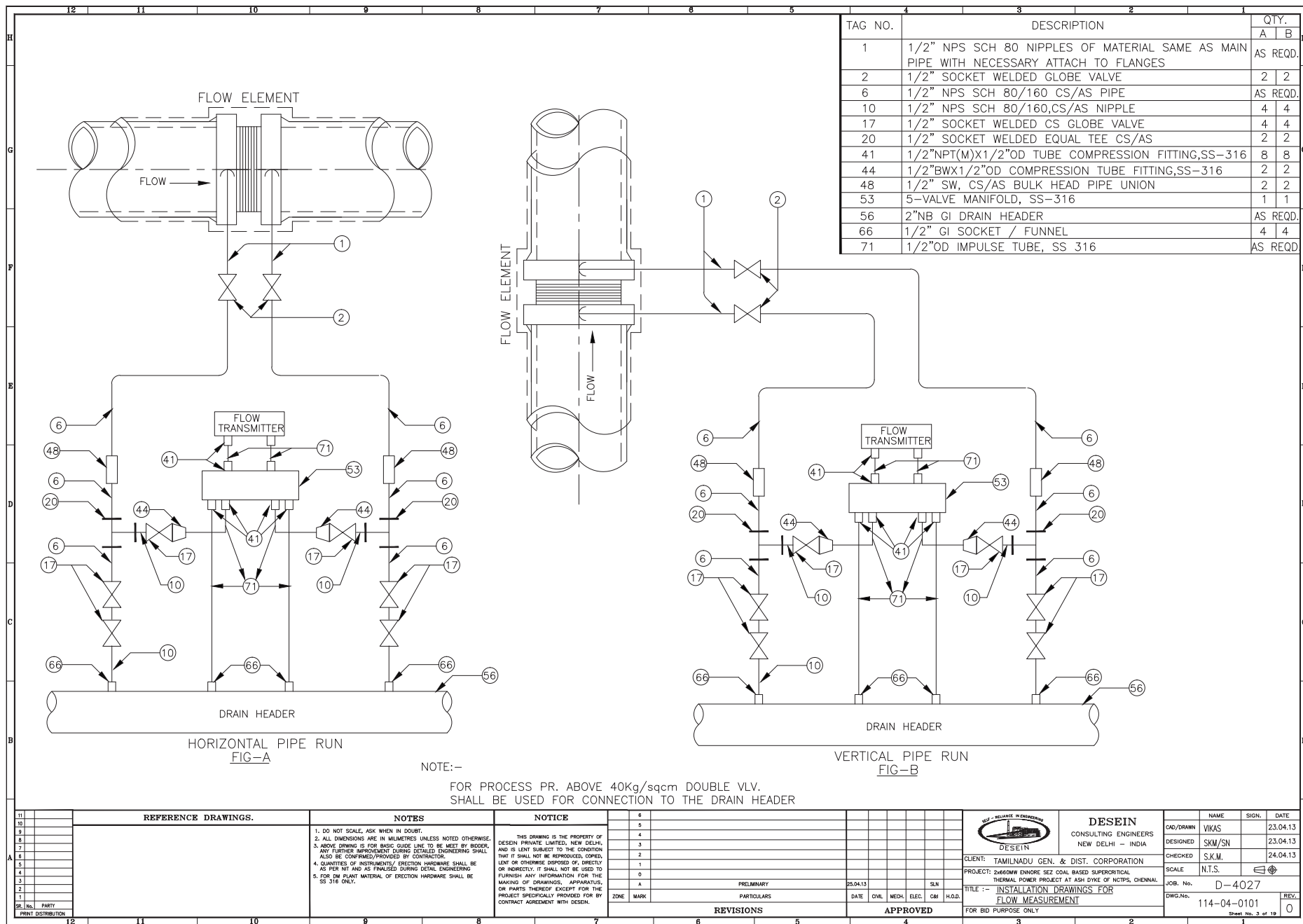
		REFERENCE DRAWINGS.										NOTES										NOTICE										6										7										8										9										10										11										12										13										14										15										16										17										18										19										20										21										22										23										24										25										26										27										28										29										30										31										32										33										34										35										36										37										38										39										40										41										42										43										44										45										46										47										48										49										50										51										52										53										54										55										56										57										58										59										60										61										62										63										64										65										66										67										68										69										70										71										72										73										74										75										76										77										78										79										80										81										82										83										84										85										86										87										88										89										90										91										92										93										94										95										96										97										98										99										100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
												1. DO NOT SCALE, ASK WHEN IN DOUBT.										2. ALL DIMENSIONS ARE IN MILLIMETRES (UNLESS NOTED OTHERWISE).										3. BULK HEAD FITTING 5% TYPE SHALL BE PROVIDED AT LEV/LR.										4. ABOVE DRAWING IS FOR BULK HEADS LIKE TO BE MET BY BULKHEAD. ANY FURTHER IMPROVEMENT DURING DETAILS ENGINEERING SHALL ALSO BE CONFIRMED BY CONTRACTOR.										5. QUANTITIES OF INSTRUMENTS / ERECTION HARDWARE SHALL BE AS PER NIT AND AS FURNISHED DURING DETAIL ENGINEERING.										6. FOR DM PLANT MATERIAL OF ERECTION HARDWARE SHALL BE SS 316 ONLY.										7. THIS DRAWING IS THE PROPERTY OF DESIGN PRIVATE LIMITED, NEW DELHI, AND IS LENT SUBJECT TO THE CONDITION THAT IT SHALL NOT BE REPRODUCED, COPIED, LOANED OR OTHERWISE DISPOSED OF, DIRECTLY OR INDIRECTLY. IT SHALL NOT BE USED TO OBTAIN ANY INFORMATION FOR THE MAKING OF DRAWINGS, APPARATUS, OR PARTS THEREOF EXCEPT FOR THE PROJECT SPECIFICALLY PROVIDED FOR BY CONTRACT AGREEMENT WITH DESIGN.										8. PRELIMINARY										9. 25.04.13										10. SLN										11. ZONE										12. MARK										13. PARTICULARS										14. DATE										15. CIVL										16. MECH										17. ELEC										18. CBI										19. H.O.D.										20. REVISIONS										21. APPROVED										22. FOR BID PURPOSE ONLY:										23. CLIENT: TAMILNADU GEN. & DIST. CORPORATION										24. PROJECT: 246X900 ENCORE SEZ CALABATED SUPERIOR THERMAL POWER PROJECT AT ASH DYKE OF NCTPS, CHENNAI.										25. TITLE :- INST. DRAWING FOR PRESS. & LIFT PRESS. TRANSMITTER/SWITCH (STEAM & LIQUID SERVICE)										26. FOR BID PURPOSE ONLY:										27. NAME										28. SIGN.										29. DATE										30. CAD/DRAWN										31. VIKAS										32. 23.04.13										33. DESIGNED										34. SKM/SN										35. 23.04.13										36. CHECKED										37. S.K.M.										38. 24.04.13										39. SCALE										40. N.T.S.										41. JOB. No.										42. D-4027										43. DWG. No.										44. 114-04-0104										45. REV.										46. 1										47. 0										48. 9										49. 7										50. 1										51. 0										52. 1										53. 0										54. 1										55. 0										56. 1										57. 0										58. 1										59. 0										60. 1										61. 0										62. 1										63. 0										64. 1										65. 0										66. 1										67. 0										68. 1										69. 0										70. 1										71. 0										72. 1										73. 0										74. 1										75. 0										76. 1										77. 0										78. 1										79. 0										80. 1										81. 0										82. 1										83. 0										84. 1										85. 0										86. 1										87. 0										88. 1										89. 0										90. 1										91. 0										92. 1										93. 0										94. 1										95. 0										96. 1										97. 0										98. 1										99. 0										100. 1																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																									
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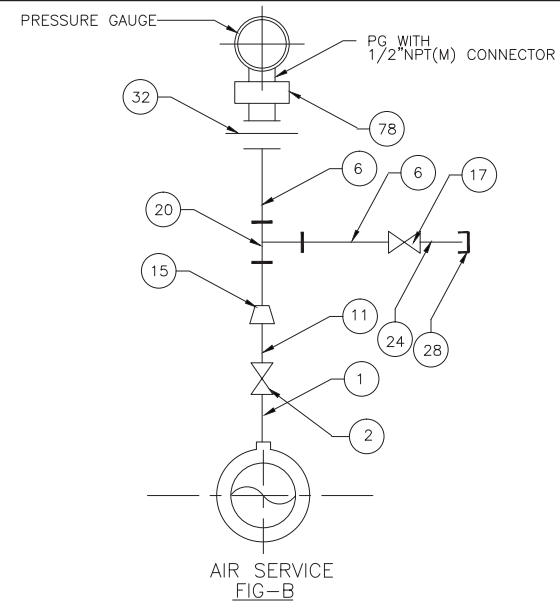
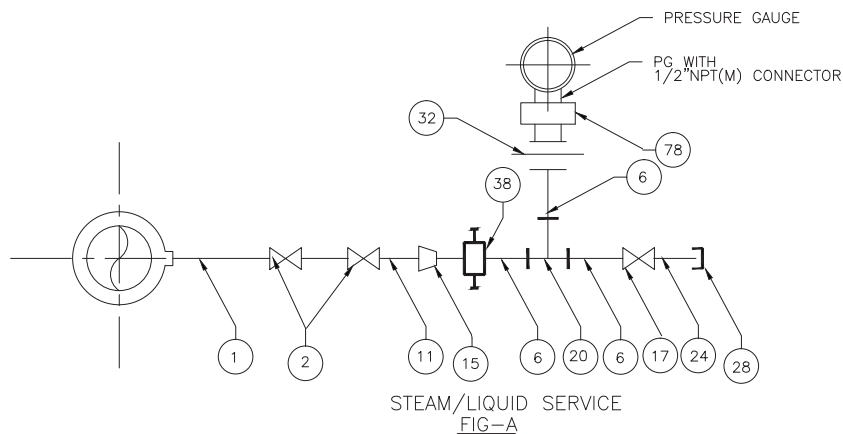


TEMPERATURE STUB FOR SLANT IMMERSION

NOTE :-

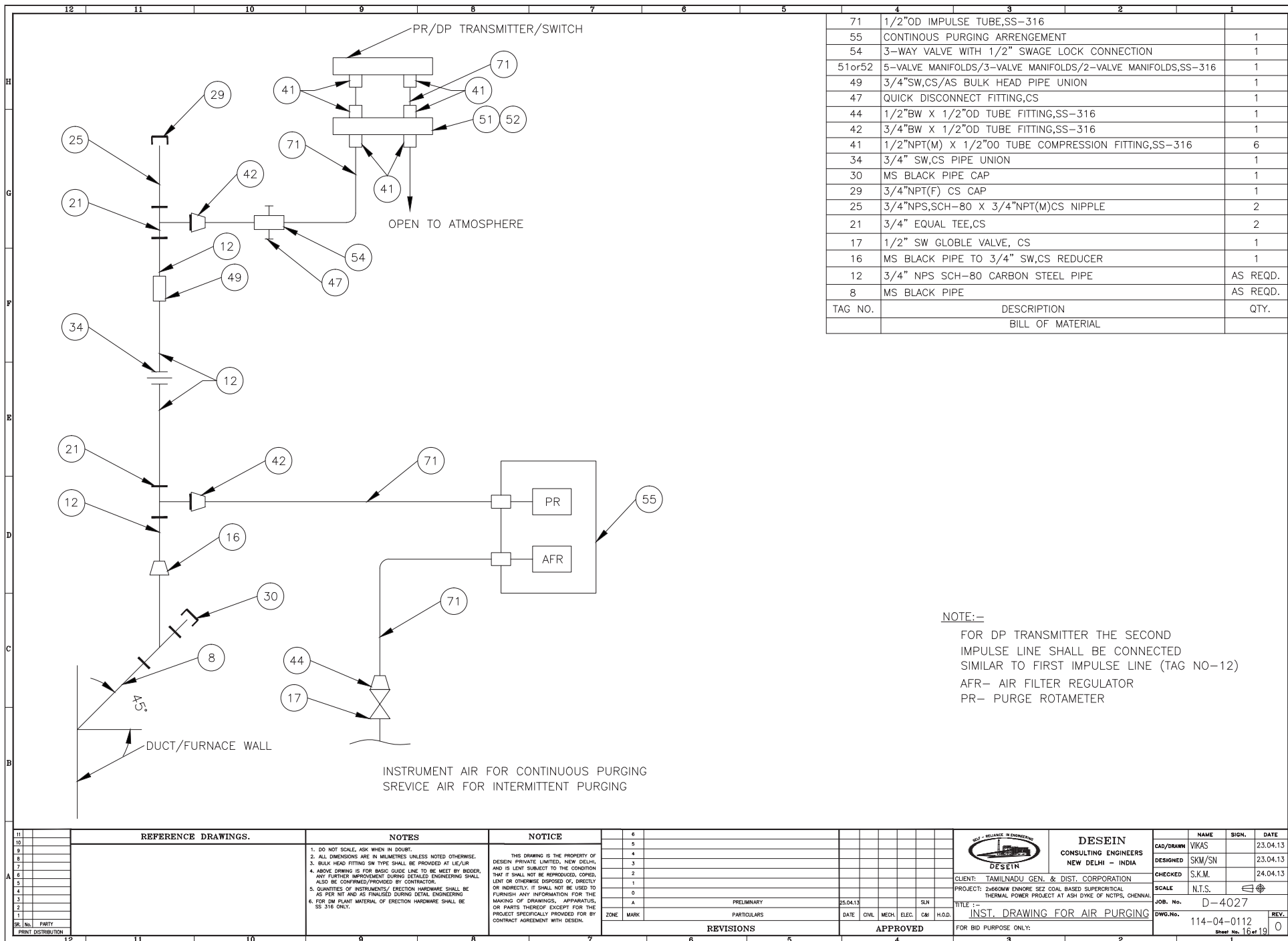
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78	1/2"NPT(F)X1/2"NPT(M) SNUBBER/PULSATION DAMPER	1	1
59	1/2"SW, STRAIGHT PIPE CONNECTOR, CS/AS	—	—
38	3 WAY GAUGE VALVE 1/2" NB SW	1	—
37	6" COILED SYPHON SCH 80/160 1/2"NB CS/SS	—	—
32	1/2"NPS,3PIECE PIPE UNION WITH 1/2"NPT(F) SCREWED	1	1
28	1/2"NPT (F) CS CAP	1	1
24	1/2"NPS,SCH-80/160X1/2"NPT(M)CS/AS NIPPLE	1	1
20	1/2"SW EQUAL TEE, CS/AS	1	1
17	1/2" SW CS/AS GLOBE VALVE	1	1
15	1" TO 1/2" SOCKET WELDED REDUCER	1	1
11	1" NPS SCH-80/160 CS/AS NIPPLE	1	1
6	1/2" NPS. SCH-80/160 CS/ AS PIPE	AS REQD.	
2	1/2"/3/4"/1" ROOT VALVE-SW GLOBE VALVE	2	1
1	1/2"/3/4"/1" CARBON/ALLOY STEEL NIPPLE OF MTL. SAME AS THAT OF MAIN PIPE(AS PER PROCESS REQD.)	AS REQD.	
TAG NO.	DESCRIPTION	A	B
		QTY.	
BILL OF MATERIAL			

REFERENCE DRAWINGS. 11. _____ 10. _____ 9. _____ 8. _____ 7. _____ 6. _____ 5. _____ 4. _____ 3. _____ 2. _____ 1. _____		NOTES 1. DO NOT SCALE, ASK WHEN IN DOUBT. 2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE. 3. ABOVE DRAWING IS FOR BASIC GUIDE LINE TO BE MET BY ROOOF. ANY FURTHER IMPROVEMENT DURING DETAILED ENGINEERING SHALL ALSO BE CONFIRMED/PROVIDED BY CONTRACTOR. 4. QUANTITIES OF INSTRUMENTS/ ERECTION HARDWARE SHALL BE AS PER INT AND AS FINALISED DURING DETAIL ENGINEERING. 5. PRESSURE GAUGE SHALL BE PROVIDED WITH SS-316. 6. FOR DM PLANT MATERIAL OF ERECTION HARDWARE SHALL BE SS 316 ONLY.		NOTICE THIS DRAWING IS THE PROPERTY OF DESEIN PRIVATE LIMITED, NEW DELHI, AND IS LENT SUBJECT TO THE CONDITION THAT IT SHALL NOT BE REPRODUCED, COPIED, LENT OR OTHERWISE DISPOSED OF DIRECTLY OR INDIRECTLY. IT SHALL NOT BE USED TO FURNISH ANY INFORMATION FOR THE MAKING OF DRAWINGS, APPARATUS, OR PARTS THEREOF EXCEPT FOR THE PROJECT SPECIFICALLY PROVIDED FOR BY CONTRACT AGREEMENT WITH DESEIN.		REVISIONS <table border="1"> <tr> <th>NO.</th> <th>DATE</th> <th>BY</th> <th>REASON</th> </tr> <tr> <td>1</td> <td>23.04.13</td> <td>SKM</td> <td>PRELIMINARY</td> </tr> </table>		NO.	DATE	BY	REASON	1	23.04.13	SKM	PRELIMINARY	APPROVED <table border="1"> <tr> <th>DATE</th> <th>CIVIL</th> <th>MECH</th> <th>ELEC</th> <th>CM</th> <th>H.O.D.</th> </tr> <tr> <td>23.04.13</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>		DATE	CIVIL	MECH	ELEC	CM	H.O.D.	23.04.13						 DESEIN CONSULTING ENGINEERS NEW DELHI - INDIA CLIENT: TAMILNADU GEN. & DIST. CORPORATION PROJECT: 2x660MW DANORE SEZ COAL BASED SUPERCRITICAL THERMAL POWER PROJECT AT ASH DIKE OF NCTPS, CHENNAI. TITLE :- INST. DRAWING FOR LOCAL PRESSURE GAUGE FOR BID PURPOSE ONLY		<table border="1"> <tr> <th>NAME</th> <th>SIGN.</th> <th>DATE</th> </tr> <tr> <td>QAD/DRAWN</td> <td>VIKAS</td> <td>23.04.13</td> </tr> <tr> <td>DESIGNED</td> <td>SKM/SN</td> <td>23.04.13</td> </tr> <tr> <td>CHECKED</td> <td>S.K.M.</td> <td>24.04.13</td> </tr> <tr> <td>SCALE</td> <td>N.T.S.</td> <td></td> </tr> <tr> <td>JOB. No.</td> <td colspan="2">D-4027</td> </tr> <tr> <td>DWG.No.</td> <td>114-04-0106</td> <td>REV. 0</td> </tr> </table> Sheet No. 9 of 10		NAME	SIGN.	DATE	QAD/DRAWN	VIKAS	23.04.13	DESIGNED	SKM/SN	23.04.13	CHECKED	S.K.M.	24.04.13	SCALE	N.T.S.		JOB. No.	D-4027		DWG.No.	114-04-0106	REV. 0
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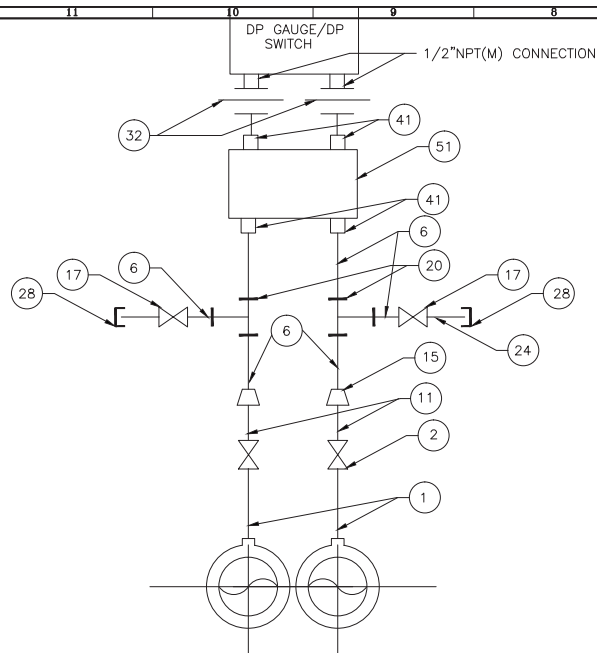


FIG-A

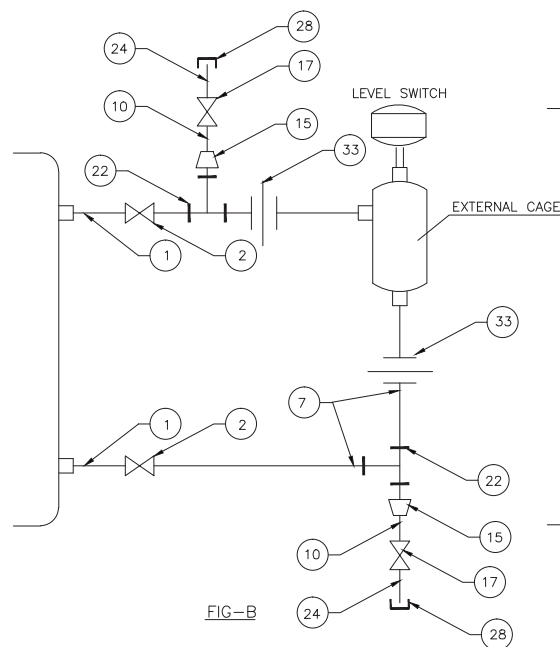


FIG-B

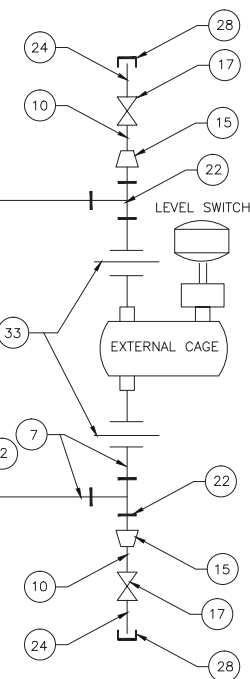


FIG-C

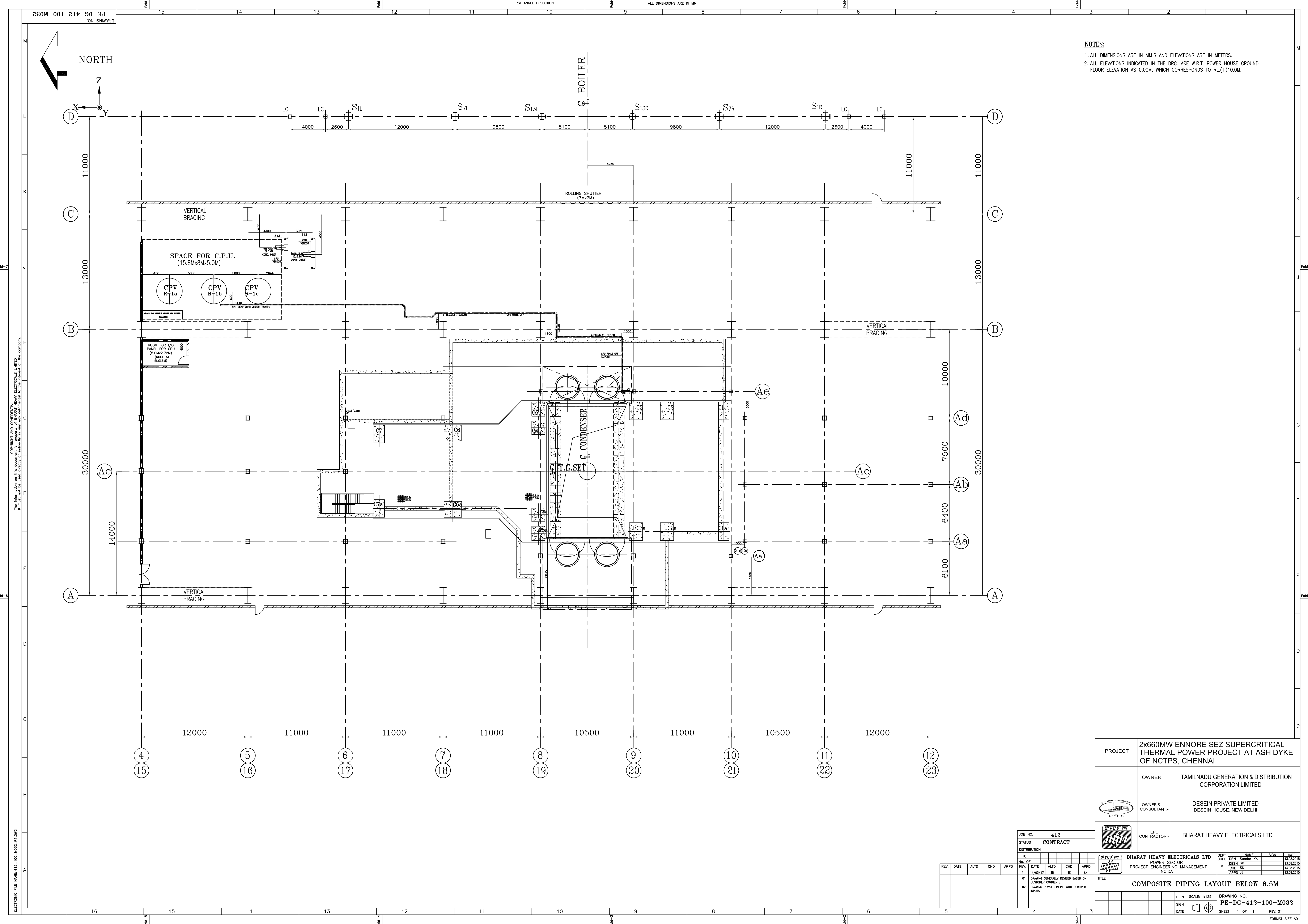
NOTE:-
WITH VALVE OF SIZE 1/2"SW NIPPLE PIECE IS NOT REQUIRED

78	1/2" NPT(F) X 1/2" NPT(M) SNUBBER/PULSATION DAMPNER	1	—	—
51	5 VALVE MANIFOLDS, SS-316	—	—	—
41	1/2" NPT(M) X 1/2" OD TUBE COMPRESSION FITTING,SS-316	—	—	—
38	3 WAY GAUGE VALVE 1/2"NB SW	1	—	—
33	1" SW EQUAL PIPE UNION	—	2	2
32	1/2" NPS,3 PIECE PIPE UNION 1/2" NPT(F) SCREWED AND 1/2" SW CONNECTION	1	—	—
28	1/2" NPT(F) CS. CAP	1	2	2
24	1/2" NPS,SCH 80/160 X 1/2" NPT(M) CS/AS NIPPLE	1	2	2
22	1" SW EQUAL TEE CS/AS	—	1	2
20	1/2"SW EQUAL TEE CS/AS	1	—	—
17	1/2" SW,CS/AS, GLOBE VALVE	1	2	2
15	1" TO 1/2" SOCKET WELD REDUCER	1	2	2
11	1"NPS SCH 80/160 CS/AS NIPPLE	1	—	—
10	1/2"NPS,SCH 80/160 CA/AS NIPPLE	—	2	2
6	1/2"NPS,SCH 80/160 CARBON/ALLOY STEEL PIPE	AS REQD.		
7	1" NPS,SCH 80/160 CS/AS STEEL PIPE	AS REQD.		
2	1/2"3/4"/1" ROOT VALVE — SW GLOBE VALVE	2	2	2
1	1/2"/3/4"/1" CARBON/ALLOY STEEL NIPPLE OF MTL SAME AS THAT OF MAIN PIPE (AS PER PROCESS REQD.)	AS REQD.		
TAG NO.	DESCRIPTION	A	B	C
		QTY.		

REFERENCE DRAWINGS.		NOTES		NOTICE	
11		1. DO NOT SCALE, ASK WHEN IN DOUBT.		6	
10		2. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.		5	
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8		4. QUANTITIES OF INSTRUMENTS/ ERECTION HARDWARE SHALL BE AS PER INT AND AS FINALISED DURING DETAIL ENGINEERING		3	
7		5. FOR O&M PLANT MATERIAL OF ERECTION HARDWARE SHALL BE SS 316 ONLY.		2	
6				1	
5				0	
4				A	
3				ZONE	MARK
2					
1					
SR. No.	PARTY				

REVISIONS		APPROVED	
DATE	25.04.13	DATE	25.04.13
CIVIL		MECH	
ELEC		CM	
H.O.D.			
PARTICULARS		SIGN	
PRELIMINARY		DATE	

 DESEIN CONSULTING ENGINEERS NEW DELHI — INDIA		NAME	SIGN.	DATE
CLIENT: TAMILNADU GEN. & DIST. CORPORATION		CAD/DRAWN	VIKAS	23.04.13
PROJECT: 24660MW ENCORE SEZ COAL BASED SUPERCRITICAL THERMAL POWER PROJECT AT ASH DYNES OF NCTPS, CHENNAI		DESIGNED	SKM/SN	23.04.13
TITLE :- INST. DRAWING FOR DIFF. PRESS. SWITCH/GAUGE/LEVEL SWITCHES		CHECKED	S.K.M.	24.04.13
FOR BID PURPOSE ONLY		SCALE	N.T.S.	
		JOB. No.	D-4027	
		DWG.No.	114-04-0108	REV. 0
		Sheet No. 11 of 19		



- NOTES:**
1. ALL DIMENSIONS ARE IN MM'S AND ELEVATIONS ARE IN METERS.
 2. ALL ELEVATIONS INDICATED IN THE DRG. ARE W.R.T. POWER HOUSE GROUND FLOOR ELEVATION AS 0.00M, WHICH CORRESPONDS TO RL.(+)10.0M.

PROJECT		2x660MW ENNORE SEZ SUPERCRITICAL THERMAL POWER PROJECT AT ASH DYKE OF NCTPS, CHENNAI																		
OWNER		TAMILNADU GENERATION & DISTRIBUTION CORPORATION LIMITED																		
OWNER'S CONSULTANT-		DESEIN PRIVATE LIMITED DESEIN HOUSE, NEW DELHI																		
		EPC CONTRACTOR:-																		
		BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA		DEPT M	<table><tr><th>NAME</th><th>SIGN</th><th>DATE</th></tr><tr><td>DRN Sunder Kr.</td><td></td><td>13.08.2015</td></tr><tr><td>DRN HO</td><td></td><td>13.08.2015</td></tr><tr><td>CHD SK</td><td></td><td>13.08.2015</td></tr><tr><td>APPRO JIJ</td><td></td><td>13.08.2015</td></tr></table>	NAME	SIGN	DATE	DRN Sunder Kr.		13.08.2015	DRN HO		13.08.2015	CHD SK		13.08.2015	APPRO JIJ		13.08.2015
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APPRO JIJ		13.08.2015																		
TITLE																				
COMPOSITE PIPING LAYOUT BELOW 8.5M																				
DEPT.			SCALE: 1:125																	
SIGN			DRAWING NO.																	
DATE			PE-DG-412-100-M032																	
SHEET			1 OF 1		REV. 01															

	TITLE : 2X660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-155A-A001	
		SECTION : I	
	TECHNICAL SPECIFICATION FOR CONDENSATE POLISHING UNIT	SUB-SECTION: I A	
		REV. NO. 00	DATE :

ANNEXURE I
QUALITY PLAN



TITLE :
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR CONDENSATE
POLISHING UNIT**

SPECIFICATION NO. PE-TS-412-155A-A001

SECTION : I

SUB-SECTION: I A

REV. NO. 00

DATE :

CONENSATE POLISHING PLANT

Tests/Check Items / Components	Material Test	WPS/PQR/Welder Qualification	DPT/MPI	Assembly Fit up	Dimension	RT	Hydraulic / Water Fill	Pneumatic Test	Functional/operational Test	Bleeding resistance tests	Adhesion/ Spark Test	Performance Test	Other Test	All Test as per relevant Std/ Appd Data Sheets	Dynamic Balancing	Remarks
CPU Service Vessel	Y ^a	Y	Y	Y	Y	Y	Y ³						Y ¹			
Acid Alkali/Chemical Storage Tanks/ Vessels (LP)	Y ^a	Y	Y	Y	Y	Y ⁴	Y									
Resins/Activated Carbon & Internals of CPU	Y ^a				Y									Y		
Rubber Lining of Vessels/ Tanks/ Pipes etc	Y ^a				Y					Y ²	Y			Y		
Dosing Pumps/Metering Pumps	Y ^a						Y					Y ⁵		Y		
Diaphragm Valves	Y ^a				Y		Y ⁶	Y ⁶						Y ⁷		
Butterfly Valves (Low Pressure)					Y		Y ⁶		Y				Y ⁸			
1. Body (Cast)	Y ^a		Y ^b													
2. Disc (Cast)	Y ^a		Y ^b													
3. Shaft	Y ^a		Y										Y ^c			
High Pressure Ball Valves & Butterfly Valves	Y ^a						Y							Y		
Horizontal Centrifugal Pumps				Y	Y							Y ⁵		Y		
1. Casing	Y ^a		Y ^b				Y									
2. Impeller	Y ^a		Y ^b												Y	
3. Shaft	Y ^a		Y										Y ^c		Y	
Rotary Blowers				Y	Y							Y		Y		
1. Casing	Y ^a		Y ^b				Y									
2. Rotor	Y ^a		Y										Y		Y	

SECTION - 5

QUALITY ASSURANCE PLAN

1.0. GENERAL REQUIREMENTS

a) Shop Tests

Shop tests shall include all tests to be carried out at Bidder's works, at works of his sub-contractor and at works where raw materials 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 Bidder 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, precommissioning 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 Bidder 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 BHEL/TANGEDCO. The same shall be discussed and finalised with the BHEL/TANGEDCO and six numbers of such finalised copies shall be submitted.

2.0. STEAM TURBINE AND ASSOCIATED EQUIPMENT

2.1. High Pressure & Intermediate Enclosure

High pressure Cast Steel Enclosures (for example High pressure and Intermediate Pressure Inner and Outer Cylinders, Steam Chests and liner, Steam Inlet Pipes, nozzle boxes).

- 1) Test pieces fully representative of the material and condition of the casting shall be provided to enable the properties of material to be determined.

Creep requirements:

- a) Steels chosen for design metal temperatures less than 400°C are exempt from creep /stress rupture testing.
 - b) Steels chosen for design metal temperatures between 400°C to 540°C and having less than 3% chromium, shall require 5 years performance feedback experience in the absence of which, creep rupture test will be required to be carried out for maximum test duration of 1000 hrs/mutually agreed parameters for employer's approval.
 - c) Steels chosen for design metal temperatures above 540°C and/or having more than 3% chromium, shall require 10 years performance feedback experience OR adequate stress rupture data, in the absence of which, creep rupture test will be required to be carried out for maximum test duration of 1000 hrs/mutually agreed parameters for employer's approval.
 - d) Unspecified alloying elements shall be controlled as per the applicable standard.
- 2) Each casting shall be subjected to magnetic particle examination on the entire inner and outer surfaces after heat treatment.

- h) Shroud bands after punching and after rivet-ting shall be subjected to 100% DPT to ensure freedom from harmful surface defects.
- i) In case of cast blades, following testing shall be done:-
1. Chemical analysis/Mechanical testing per heat/heat treatment batch.
 2. Rough machined and finish machined blade shall be subjected to MPI.
 3. RT on blades.
 4. Before starting mass productions, following technological tests shall be carried out on the first lot of 10 to 15 blades :-
 - i. 100% radiography and 100% MPI on blades
 - ii. 100% hardness testing.
 - iii. Mechanical testing and metallurgical testing.
 - iv. Weld repair shall not be permitted unless prior approval of Employer is obtained.
- In case of repair is allowed, manufacturer shall submit WPS/PQR and defectogram for Employer's approval before welding. After weld repair, RT shall be carried out on repaired area.

2.5. Diaphragms

- a) Welded and fabricated Diaphragms
- 1) Concentricity checks shall be carried out on finally machined diaphragms to ensure that there are no negative overlaps between guide and moving blades.
 - 2) 10% Ultrasonic examination and 100% magnetic particle examination shall be carried out on finished, stress relieved and machined welds.
- b) Cast/Forged/Machined Diaphragms
- 1) Details of the results of the tests conducted to determine mechanical properties together with chemical analysis, metallographic/ metallurgical examination, and heat treatment procedures recommended and actually followed shall be recorded on certificates.
 - 2) Concentricity, flatness, blade drop and area checks shall be carried out on finally machined diaphragms to ensure that there are no negative overlaps between guide and moving blades and port wall. Finish shall be to employer's approval.
 - 3) A 100% ultrasonic examination shall be carried out on diaphragm materials. Blade junction areas with the side walls shall be checked by magnetic particle or dye penetrant testing.
- c) Colour matching of all the diaphragms by putting two halves together, and feeler gauge tightness check shall be carried out.

2.6. Stop, Control and bypass valves, actuators/servo-motors and steam strainers

- a) Test pieces shall be provided to enable the mechanical properties of valve bodies, bonnets, valve disc and seat, and valve spindle material to be determined.

Test Creep requirements:

- i. Steels chosen for design metal temperatures less than 400°C are exempt from creep /stress rupture testing.
 - ii. Steels chosen for design metal temperatures between 400°C to 540°C and having less than 3% chromium, shall require 5 years performance feedback experience in the absence of which, creep rupture test will be required to be carried out for maximum test duration of 1000 hrs/mutually agreed parameters for employer's approval.
 - iii. Steels chosen for design metal temperatures above 540°C and/or having more than 3% chromium, shall require 10 years performance feedback experience OR adequate stress rupture data, in the absence of which, creep rupture test will be required to be carried out for maximum test duration of 1000 hrs/mutually agreed parameters for employer's approval.
 - iv. Unspecified alloying elements shall be controlled as per the applicable standard.
- b) Dye penetrant checks shall be carried out on stellited / nitrided areas of components and stellite components in the finish ground or honed condition. Hardness checks shall be carried out to ensure required hardness.
 - c) Valve body and bonnet castings/forgings shall be subjected to 100% radiography or 100% ultrasonic examination. Body and bonnet shall also be subjected to 100% magnetic particle examination on entire surface. All pressure containing welds in body and bonnet shall be subjected to 100% RT/UT and MPI examination.
 - d) Wall thickness of the body and bonnet after finish machining shall be measured by ultrasonic method and valve seat bore shall be checked for size and concentricity.
 - e) Bar stock for valve stem shall be subjected to ultrasonic examination and finish machined stem shall be subjected to magnetic particle/Dye penetrant examination.
 - f) Each valve body and bonnet shall be hydraulically tested at minimum 1.5 times the maximum working pressure after applying temperature corrections.
 - g) All the actuating cylinders/servomotors shall be performance tested.
 - h) Performance testing shall be carried out on valve operators/ actuators to check functional requirements like trip closing and opening time, valve lift and hysteresis.
 - i) Colour matching of the valve disc and seat to ensure the required contact area is to be carried out.
- 2.7. Cast and Forged Steel Components such as LP casing, in case of cast design, inlet & extraction / exhaust connections, shaft seal covers and rings, governor shaft, bracket, nut, threaded ring, angle ring, U-ring, servomotor parts such as body, piston, cover, yokes; turning gear casing and other items which are not specifically covered elsewhere

Results of tests conducted to determine mechanical properties, chemical analysis, metallurgical/ metallographic examination, and heat treatment procedures recommended and actually followed shall be recorded on certificates.

Each pressure containing enclosure shall be subjected to a hydraulic pressure test at 1.5 times the design pressure.

Each casting/forging shall be subjected to suitable non-destructive examination by Radiographic or ultrasonic and magnetic particle or dye penetrant examination methods to ensure freedom from harmful defects.

- ~~b) Surface defect test shall be carried out on all the springs after coiling and heat treatment.~~
- ~~c) Surface cleaning shall be checked prior to painting and check for thickness of painting shall be carried out.~~

~~5.0. Condenser air evacuation system for main turbine condenser and drive turbine condenser (if offered)~~

5.1. Pumps

- a) Vacuum pump shafts shall be subjected to ultrasonic test. After finish machining, shaft shall be subjected to magnetic particle examination/dye penetration test.
- b) Pump casings and impellers shall be subjected to magnetic particle/dye penetration test. Finished pump rotor shall be subjected to dynamic balancing.
- c) Pump casings shall be subjected to hydraulic test at 1.5 times the shut off pressure or twice the maximum operating pressure, whichever is higher.
- d) Each pump shall be tested at supplier's works at full speed and load conditions to demonstrate successful operation and performance in accordance with the design requirements.
- e) Supplier shall demonstrate by carrying out visual cavitation test that pump will be operating under all operating condition including blank off condition without cavitation.
- f) Refer relevant clauses of the specification for other items such as heat exchangers, filters, piping, valves, etc. in this system.

5.2. The complete package shall be subjected to hydraulic pressure and leakage test and shop tested to check interlocks and functional requirements. The one complete unit shall also be subjected to demonstrate successful operation and performance testing, with saturated air conditions at condenser design vacuum point as well as vacuum pump design point with total minimum three points. The test should be conducted with the respective motors to be supplied. The test shall include check for vibration and noise level.

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 Employer's 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 hydrotest, the heat exchangers shall be suitably dried and nitrogen capped. Atmospheric tanks shall be tested for leakage by water fill test for atleast 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 > 400⁰C and / or pressure exceeding 71 bar.
 - i. 100% RT/UT on butt welds and full penetration branch welds.
 - ii. 100% MPE.
 - 2) Temperature > 1750C up to 4000C 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 under ground 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.

7.2. Metallic Expansion Bellows

- a) Hydraulic pressure test shall be carried out on each pipe and expansion bellow.
- b) Longitudinal butt weld on bellow shall be subjected to suitable NDT examination before forming, and after forming MPE / DP test shall be carried out.
- c) All welds shall be subjected to 100% magnetic particle/dye penetrant check and butt welds shall be subjected to 100% radiographic testing.
- d) All the bellows subjected to vacuum service shall be subjected to vacuum test.
- e) The bellows shall be subjected to movement test to establish suitability to perform satisfactorily in site conditions. During this test spring rate shall also be measured.
- f) Life cycle test, meridional yield rupture test and squirm test to be carried out on a prototype / expansion bellow as per Sec.D clause 3.2 of standards of Expansion joint Manufacturer Association (EJMA). In case these tests have already been accepted by employer on a prototype expansion bellow, as defined in Sec.D Clause 3.2 of Expansion Joints Manufacturers Association (EJMA) test reports may be furnished by manufacturer for consideration and approval of Employer.

7.3. Rubber Expansion Joint

- a) Rubber compound test slab after vulcanising shall be tested for tensile strength, elongation and shore hardness. Tests on rubber compound shall also include hydrostability test as per ASTM D-3137 and ozone resistance test as per ASTM D- 380.

- b) Fabric strength of synthetic fibre for reinforcement shall be checked, and test for rubber to fabric adhesion as per IS:3400/ASTM D- 413, rubber to metal adhesion as per IS 3100/ASTM D-429 shall be carried out.
- c) All expansion joints in assembled condition shall be subjected to vacuum test at 730 mm Hg under conditions to ensure its suitability to withstand deflection in each axial transverse and longitudinal direction. Duration of test shall be of minimum 10 minutes.
- d) All bare bellows shall be subjected to hydraulic pressure test in normal condition at twice the design pressure for a duration of 30 minutes.
- e) Additionally, all bare bellows shall be subjected to deflection tests under pressure, pressure being raised from zero to the design value in regular steps and deflection measured at each step.
- f) All expansion joints in assembled condition alongwith control rod assembly shall be subjected to deflection test under design pressure. The details of test procedure shall be subjected to approval by employer.
- g) Either during the hydraulic test or during the vacuum test, change in circumference at the top position of the arch shall not exceed 1.5% of measured circumference at normal position.
- h) Twenty Four (24) hours after the above tests, the permanent set (variation in dimensions with respect to its original dimension) shall be measured and recorded. The permanent set shall not be more than 0.5%.
- i) Life cycle test and burst test shall be carried out on bellows of each type, design and size. In case these test have already been accepted by employer in earlier projects for the same type / size /design, test certificate for the same may be furnished for approval of Employer.

7.4. THERMAL INSULATION

- a) For mineral wool insulation, testing shall be carried out as per IS:3144.
- b) For sprayed mineral wool, testing shall be carried out as per IS:9724.
- c) Thermal conductivity (k value) shall generally be measured in line with IS:3346.

7.5. Hangers and Supports

- a) Forged components such as clevis, turnbuckle, eye- bolts, coupling etc. will be subjected to material testing, hardness, MPE, proof load test etc.
- b) Dampers with viscous fluids will be checked for viscosity of liquid used, damping resistance of the damper, stiffness of the damper etc.
- c) Springs used for variable constant load and spring hangers shall be checked for chemical, mechanical and spring rate tests.
- d) Complete variable and constant load spring cage will be subjected to performance test and load/deflection test.
- e) Complete hanger will be subjected to performance test and load test.

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 / stellited 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/stellited 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 Employer 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 vulcanising 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 employer.
- 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.

9.3. LP CHEMICAL DOSING SYSTEM

- a) Pumps of chemical doing system shall be performance tested as per relevant international codes.
- b) In case of diaphragm type of pumps, the life cycle test shall be done on pumps. If this test is already conducted for same model in earlier projects of TANGEDCO, then TCs for same shall be reviewed.
- c) Dosing skid shall be subjected to leakage test and functional test.

10.0. Electrical and Control & Instrumentation:

Refer Electrical and Control & Instrumentation Sections.

11.0. SITE TEST:

Quality requirements for site activities shall be as a minimum, those specified for corresponding shop activities.

11.1. Hydraulic Test of Pressure Parts :

On completion of erection of pressure parts of each steam turbine generator, the unit with its fittings and mountings in position shall be subjected to hydraulic test pressure in accordance with requirement of Indian Boiler Regulations. Water used for hydraulic test shall be made alkaline by addition of suitable chemical. After the test, all parts shall be drained and suitably preserved.

11.2. Condenser Assembly :

- a) If the condenser sections calls for site assembly, care shall be taken in assembly of sections and correctness of alignment and fit up shall be checked. Site welding shall be carried out as per the procedure approved by the employer.
- b) All weld seams shall be subjected to magnetic particle examination. At least 10% of butt welds shall be subjected to radiographic examination.
- c) All welds between condenser neck and LP turbine shall be subjected to 100% radiographic and magnetic particle examination.

- d) Condenser tubes shall be visually examined for dents, mechanical damages or any other defects prior to insertion. Both tube ends shall be thoroughly cleaned to a length of 100mm to remove oil, grease etc. and shall be checked for freedom from burrs prior to insertion.
- e) Tube expansion shall be carried out by electronic automatic torque control expanding unit, which shall be calibrated before use. Tube wall thinning and length of expansion shall be controlled and recorded.
- f) Hydrostatic testing of condenser steam space shall be carried out after connecting all the pipes with the condenser along with condenser vacuum systems by filling the steam space with water upto the tip of the last stages of blades of LP cylinder.
- g) Condenser water boxes shall be tested hydraulically at a minimum test pressure of 1.5 times the design pressure.

11.3. TURBINE ASSEMBLY

Bidder shall clearly indicate the extent of assembly to be carried out at site. Accordingly, bidder shall submit elaborate erection and assembly inspection programme of turbine for Employer's approval.

12.0. CONDENSER ON LOAD TUBE CLEANING SYSTEM/DEBRIS FILTER FOR MAIN TURBINE CONDENSER AND DRIVE TURBINE CONDENSER (IF OFFERED)

General Requirements

12.1. Ball Recirculation Pump

- a) All rotating parts shall be dynamically balanced.
- b) Pump casing shall be subjected to hydraulic test at 1.5 times the shut off head or twice the maximum working pressure whichever is higher.
- c) Complete pump assembly shall be subjected to shop performance test at supplier's works.

12.2. Ball Sorter / Fabricated Body (housing)

- a) In the case of fabricated design, all butt welds shall be subjected to 10% radiographic/ultrasonic examination. All welds shall be examined by 10% magnetic particle testing method to ensure freedom from surface and subsurface defects.
- b) Body shall be subjected to hydraulic pressure test at 1.5 times the design pressure.
- c) Performance test shall be carried out on ball sorter assembly.

12.3. Strainer

- a) Strainer mesh shall be checked for chemical composition and mesh size.
- b) Strainer body shall be subjected to hydraulic pressure test at 1.5 times the design pressure.
- c) Strainer assembly shall be checked for its function.

- 12.4. The complete system and the individual equipment shall be subjected to performance testing at Site to demonstrate successful operation and performance to meet the design conditions. The tests shall also include hydraulic test, function test, check for interlocks and sequential

operation. Site test shall also include test to establish pressure drop across the strainer section, proper functioning of DELTA-P system.

12.5. Piping and Fittings

Piping and fabricated fittings shall be subjected to following NDT.

- a) Butt welds of piping shall be subjected to 10% RT and 10% DP Test. Butt welds of Segmental flanges shall be checked by 100% RT and DPT.
- b) 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.

Wrought/ forged fittings shall be tested as per relevant code/ specification/ standard.

12.6. Coating / lining

12.7. Coating shall be checked for DFT and adhesion. Further, Contractor shall furnish his practice for testing of coating to ensure the uniformity and freedom from pinholes.

12.8. Rubber lined items 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:

- a) Adhesion test
- b) Check for resistance to bleeding
- c) Measurement of thickness
- d) Shore hardness test
- e) Visual examination and spark test at 5 kv/mm of thickness.

12.9. VALVES

Conventional gate/ globe/ check/ ball valves shall be tested as per relevant standard.

13.0. CONDENSATE EXTRACTION PUMPS AND DRIP PUMPS (IF OFFERED)

CONDENSATE EXTRACTION PUMP

INPROCESS TEST											FINAL TESTS						
TEST	Chemical Analysis	Mechanical Prop.	Heat Treatment	Run out	U.T.	R.T	D.P.T.	M.P.I.	Balancing	Hyd. Test	Inclusion Rating	Pressure Drop Test	Performance test	NPSH Test	Vibration	Noise	Strip Down Test
ITEM DESCRIPTION	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Pump Casing	Y	Y ^①	-	-	-	-	Y	-	-	Y	-						
Suction Bell	Y	Y ^①	-	-	-	-	Y	-	-		-						
Shaft	Y	Y ^①	Y	Y	Y	-	Y	Y	-		Y						
Impeller	Y	Y ^①	Y	-	-	-	Y	-	Y		-						
Rotor	-	-	-	Y	-	-	-	-	Y		-						

16.0. 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/operati on 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 ^b			Y				Y ^b		
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. Note14
4)	Gate / Globe / Swing Check Valves	Y ^a	Y ^b	Y ^c			Y ^b	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			

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/operati on al Test	Performance Test	Other tests	All Tests as per Relevant Std	Adhesion / Spark	Remarks
10)	Rubber Expansion Joints	Y ^a					Y ¹²		Y				Y ¹³			
11)	Rubber Lining of Pipes	Y ^a	Y ^b		Y		Y			Y				Y ^a	Y	
12)	Hangers & Supports	Y ^a						Y								
13)	Fastners	Y ^a		Y ^b				Y								
14)	Site Welding		Y ¹		Y		Y									

Notes:

1. Weld Joints not subjected to hydraulic test shall be subjected to 100% RT.
2. Spark Test, Adhesion Test and Material Test for primer and enameled & Coal Tar Tapes as per AWWA-C-203-91
3. DPT on route run and after back gouging and on finish welds.
4. Dry Cycle Test (Spring Cycle Test) for one lakh Cycles shall be carried out as a type test..
5. Seat Leakage Test for Actuator Operated Valves, shall be done with by closing the valves with actuator.
6. 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.
7. Hydraulic Test of Body, Seat and disc-strength shall be carried out in accordance with latest edition of AWWA-C-504 in presence of Employer's 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.

8. 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.
9. Hardness, Bleeding Test and Ozone resistance test shall be done on rubber material
10. 2% of welds shall be subjected to DPT.
11. Pressure drop across the strainer for each type and size as a special test shall be carried out
12. 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%.
13. 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 joints 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 > or = 50 m

17.0 POWER CYCLE PIPING

17.1 H.P. PIPING FOR TURBINE AND AUX.

1. Piping & Fittings

- a) All raw materials used shall have co-related mill test certificate meeting mandatory and supplementary checks of material specification.
- b) Raw material of all forged/formed fittings shall be ultrasonically tested. All mother pipes used for fitting shall either be ultrasonically tested or hydraulic tested. Forged fittings shall be ultrasonically tested and formed fittings shall be MPI tested.
- c) All pipe lengths shall be subjected to 100 % ultrasonic examination or hydraulic tests and UT/RT on longitudinal welds at the tube mill.
- d) Welded and cast fittings if any shall be subjected to suitable NDT as per applicable standards. However, 100 % RT shall be carried out on alloy steel fittings and on carbon steel fittings for use above 71 bar design conditions.
- e) The edge preparation for shop and site welds in stainless steel /alloy steel shall be subjected to a dye penetrate check
- f) Thickness of pipe bend 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) For welds in P91, X20 & X22 materials, induction type of heating shall be deployed for heat treatment, or heat treatment can be carried out in furnace.
- i) 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.
 - a) 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.
 - b) 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.
 - c) 100% UT & 100% MPI on all butt welds of P 91 and X22 UT shall be carried out by digital recorded type.

Wherever SR/PWHT is envisaged, above NDTs shall be after SR/PWHT.
- j) 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.

- k) 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 piping) and 3% hardness survey on welds of other alloy steel.

2. 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.

3. Thermal Insulation & Lagging, Cladding

a) Light resign bound mineral wool:

LRB mattresses of Rockwool/Glasswool from approved manufacturing sources confirming to 8183, tested as per relevant clauses of IS 3144. Wire mesh of diameter 0.71mm (min.) shall only be used.

b) Lagging & Cladding

Aluminium sheeting confirming to ASTM B-203-1060 temper H14 from reputed manufacturer.

4. Valves

- a) Pressure retaining parts of valves shall be subjected to (min.) NDT as per Table 2.
- 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.

TABLE-2

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:

For body and bonnet forgings UT with MPI may be adopted in place of RT.

For austenitic steel MPI may be replaced by LPI.

	MANUFACTURER'S NAME & ADDRESS :	<u>MANUFACTURING QUALITY PLAN</u> ITEM : Chain Pulley Block QP No.: PE-TS-XXX-XXX-A001 REV.: 0, Date.: , PAGE: 1 OF 4	PROJECT : PACKAGE : CHAIN PULLEY BLOCKS VOL IIB, SEC C
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Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTU M OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY	REMARKS
									M C N	
									10.	
1.	2.	3.	4.	5.	6.	7.	8.	9.		11.

1	RAW MATERIAL & B/OUT ITEMS:												
1.1	HOOKS	DIMENSIONS,	MA		One sample	IS: 15560	IS: 15560	MTC	✓	P	V	V	UT FOR SHANK DIA 50MM AND ABOVE
		CHEMICAL COMPOSITION, MECHANICAL, PHYSICAL PROPERTIES	MA	LAB ANALYSIS	PER LOT	Material specification as per approved drawings		T.C.	✓	P	V	V	
		IDENTIFICATION & COMPLIANCE WITH TC.	MA	VISUAL	100%	HOOK TC FROM COMPETENT AUTHORITY		IR	✓	P	V	V	
		INTERNAL DEFECTS	MA	UT	100%	ASTM A-388 (REFER NOTE 1)		TC	✓	P	V	V	
		PROOF LOAD TEST	MA	REVIEW	100%	IS 15560		TC	✓	P	V	V	
		NDT AFTER PROOF LOAD	MA	DPT	100%	ASTM E-165	NO RELEVANT IDENTIFICATION	TC	✓	P	V	V	
1.2	LOAD CHAIN	- DIMENSIONS	MA	MEASUREMENT	100 %	IS: 6216 & APPD. DRGS.	IS: 6216 & APPD. DRGS.	IR	✓	P	V	V	
		- BREAKING STRENGTH	MA	-TENSILE TEST	1/LOT			MTC	✓	P	V	V	
		- PROOF LOAD	MA	-TENSILE TEST	100%			HT	✓	P	V	V	
		-HEAT TREATMENT	MA	REVIEW	100%			CHA	✓	P	V	V	
		-GRADE	MA	REVIEW	1/BATCH			RT	✓	P	V	V	
								MTC	✓	P	V	V	
1.3	RAW MATL. FOR GEAR/ RATCHET PAWL / RATCHET WHEEL	CHEMICAL COMPOSITION, MECHANICAL PROPERTIES	MA	LAB ANALYSIS	ONE SAMPLE PER LOT	MATERIAL SPECIFICATION AS PER	MATERIAL SPECIFICATION AS PER	MTC	✓	P	V	V	TC or inspection report for components

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

	MANUFACTURER'S NAME & ADDRESS :	<u>MANUFACTURING QUALITY PLAN</u> ITEM : Chain Pulley Block QP No.: PE-TS-XXX-XXX-A001 REV.: 0, Date.: , PAGE: 2 OF 4	PROJECT : PACKAGE : CHAIN PULLEY BLOCKS VOL IIB, SEC C
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Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
									M	C	N	
									10.			
1.	2.	3.	4.	5.	6.	7.	8.	9.				11.

						APPROVED DRAWING	APPROVED DRAWING						shall be given.
		INTERNAL DEFECTS	MA	UT	10%	ASTM A-388 (REFER NOTE 1)		IR	✓	P	V	V	
1.4.	LOAD CHAIN WHEELS	- CHEMICAL COMPOSITION MECHANICAL PROPERTIES	MA MA	CHEMICAL MECHANICAL PROPERTIES	ONE SAMPLE PER LOT	APPD. DRG.	APPD. DRG.	MTC	✓	P	V	V	
1.5	BEARINGS	MAKE, TYPE, CATALOGUE 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	
1.8	TROLLEY GEARS, PINION, WHEELS, AXLE	CHEMICAL & MECHANICAL	MA	LAB ANALYSIS,	100%	APPVD DRGS	APPVD DRGS	IR/T C	✓	P	V	V	
2	IN PROCESS												
2.1	RATCHET PAWL / RATCHET WHEEL	-HARDNESS	MA	HARDNESS	100%	IS:3832 / APPD DRG.	IS:3832/ APPD. DRG.	IR	✓	P	V	V	

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

	MANUFACTURER'S NAME & ADDRESS :	<u>MANUFACTURING QUALITY PLAN</u> ITEM : Chain Pulley Block QP No.: PE-TS-XXX-XXX-A001 REV.: 0, Date.: , PAGE: 3 OF 4	PROJECT : PACKAGE : CHAIN PULLEY BLOCKS VOL IIB, SEC C
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Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTU M OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY	REMARKS
									M C N	
									10.	
1.	2.	3.	4.	5.	6.	7.	8.	9.		11.

		-SURFACE CRACK	MA	DPT	100 %	ASTM E165	NO DEFECT	IR	✓	P	V	V	
2.2	GEARS AND PINIONS AFTER MACHINING	SURFACE HARDNESS HEAT TREATMENT, SURFACE CRACK, CASE DEPTH	MA	HARDNESS HT CHART, DPT FOR SURFACE CRACK	RANDOM ASTM E 165 FOR DPT	MFG STANDARD NO DEFECT	MFG STANDARD	IR	✓	P	V	V	
								IR	✓	P	V	V	
3.0	<u>FINAL INSPECTION</u>												
3.1	COMPLETE ASSEMBLY	OVERALL DIMENSION	MA	MEASUREMENT	100 %	IS:3832 /APPD DRG	IS:3832 /APPD DRG	IR	✓	P	W	V	
		PROOF LOAD TEST	CR	LOAD TEST	100%	-DO-	No cracks, flaws & other defects	IR	✓	P	W	V	
		LIGHT LOAD TEST	MA	LOAD TEST	100%	IS 3832	IS 3832	IR	✓	P	W	V	
		HEIGHT OF LIFT	MA	MEASUREME NT	100%	-DO-	-DO –	IR	✓	P	W	V	
		SWIVELING OF HOOK	MA	VISUAL	100 %	-DO-	-DO-	IR	✓	P	W	V	
		EFFORT	MA	PULL ON CHAIN	100%	-DO-	-DO-	IR	✓	P	W	V	
3.2	PAINTING	-CLEANING	MA	VISUAL	AT RANDOM	APPROVED	APPROVED	IR		P	--	--	
		- SHADE & DFT OF PAINT (Blue / Black)	MI	VISUAL	AT RANDOM	DRAWING/ SPECIFICATION	DRAWING/ SPECIFICATION	IR		P	W	-	

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

	MANUFACTURER'S NAME & ADDRESS :	<u>MANUFACTURING QUALITY PLAN</u> ITEM : Chain Pulley Block QP No.: PE-TS-XXX-XXX-A001 REV.:0, Date.: , PAGE: 4 OF 4	PROJECT : PACKAGE : CHAIN PULLEY BLOCKS VOL IIB, SEC C
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Sr. No.	COMPONENT / OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS
									M	C	N	
									10.			
1.	2.	3.	4.	5.	6.	7.	8.	9.				11.

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: BACK WALL ECHO SHALL BE ADJUSTED TO 100% OF FULL SCREEN HEIGHT IN SOUND (DEFECT FREE) AREA. DEFECT ECHO HEIGHT MORE THAN 20% OF SCREEN HEIGHT SHALL BE TREATED AS UNACCEPTABLE. BACK WALL ECHO SHALL NOT BE LESS THAN 80% OF SCREEN HEIGHT IN ANY CASE.

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

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

		MANUFACTURERS NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT		STANDARD TECHNICAL SPECIFICATION			
		AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO	PE-TS-STD-563-A002	PACKAGE		ELECTRIC WIRE ROPE HOIST			
						REV	0	CONTRACT No					
						DATE	Sep-16	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	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 plate thickness above 40mm
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,PINIONS, SHAFT/AXLES, WHEELS	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 machining/grinding	MA	DPT/MPI	100%	ASTM E -165 /E-709, No linear indication		MTC	√	P	V	V	
1.3	WIRE ROPE	Dimensional, type, constrction ,	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.
		DP 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	

[illegible]

		MANUFACTURERS NAME & ADDRESS		MANUFACTURING QUALITY PLAN				PROJECT		STANDARD TECHNICAL SPECIFICATION				
		AS PER APPROVED VENDOR LIST		ITEM:	ELECTRIC WIRE ROPE	QP NO	PE-TS-STD-563-A002	PACKAGE		ELECTRIC WIRE ROPE HOIST				
				REV		0	CONTRACT No							
				DATE		Sep-16		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		
4.1	COMPLETELY ASSEMBLED HOIST	1. COMPLETENESS, CORRECTNESS, WELD QUALITY, OVERALL DIMENSIONS	MA	VISUAL, MEAS	100%	APPD. DRG.	APPD. DRG.	MNFRS' TEST CERT.	√	P	W	W	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	W	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	W	CHP	
		3. OPERATION OF ALL PROTECTIVE DEVICES	CR	VISUAL	100%	TECH SPEC	TECH SPEC.	MNFRS' TEST CERT.	√	P	W	W	CHP	
4.3	OVER LOAD TEST	OVER LOAD TEST INCLUDING HOLDING CAPACITY OF BRAKES, LIFTING LOAD FROM MID AIR, SOUNDNESS OF WELD AFTER OVERLOAD	CR	TEST AT 125 % OF-SWL	100%	IS:3938	IS:3938	INSPN. REPORT	√	P	W	W	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 center of 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												
MANUFACTURER/ SUB CONTRACTOR		N: CUSTOMER/CUSTOMER'S CONSULTANT/CUSTOMER'S APPOINTED THIRD PARTY												
		'P'- PERFORM", "W"- WITNESS AND "V"- VERIFICATION												
SIGNATURE		" CHP" CUSTOMER HOLD POINT					REVIEWED BY		NAME & SIGN OF APPROVING AUTHORITY & SEAL					

THIS IS A PART OF TECHNICAL SPECIFICATION NO. PE-TS-412-155A-A001

		QUALITY PLAN		CUSTOMER : M/s TANGEDCO		PROJECT : 2X 660 MW ENNORE SEZ STPP TITLE		SPECIFICATION : NUMBER : PE-TS-412-155A-A001					
				BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01		SPECIFICATION TITLE					
		SHEET 1 OF 2		SYSTEM		ITEM : AC ELECT. MOTORS BELOW 55KW (LV)		SECTION : VOLUME III					
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS	
1	2	3	4	5	6	7	8	9	P	W	V	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	-	-		
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										
			DATE										
									BIDDER'S/VENDORS COMPANY SEAL				

THIS IS A PART OF TECHNICAL SPECIFICATION NO. PE-TS-412-155A-A001

		QUALITY PLAN SHEET 2 OF 2		CUSTOMER : M/s TANGEDCO		PROJECT 2X 660 MW ENnore SEZ STPP		SPECIFICATION : NUMBER : PE-TS-412-155A-A001				
				BIDDER/ : VENDOR		TITLE QUALITY PLAN		SPECIFICATION : TITLE :				
				SYSTEM		NUMBER PED-506-00-Q-006, REV-01		SECTION VOLUME III				
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	P	W	V	11
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1	-	
NOTES: 1 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON 2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. 3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY.												
<u>Legends for Inspection agency</u> 1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER) P. PERFORM W. WITNESS V. VERIFY												
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

THIS IS A PART OF TECHNICAL SPECIFICATION NO. PE-TS-412-155A-A001

		QUALITY PLAN		CUSTOMER : M/s TANGEDCO		PROJECT 2X 660 MW ENNORE SEZ STPP TITLE		SPECIFICATION : NUMBER : PE-TS-412-155A-A001				
				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	RELEVENT 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	RELEVENT 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			

THIS IS A PART OF TECHNICAL SPECIFICATION NO. PE-TS-412-155A-A001

		QUALITY PLAN		CUSTOMER : M/s TANGEDCO		PROJECT 2X 660 MW ENNORE SEZ STPP TITLE		SPECIFICATION : NUMBER : PE-TS-412-155A-A001				
				BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE				
				SHEET 2 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
1.5	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	
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	FOR DIA OF 55 MM & ABOVE
		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				

THIS IS A PART OF TECHNICAL SPECIFICATION NO. PE-TS-412-155A-A001

		QUALITY PLAN		CUSTOMER : M/s TANGEDCO		PROJECT 2X 660 MW ENNORE SEZ STPP		SPECIFICATION : NUMBER : PE-TS-412-155A-A001				
				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
									P	W	V	
1	2	3	4	5	6	7	8	9	10			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*	
		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	* 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.
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

THIS IS A PART OF TECHNICAL SPECIFICATION NO. PE-TS-412-155A-A001

		QUALITY PLAN		CUSTOMER : M/s TANGEDCO		PROJECT 2X 660 MW ENNORE SEZ STPP TITLE		SPECIFICATION : NUMBER : PE-TS-412-155A-A001				
				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
1	2	3	4	5	6	7	8	9	10	11	12	13
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			

THIS IS A PART OF TECHNICAL SPECIFICATION NO. PE-TS-412-155A-A001

		QUALITY PLAN SHEET 5 OF 9		CUSTOMER : M/s TANGEDCO		PROJECT 2X 660 MW ENNORE SEZ STPP TITLE			SPECIFICATION : NUMBER : PE-TS-412-155A-A001			
				BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
				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	12	
2.0	IN PROCESS											
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNESS	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			

THIS IS A PART OF TECHNICAL SPECIFICATION NO. PE-TS-412-155A-A001

		QUALITY PLAN SHEET 6 OF 9		CUSTOMER : M/s TANGEDCO		PROJECT 2X 660 MW ENNORE SEZ STPP TITLE			SPECIFICATION : NUMBER : PE-TS-412-155A-A001				
				BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE				
				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
2.4	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		
												FOR MV MOTOR	
2.6	IMPREGNATION	1.VISCOSCITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-		THREE DIPS TO BE GIVEN
		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				

THIS IS A PART OF TECHNICAL SPECIFICATION NO. PE-TS-412-155A-A001

		QUALITY PLAN		CUSTOMER : M/s TANGEDCO		PROJECT 2X 660 MW ENNORE SEZ STPP TITLE		SPECIFICATION : NUMBER : PE-TS-412-155A-A001				
				BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE				
		SHEET 7 OF 9		SYSTEM		ITEM: AC ELECT. 2X 660 MW ENNORE SEZ STPP		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
2.7	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												

THIS IS A PART OF TECHNICAL SPECIFICATION NO. PE-TS-412-155A-A001

		QUALITY PLAN SHEET 8 OF 9		CUSTOMER : M/s TANGEDCO		PROJECT 2X 660 MW ENNORE SEZ STPP TITLE			SPECIFICATION : NUMBER : PE-TS-412-155A-A001			
				BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE			
				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	12	
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			

THIS IS A PART OF TECHNICAL SPECIFICATION NO. PE-TS-412-155A-A001

		QUALITY PLAN		CUSTOMER : M/s TANGEDCO		PROJECT 2X 660 MW ENNORE SEZ STPP TITLE		SPECIFICATION : NUMBER : PE-TS-412-155A-A001			
				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 P W V		REMARKS
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 ASSURANCE PLAN/CHECK LIST
FOR CONTROL & INSTRUMENTATION**

CHAPTER-14**QUALITY ASSURANCE AND TESTING AND GUARANTEES****14.01.00 GENERAL REQUIREMENT**

- 14.01.01** All equipment furnished under this specification shall be subject to test by authorized quality assurance personnel of the Bidder, representatives of the Owner during manufacture, erection and on completion. Bidder quality assurance personnel for these shop and site tests shall be identified in advance and shall be acceptable to the Owner. The approval of the Owner or passing of such inspection of tests will not, however, prejudice the right of the owner to reject the equipment if it does not comply with the specifications when erected or fails to give complete satisfaction in service.
- 14.01.02** The Bidder shall furnish details of shop and site tests proposed to be conducted by him at various stages to meet the specification requirements for each type of instrument/system along with his proposal. Bidder shall also furnish details of his proposed shop and site quality assurance organization for this contract
- 14.01.03** Bidder shall prepare a detailed shop and site 'Quality Assurance Programme' to meet the requirements of these specifications for Owner's approval. This document shall also contain the formats for reports and maintenance of test records specification of test equipment to be used for site tests.
- 14.01.04** All equipment and systems furnished under this specification shall be subjected to shop & site tests in accordance with the Quality Assurance Program approved by the Owner and shall be adequate to ensure full compliance with these specification, all applicable codes & standards and detailed engineering drawings and documents approved by the Owner.
- 14.01.05** The Bidder shall provide all required test equipment and simulation devices for performing all shop and site tests. All tests equipment shall be of reputed make, required accuracy class and shall be recently calibrated. The record of calibration of test equipment shall be made available to the Owner on demand.
- 14.01.06** The cost of all tests as per the requirements of this specification and approved quality assurance programme shall be included in Bidder's lump sum price for this package and no extra price shall be payable by the Owner for conducting any test as per the intent and requirements of this specification.
- 14.01.07** All approval/Inspection are to be carried out by the Owner only.



14.02.04.21 Calibration of Instruments

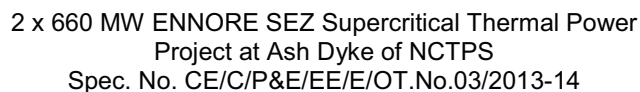
The Bidder shall carry out the calibration of instruments as indicated below by submitting the test procedure and quality assurance plan for the Owner's approval. Bidder shall also prepare detailed checklist/calibration sheets for each of the systems/equipment clearly indicating the step-by-step procedures to be carried out for calibration pre commissioning, loop checking, powering and commissioning.

The calibration of all instruments shall be checked and calibration records prepared for the Owner's use. If the instruments require recalibration, Bidder shall recalibrate the instruments and revise the calibration records and submit to the Owner.

i TESTS TO BE PERFORMED FOR FIELD INSTRUMENTS

1.	Pressure Gauges
	Calibration Hydro test (1.5 times max. pr.)
2.	Pressure switches
	Calibration test / Hydro test / Contact rating test / Accuracy test / Repeatability
3.	Differential Pressure Gauges
	Calibration test / Hydro test / Leak test / Over range test / Accuracy test / Repeatability test.
4.	Differential Pressure Switches
	Calibration test / Hydro test / Contact rating test / Leak test / Accuracy test / Repeatability test.
5.	Thermometers
	Calibration / Material test / Accuracy test / Bore concentricity : $\pm 5\%$ of wall thickness / Hydrostatic test for TW (1.5 times max. pr.)
6.	Temperature switch
	Calibration / Material test / Accuracy test / Bore concentricity : 1.5% of wall thickness / Hydrostatic test for TW (1.5 times max. pr.) / Contact rating test.
7.	Resistance temperature detector assembly.
	Calibration / Material test / Bore concentricity test / Insulation test ($\leq 500 \text{ M}\Omega$ at 500V DC) as per ISA, Hydro test for TW. Bore concentricity: $\pm 5\%$ of wall thickness, Accuracy test.
8.	Thermocouple assembly
	Calibration / Material test, Insulation test ($\geq 500 \Omega$ at 500 V, DC) as per ISA, Hydro static test (1.5 times max. pr.), Bore concentricity : $\pm 5\%$ of wall thickness.
9.	Thermowells
	Material test / Bore concentricity : $\pm 5\%$ of wall thickness / Hydrostatic test for TW (1.5 times max. pr.)





	Hydro test, IBR Certificate
28.	Sampling racks :
	Hydro test, IBR Certificate for tubes and fittings.
29.	S02 / Nox analyser / SPM analyser:
	Calibration test, accuracy test
30.	Interposing relay
	Functional test, temperature rise test, H.V test, Insulation test
31.	Transmitter Racks :
	Hydro test, air leak test for piping / tubing and fittings. IBR certification as required for tubing / piping and fittings.
32.	Pressure Transmitter
	Calibration test / Hydro test / Leak test / Over range test / Accuracy test / Repeatability test.
33.	Differential pressure transmitter
	Calibration test / Hydro test / Leak test / Over range test / Accuracy test / Repeatability test.
34.	Temperature Transmitter
	Calibration test / Accuracy test / Ambient temperature error test
35	Pneumatic Block Valves
	a) IBR certificate form III C b) Hydrostatic test : ANSI B 16.34 c) Seat leakage test : As per ANSI B 16-104 d) CV test: As per ISA procedure e) Magnetic particle test ANSI B 16.34 special class (applicable for pr.>70 bar & temp< 400 DegC) f) Liquid penetration test: ANSI B 16.34 special class (applicable for pr.>70 bar & temp< 400 DegC) g) Radiography test: ANSI B 16.34 special class h) Calibration and Hysteresis test i) Actuator leakage test
36.	Pressure Regulating Valve



	a) IBR certificate form III C b) Hydrostatic test : ANSI B 16.34 c) Seat leakage test : As per ANSI B 16-104 d) CV test: As per ISA procedure e) Magnetic particle test ANSI B 16.34 special class (applicable for pr.>70 bar & temp< 400 DegC) f) Liquid penetration test: ANSI B 16.34 special class (applicable for pr.>70 bar & temp< 400 DegC) g) Radiography test: ANSI B 16.34 special class h) Calibration and Hysteresis test i) Actuator leakage test
37.	Local Panels : Visual inspection, wiring & continuity check, H.V. and I.R. tests on panels, checking of bill of materials, functional tests.
38	Wiring Termination & Accessories Routine test: Conductor resistance test/High voltage test/Impulse dielectric test/insulation test/Humidity test/Temperature rise test on power circuits/short time current test on power circuits. Type test: Annealing test/Test for insulation and sheath/ Flame retardance test - a) Oxygen index, b) Flammability / Test for acid gas generation/test for water absorption/wet dielectric test
39	Marshalling/System cabinets Verification of degree of protection/Electrical tests as detailed under wiring Termination & accessories/Type test and routine test as per relevant Indian standards.
	Notes:
	1. Test Certificates in addition to inspection at manufacturers works shall be furnished for all the instruments for Owner's review.
	2. Above Test to be witnessed shall be finalized by Owner.
	3. In addition to above test, test as per approved QAP shall also be witnessed by owner.

17.02.05 TYPE TESTING

The BIDDER shall furnish the Type test reports of all type tests as per relevant standards and codes. As well as other specifics test indicated in the specification. A list of such test are given for various equipment in table titled, TYPE TEST REQUIREMENT FOR C&I SYSTEM and under the item special requirement for solid state requirements/systems. For the balance equipments/instruments. type test may be conducted as per manufacturer standards or if required by relevant standards.

A. Out of these test listed , the bidder /subvendor/manufacture is required



to conduct certain type test specifically for this contract (and witnessed by employer or his authorized representative). Even if the same have been conducted earlier as clearly indicated subsequently such tests.

- B. For the rest, submission of type test , results, and certificates shall be acceptable provided following points
- i. The same have been carried out by the bidder/ subvendor on exactly the same model/rating of equipment. (For control valves this shall be same size, type & design).
 - ii. There has been no change in the components from the offered equipments and tested equipments.
 - iii. The test has been carried out as per the latest standards along with amendements as on the date of bid opening.
- C. In case the approved equipment is different from the one on which the type test had been conducted earlier or any of the above grounds, then the tests have to be repeated and the cost of such tests shall be borne by the bidder/sub-vendor within the quoted price and no extra cost will be payable by the owner on this account.

17.02.05.1 As mentioned against certain items, the test certificates for some of the items shall be reviewed and approved by the main bidder or his authorized representative and balanced have to be approved by the employer.

The schedule of conduction of type test/submission of reports shall be submitted and finalized during pre award discussion.

17.02.05.2 For the type test to be conducted, bidder shall submit detailed test procedure for approval by owner. This shall clearly specify test setup, instruments to be used, procedure, acceptance norms (wherever applicable). , recording of different parameters, intervals of recording precaution to be taken etc. for the test to be carried out.



17.02.05.4 TYPE TEST REQUIREMENTS FOR C&I SYSTEMS

S.No.	Item	Test requirement	Standard	Test to be specifically conducted	Owner's Approval required on Test Certificate
1	Electrical metering instruments	As per standards	IS 1248	No	Yes
2	Thermocouple	Degree of Protection Test	IS - 13947	No	No.
3	Junction Box	Degree of Protection Test	IS - 13947	Yes	Yes
4	RTD	As per standards	IEC-60751	No	No
5	Electronic Transmitter	As per standards	BS 6447/IEC 60770	No	Yes
6	E/P convertor	As per standards	Manufacturing standard	No	Yes
7	Instrumentation cable (Twisted and shielded) (Refer Vol. V, Chapter 9)				
8	Battery	As per standard	IS 10918	Yes	YES
9.	Voltage stabiliser	Over load test	Approved procedure	No	YES
		Temp. rise test without redundant fans	Approved procedure	No	YES
		Input voltage variation test	Approved procedure	No	YES



12	Local gauges	Degree of protection test	IS 13947	No	No
13	Process actuated switches	Degree of protection test	IS 13947	No	No
16	LIE/LIR	Degree of protection test	IS 13947	YES	YES
18	Flow Orifice plates	calibration	ASME PTC BS 1042	YES	YES

Note:

Type test are to be conducted only for the items, which are being supplied as part of this package.





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

CHECK LIST FOR ANALYTICAL INSTRUMENTS

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	V	V	
	VISUAL						
	MAKE, MODEL No.						
	POWER SUPPLY						
	TYPE						
2	DIMENSIONS CHECK			P	V	V	
3	FUNCTIONAL CHECK			P	V	V	
4	LEAKAGE TEST			P	V	V	
5	HV / IR TEST			P	V	V	
6	LINEARITY			P	V	V	
7	RESPONSE TIME			P	V	V	
8	ENCLOSURE CLASS			P	V	V	
9	ACCESSORIES, AS APPLICABLE			P	V	V	
10	ACCURACY / CALIBRATION			P	V	V	
11	ALARM CONTACT TEST			P	V	V	
12	ANALOG OUTPUT CHECK			P	V	V	
13	BURN-IN TEST OF ELECTRONIC PARTS	1/LOT		P	V	V	
14	IN-BUILT INDICATOR, ZERO, SPAN, RANGE SCALE SELECTION ETC	SEE NOTE-1 BELOW		P	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.
- 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 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 SOLENOID VALVES

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						
	MAKE						
	MODEL No.						
2	MATERIAL (BODY. PLUNGER/TRIM)			P	W	V	
3	PORT SIZE			P	W	V	
4	CABLE CONNECTION SIZE			P	W	V	
5	ENCLOSURE CLASS			P	W	V	TYPE TEST CERTIFICATE TO BE FURNISHED BY VENDOR
6	No. OF COILS & INSULATION CLASS			P	W	V	TEST CERTIFICATE TO BE FURNISHED FOR INSULATION CLASS BY VENDOR
7	POWER SUPPLY CHECK			P	W	V	
8	IR / HV TEST			P	W	V	
9	FUCTIONAL TEST			P	W	V	

Legend :

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

Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- 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 TEMPERATURE 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	
	DIAL SIZE						
	MODEL NO./TAG NO./TYPE						
	RANGE/SCALE						
	END CONNECTION						
2	CALIBRATION	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	ACCURACY						
	REPEATABILITY						
	HYSTERESIS						
3	OVER TEMP. TEST	1 OF TYPE	APPROVED SPEC./ DATA SHEETS	P	W	V	
4	AMBIENT TEMP. COMPENSATION CHECK			P	V	V	
5	REVIEW OF TC FOR MATERIALS OF			V	V	V	
	SENSOR	FOR LOT	APPROVED SPEC./ DATA SHEETS				
	MOVEMENT						
	PROCESS CONNECTION						
	THERMOWELL						
	HOUSING	TYPE TEST	APPROVED SPEC./ DATA SHEETS	V	V	V	
6	REVIEW OF TC FOR DEGREE OF PROTECTION						
7	THERMOWELL	SEE NOTE-1 BELOW	AS PER APPD DWG		V	V	
	MATERIAL TC & DIMN. CHECK						
	HYD.TEST						
	OVER RANGE TEST						

Legend :

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

Note :

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

[illegible]

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

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

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Notes:

1. Heat Treatment shall be done as per ASME code.
2. Bleeding Resistance tests shall be done by keeping the sample in 33% HCl, 48% NaOH and DM Water for 72 Hrs.
3. Hydro Test shall be conducted, before Rubber lining.
4. As per code requirements.
5. As per HIS, USA.
6. Hydro test of body before Rubber lining. Seat Leakage test for Actuator operated valves shall be done by closing the Valves with Job Actuator.
7. Tests on Rubber parts such as Diaphragms shall be done per batch of Rubber mix, such as Tensile, Hardness, Adhesion, Spark Test, Bleed Resistance test and Flex test. Life Cycle test for Diaphragms for 50000 cycles etc shall also be done.
8. Hydro Test of Body, Seat & Disc Strength shall be carried out in accordance with latest edition of AWWA C-504 Standard. Proof of Design Test in accordance with latest edition of AWWA C-504 Standard shall also be carried out, if not carried out earlier. Seat Leakage test for Actuator operated valves shall be done by closing the Valves with Job Actuator. Seat leakage test shall be carried out in both directions.
 - a) One per Heat/Heat Treatment batch/Lot
 - b) On machined surfaces only.
 - c) UT shall be done for shafts with Dia 50 mm or above.
9. For all other Misc. items, refer Table on LP piping.
10. Inspection / test / check requirements for pressure vessels other than service vessel are same as for inspection / test / check requirements for service vessel as indicate in table given above.
11. For piping, vales, fillings in service vessel area quality requirements please also refer power cycle piping quality plan.
12. 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.
13. 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.

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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	
		ARUL RUBBERS	CHENNAI	



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		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	
9.	HORIZONTAL CENTRIFUGAL PUMPS	KISHORE PUMPS	PUNE	
		SU MOTORS	MUMBAI	



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SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
	(RUBBER LINED)			
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	
14.	COATING & WRAPPING MATERIAL TAPE	STATCON POWER CONTROLS LTD	NOIDA (U.P)	
		13. UNDER BED NOZZLE	JONSONS SCREEN	AUSTRALIA/ IRELAND
		IWL LTD.	CHENNAI	
		MP TAR PRODUCT	BHILAI	
		PORWAL INDUSTRIES	RAIPUR	
15.	HEATER	RUSTECH	KOLKATA	
		STP	JAMSHEDPUR	
		ESCORTS	FARIDABAD	
16.	RESIN	RACOLDS	FARIDABAD	
		ROHM & HASS	FRANCE / USA	
		LANXESS	GERMANY	
17.	HIGH PRESSURE BUTTERFLY VALVE	PUROLITE	ROMANIA/CHINA	
		DeZURICK (Upto 400 NB)	USA	
		TYCO VALVES (UPTO 450 NB)	USA	
18.	BALL VALVE (HIGH PRESSURE) SIZE 100 NB	BRAY	CHINA	
		VELAN	CANADA	
		BRAY	USA	
19.	CAST IRON	A.V. VALVES LTD	AGRA	



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	GATE/GLV/NRV/SRV	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	
		ASEA BROWN BOVERI (ABB)	HARYANA	
		MARATHON	FARIDABAD	
22.	BUTTER-FLY VALVE	ADVANCE VALVES PVT. LTD.	NOIDA	



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SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		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	
23.	DIAPHRAGM VALVE (MANUAL / PNEUMATIC) CLASS 150	WEIR BDK	HUBLI	
		CRANE FLOW PROCESS	SATARA	
		PROCON	MUMBAI	
		MAJESTIC VALVES (LABLINE)	-	
		HAWA ENGINEERS	AHMEDABAD	
24.	DUAL PLATE CHECK VALVES	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
		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.
25.	Y-TYPE STRAINER / STRAINER (WATER SERVICE)	OTOKLIN GLOBAL BUSINESS LIMITED	MUMBAI	
		GRAND PRIX	NEW DELHI	
		JAYPEE	NEW DELHI	
		GREAVES COTTON	MUMBAI	
		MULTITEX FILTRATION ENGINEERS LIMITED,	NEW DELHI / NOIDA	



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		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,	
		GLOBAL TECHNOLOGIES	HYDERABAD	
		HERCULES HOISTS LTD.	RAIGAD	
		LIFTING EQUIPMENTS AND ACCESSORIES	DELHI	
		MANGLA HOISTS PVT LTD	NEW DELHI	



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		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	
		INCAB	KOLKATA	
31.	CABLE LUGS	DOWELLS	MUMBAI	
		UNIVERSAL MACHINES LTD.	CALCUTTA	
32.	MS PLATES	SAIL		
		ESSAR STEEL		



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		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	CHATTRAL	
		REMI	TARAPUR	
		PRAKASH STEELAGE	-	
36.	SAFETY SHOWER	UNICARE	-	
		MOHAN INDUSTRIES	-	
		SUPER SAFETY SERVICES	-	



TITLE :
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR CONDENSATE
POLISHING UNIT**

**SPECIFICATION NO. PE-TS-412-155A-
A001**

SECTION : I

SUB-SECTION: IA

REV. NO. 00

DATE :

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
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 NB TO 300 NB (#150) (2) CARBON STEEL GLOBE VALVES: 15 NB TO 50 NB (#800) & 65 NB TO 200 NB (#150)



TITLE :
2X660 MW ENNORE SEZ STPP

SPECIFICATION NO. PE-TS-412-155A-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR CONDENSATE
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SUB-SECTION: IA

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DATE :

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		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 , GV/GLV/NRV/900/25 0 , GLV/300/300, GLV/1 50/350/ , SCNRV/150/700, SCNRV/300/350, SCNRV/600/250.
		V.K. VALVES PVT. LTD.,	JALANDHAR	



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SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		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	
		EBY	MUMBAI	
48.	FLANGES (SS/CS)	PRADEEP METALS LTD	MUMBAI	
		TUBE PRODUCT INCOROPORATION	BARODA	
		MS FITTINGS	KOLKATA	
		HAWA ENGINEERING	-	
		ALIANCE PIPE & PLANGES	KOLKATA	



TITLE :
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REV. NO. 00

DATE :

SR. NO.	ITEM	SUPPLIERS	PLACE	REMARKS
		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.	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)		
53.	PNEUMATIC ACTUATOR	JOTUN PAINTS		
		PROCON ENGINEERS	-	
		TYCO	-	
		CRANE PROCESS	-	
		BDK	-	
		INTERVALVE	-	
54.	FRP CABLE TRAYS & ACCESSORIES	BRAY CONTROL	-	
		EPP COMPOSITES PRIVATE LIMITED	Rajkot-Gujarat	
		SUMIP COMPOSITES PVT.LTD.	Ahmedabad-Gujarat	

C&I
SUB-VENDOR LIST

2X660 MW ENNORE SEZ SUPERCRITICAL TPS

APPROVED VENDOR LIST [SUMMARIZED] DATED 15-DEC-2016

Sl. No.	Package Name	Vendor Name	Approval Status for Ennore Project
CONTROL AND INSTRUMENTATION (C&I) PACKAGES			
1	ANUBAR (DELTA TUBE)	STAR-MECH CONTROLS (I) PVT.LTD.	Approved
		TM TECNOMATIC SPA	Credentials Required
		SWITZER INSTRUMENT LTD.	Approved
2	CONTROL VALVE	RINGO VALVULAS S.L,	Credentials Required
		Severn Glocon India Pvt. Ltd.	Credentials Required
		CONTROL COMPONENT INC.	Approved
		DRESSER VALVE INDIA PVT. LTD	Credentials Required
		LESLIE CONTROLS, INC	Credentials Required
		SPX Corporation, USA	Credentials Required
		Daume Regelarmaturen GmbH,	Credentials Required
		INSTRUMENTATION LTD.	Approved
		Valvitalia S.P.A. ,	Credentials Required
		WEIR VALVES & CONTROLS UK LTD.	Approved
		Koso India Private Limited,	Credentials Required
		FORBES MARSHALL ARCA PVT.LTD.	Approved
		R.K.CONTROL INSTRUMENTS PVT. LTD.	Approved
		EMERSON PROCESS MANAGEMENT CHENNAI LIMITED	Approved
		HOLTER REGELARMATUREN GmbH & Co.KG	Credentials Required
		MIL CONTROLS LTD.	Approved
		SHENJIANG VALVE CO. LTD.	Credentials Required
		Metso Singapore PTE. LTD.,	Approved

2X660 MW ENNORE SEZ SUPERCRITICAL TPS

APPROVED VENDOR LIST [SUMMARIZED] DATED 15-DEC-2016

Sl. No.	Package Name	Vendor Name	Approval Status for Ennore Project
3	FLOW ELEMENT - NOZZLE	HYDROPNEUMATICS PVT. LTD.	Approved
		INSTRUMENTATION LTD.	Approved
		MICRO PRECISION PRODUCTS PVT. LTD.	Approved
		STAR-MECH CONTROLS (I) PVT.LTD.	Approved
		SEIKO FLOW CONTROL GMBH	Approved
4	FLOW ELEMENT - ORIFICE	MICRO PRECISION PRODUCTS PVT. LTD.	Approved
		INSTRUMENTATION LTD.	Approved
		HYDROPNEUMATICS PVT. LTD.	Approved
		Flow Star Engineering Pvt. Ltd.,	Approved
		STAR-MECH CONTROLS (I) PVT.LTD.	Approved
		MINCO (INDIA) PRIVATE LIMITED	Approved
		INSTRUMENTATION ENGINEERS PVT LTD	Approved
5	PROGRAMMABLE LOGIC CONTROLLER	GE Intelligent Platforms Private Limited	Approved
		SIEMENS LIMITED	Approved
		ROCKWELL AUTOMATION INDIA LTD	Approved
		SCHNEIDER ELECTRIC INDIA PVT.LTD.	Approved
		Honeywell Automation India Limited	Approved
6	ROTAMETER	FLOWTECH INSTRUMENTS SERVICES	Approved
		Flow Star Engineering Pvt. Ltd.,	Approved
		EUREKA INDUSTRIAL EQUIPMENTS PVT.LTD.	Approved
		SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Approved
		INSTRUMENTATION ENGINEERS PVT LTD	Approved
		C	

2X660 MW ENNORE SEZ SUPERCRITICAL TPS

APPROVED VENDOR LIST [SUMMARIZED] DATED 15-DEC-2016

Sl. No.	Package Name	Vendor Name	Approval Status for Ennore Project
7	ULTRASONIC FLOW TRANSMITTERS	New Package	
8	SIGHT FLOW INDICATORS	TELACE EQUIPMENT PVT.LTD.	Credentials Required
		BLISS ANAND PVT. LTD.	Approved
		B.K.EQUIPMENTS PVT.LTD.	Approved
		SIGMA INSTRUMENTS CO.	Approved
		FLOWTECH INSTRUMENTS SERVICES	Approved
		INSTRUMENTATION ENGINEERS PVT LTD	Approved
		SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Approved

PEM VENDOR LIST

Package Code	Package Name	Vendor Name	Vendor Communication Address	Remarks
145-04000-A	CONTROL VALVE	PARCOL S.p.A	Mr. Erminio Campanelli, Via Isonzo, 2, Canegrate MI Phone- 0349-7417774 Pincode : 200010 Email : mazurizio.para@parcol.com	Indian Representative-M/s Astrotech, 35, MV Compound, Bridge Way Colony, Tiruppur - 641607, Tamil Nadu, India, Ph. No.-+91 975 199 4989; Email- mani@astrotechindia.in , ,
145-04000-A	CONTROL VALVE	FORBES MARSHALL ARCA PVT.LTD.	A-34/35 , MIDC ESTATE, H-BLOCK, PIMPRI, PUNE, Phone- 020-27442020, Pincode : 411018 Email : mnadgaundi@forbesmarshall.com	, Technical limit reviewed on 30.04.2014 and further revised on 29.12.2015; , Reviewed in MISCC dt. 21.07.2015 for non-response in 4 consecutive tender enquiry;
145-04000-A	CONTROL VALVE	INSTRUMENTATION LTD.	KANJIKODE WEST, PALAKKAD, PALAKKAD Phone- 2566127-130,2567128 Pincode : 678623 Email : icvldil@gmail.com;fa2@ilpgt.com	SICK PSU. BIFR CASE. , ,
145-04000-A	CONTROL VALVE	MIL CONTROLS LTD.	Mr.Jacob Cherian/Mr.Geo Jolly Meladoor, Annamanada P.O. MALA, Thrissur Phone- 0480-2695700 Pincode : 680741 Email : biju.simon@ksb.com	, ,
145-04000-A	CONTROL VALVE	Koso India Private Limited,	H 33 & 34, MIDC, Ambad, Nashik, Phone- 91 944 744 3198 Pincode : 422010, Email : seemaanand_sa@koso.co.in	, The name has been changed from M/s KOSO FLUID CONTROLS (PVT) LTD to M/s Koso India Private Limited as per 11th MISCC Elect and C&I dated 30.07.2013. , Approved works at Control Valve Division, H-33&34, Ambad, Nashik w.e.f. 12.10.2015; Additional works at "J-1,MIDC,Ambad, nashik-422010" approved w.e.f. 17.06.2016;
145-04000-A	CONTROL VALVE	BOMAFSA SPECIAL VALVE SOLUTIONS PVT LTD	Mr. K.M. Anklesaria/ R. M. Anklesaria Plot No: 285/2, Panchratna Estate, Near Ramol Bridge, Vatva Ahmedabad Phone- 079-40083825 Pincode : 382445 Email : info@bomafa-india.com	, ,
145-04000-A	CONTROL VALVE	SUZHOU DELAN ENERGY SCIENCE & TECHNOLOGY CO., LTD.	No 566 Fangqiao Road Caohu Industrial Park, Xiangcheng Economic Development Zone, Suzhou Phone- 008618012776062 Pincode : 215143 Email : jeanielei@delan-valve.com	, ,
145-04000-A	CONTROL VALVE	WALDEMAR PRUSS ARMATURENFABRIK GMBH	Mr. Winfried Dremhel Schulenburgelandstrasse 261, Hannover Phone- +49-511279260 Pincode : 30419 Email : dremhel@pruss.de; vogel@pruss.de	Indian Representative-M/s H S Engineering & Marketing Services, B2/73C Safdarjung Enclave, New Delhi - 110029, Ph No.-011-26193156/9313007463; Email- joy@hsgroupdelhi.com , ,
145-04000-A	CONTROL VALVE	Valvitalia S.P.A. ,	Mr. Salvatore Ruggeri Via Tortona 69, Rivanazzano (Pavia) Phone- +39-03839459875 Pincode : 27055 Email : gianluca.angeleri@valvitalia.com	One Time Code accorded for "Control Valves" package for "1x500 MW Vindhyachal STPP Stage-V" project. , Supplier registered in permanent category as per 28th MISCC- Electrical and C&I dtd. 31.03.2014 , Deleted due to non-response in 4 consecutive tenders w.e.f. 27.07.2016;Decision revoked as per MISCC dt. 05.08.2016;
145-04000-A	CONTROL VALVE	HOLTER REGELARMATUREN GmbH & Co.KG	HOLTER REGELARMATUREN GmbH & Co.KG , Helleforthstrasse 58-60, D 33758 Schloss Holte-Stukenbrock Germany Phone- 0049-05207/88037 Pincode : Email : mail@hora.de	, HOLD due to non-responsse /non-participation w.e.f. 31.01.2013; Hold removed w.e.f. 16.10.2014; ,
145-04000-A	CONTROL VALVE	R.K.CONTROL INSTRUMENTS PVT. LTD.	PLOT NO.A-250, OPP.POLICE STATION, WAGLE INDUSTRIAL ESTATE, THANE Phone- 25820943/2331 Pincode : 400604 Email : rkcipl@vsnl.com ; rkcinpvt@bol.net.in	HOLD due to non-responsse /non-participation w.e.f. 10.01.2013.HOLD due to non-responsse /non-participation w.e.f. 01.02.2013.Hold is lifted w.e.f. 21.09.2013. , Reassessed on 26.02.2016; Technical limit added w.e.f. 26.02.2016; ,
145-04000-A	CONTROL VALVE	SPX Flow Technology (I) Pvt. Ltd.	Survey No 275, Odhav Road, Odhav Ahmedabad Phone- +91 (0) 8939963099 Pincode : 382415 Email : siva.prakash@spx.com	Name changed from M/s DeZURIK- Copes Vulcan Ltd. to M/s SPX Corporation, USA as per 25th MISCC-Electrical and C&I dtd. 20.02.2014; Put on HOLD for 6 months w.e.f. 18.05.2012 & uplifted on 19.03.2014.; , POs to be placed on Indian subs.M/s SPX Flow Technology (I) Pvt. Ltd., Ahmedabad, India and the material will be supplied as per scope matrix[Available at CMM-->VD DOCUMENTS-->SCOPE MATRIX-->PW-PE-GCC R.5 accepted by vendor. , Reviewed in MISCC dt. 21.07.2015 for non-response in 4 consecutive tender enquiry; ,
145-04000-A	CONTROL VALVE	Daume Regelarmaturen GmbH,	Mr. Björn Carstensen Am Springbrunnen 23, Barleben Phone- 9820805424, Pincode : 39179 Email : madhu@aumvn.com, info@daume-regelarmaturen.de,	
145-04000-A	CONTROL VALVE	EMERSON PROCESS MANAGEMENT CHENNAI LIMITED	147, KARAPAKKAM VILLAGE, CHENNAI Phone- 23722184, 23716242 Pincode : 600096 Email : jatinder.singh@emerson.com	Vendor's name changed from "Fisher Sanmar Limited" to "Emersion Process Management Chennai Limited" w.e.f. 22.09.2011 , ,
145-04000-A	CONTROL VALVE	DRESSER VALVE INDIA PVT. LTD	Mr. Raj Raman/Mr. Rajkumar Moria S.F. No: 608,Chettipalayam Road, Echanari Post, Coimbatore Phone- +91-98451 19085 Pincode : 641021 Email : Anoop.Ramachandran@ge.com	, ,
145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	DRESSER INDUSTRIES INC.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 02764-233682 Pincode : 382729 Email : Nishit.patel@ashcroftindia.com	, ,
145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	Barksdale GmbH, Germany	Michael Weileder Dorn Assenheimer, Strasse 27 Reichelsheim Phone- +91-9999107840 Pincode : D- 61203 Email : msingh@barksdale.de	, ,

Package Code	Package Name	Vendor Name	Vendor Communication Address	Remarks
145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	SWITZER PROCESS INSTRUMENTS PVT. LTD.	Mr. V S Jayaprakash, No.127 & 128, SIDCO North Phase, Ambattur Estates CHENNAI Phone- 044-26252017/2018 Pincode : 600050 Email : marketing@switzerinstrument.com	Name changed from "M/s Switzer Instrument Ltd." to "M/s Switzer Process Instruments Pvt. Ltd." w.e.f. 27.07.2016; , ,
145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com	Registration of "M/s Ashcroft India Pvt. Ltd." substituted to "M/s Precision Mass Products Pvt. Ltd." as per MISCC dt. 15.02.2016 based on "Termination and business transfer agreement" submitted by supplier. , ,
145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	GENERAL INSTRUMENTS CONSORTIUM	Mr. Amarendra Kulkarni 194/195, Gopi Tank Road, Off. Pandurang Naik Marg, Mahim Mumbai Phone- 9323195251 Pincode : 400016 Email : amarendra@general-gauges.com	Workas at- GAUGES BOURDON INDIA PVT. LTD. (A MFG. UNIT OF GENERAL INSTRUMENTS CONSORTIUM , PLOT NO-4, 5 & 6, JAWAHAR Co-op. INDUSTRIAL ESTATE, KAMOTHE, PANVEL- 410 209 , ,
145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	SOR INC.	LARRY DEGARMO/Avdresh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdresh@sherman-india.com,	, ,
145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	INDFOS INDUSTRIES LIMITED	B-20-21, INDUSTRIAL AREA, MEERUT ROAD, GHAZIABAD Phone- 0120-2712016 Pincode : Email : mktg@indfos.com	, ,
145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	INDFOS (INDIA) LIMITED	MR.L.C.VENKATRANGAN/MR.B.KANNAN New No.17, II Floor, Adwave Towers, Dr.Sevalia Shivaji Salai, T.Nagar Chennai Phone- +91 44 24353407 Pincode : 600017 Email : delhi@indfos.com	, ,
145-06000-A	PRESSURE SWITCH/DIFF. PRESSURE SWITCH	Kaustubha Udyog,	S.No. 36/1/1, Sinhgad Road, Vadgaon Khurd, Near Lokmat Press, Pune, Phone- 020-24393577, Pincode : Email : pressure@vsnl.com,	, ,
145-07000-A	ANALYTICAL INSTS.SAMPLE COOLER	EMERSON PROCESS MANAGEMENT (INDIA) PVT.LTD.	Mr. Amit Paithankar/Vikram Raj Singh 206-210,BALARAMA BUILDING 2ND FLR. BANDRA EAST MUMBAI Phone- 9619121500 Pincode : 400051 Email : vikramraj.singh@emerson.com	, ,
145-07000-A	ANALYTICAL INSTS.SAMPLE COOLER	FORBES MARSHAL PVT. LTD.	A-33/34, MIDC ESTATE, H-BLOCK, PIMPRI, PUNE Phone- 27470171,27477472 Pincode : 411018 Email : nkaushal@forbesmarshall.com	, ,
145-07000-A	ANALYTICAL INSTS.SAMPLE COOLER	SIEMENS LIMITED	Dr. Armin Bruck/Sandeep Mathur 130, Pandurang Budhkar Marg Worli Mumbai Phone- 0124 383 7377 Pincode : 400018 Email : ankit.varshney@siemens.com	, ,
145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA Phone- 24757784,22472509 Pincode : 700020 Email : anidel@bol.net.in	, ,
145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	BOSE PANDA INSTRUMENTS PVT.LTD.	Mr. Partha Bose 44, Saheed Hemanta Kumar Bose, Sarani, Kolkata Phone- +91 33 2548 7220 Pincode : 700074 Email : parthabosebp@gmail.com; bosepanda@vsnl.net	Trial to Hold as per SEARP amd-3,w.e.f. 15-09-12 , Supplier registered in trial category on 30.10.2010 and was thereafter put in susp-hold category as per SEARP Amd-03 on 15.09.2012. Further, on evaluation put in permanent category on 20.08.2014; ,
145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 9999464663 Pincode : 382729 Email : sales@precisionmass.com	Registration of "M/s Ashcroft India Pvt. Ltd." substituted to "M/s Precision Mass Products Pvt. Ltd." as per MISCC dt. 15.02.2016 based on "Termination and business transfer agreement" submitted by supplier. , ,
145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com	, NAME HAS BEEN CHANGED FROM M/S WAAREE INSTRUMENTS LTD. TO M/S BAUMER TECHNOLOGIES INDIA PVT. LTD. W.E.F. 13.06.2012 ,
145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	32,INDUSTRIAL SUBURB YESWANTHAPUR BANGALORE Phone- 080-23370300, Pincode : 560022 Email : info@hgurusouth.com	, ,
145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	FORBES MARSHALL (HYD) LTD.	MR SAILESH PATALAY/MR. M K SRINIVASAN PLOT NO.A-19/2, & T-4/2, IDA, NACHARAM, HYDERABAD Phone- 9849913704 Pincode : 500 076 Email : mksrinivasan@forbesmarshall.com	, ,
145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	H.GURU INDUSTRIES	Mr. G. D. Hazra/Mr. P. K. Mitra 10 B, HO-CHI-MINH SARANI, KOLKATA Phone- 033 2282 2463 / 1637 Pincode : 700071 Email : mguru@vsnl.net	, Financial limit reviewed on 05.06.2014; ,
145-08000-A	PRESSURE GAUGE/ DIFF.PRESSURE GAUGE	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,	Registered as per 26th MISCC-Electrical and C&I dtd. 06.03.2014. , ,

Package Code	Package Name	Vendor Name	Vendor Communication Address	Remarks
145-10000-A	TEMPERATURE GAUGE	FORBES MARSHALL (HYD) LTD.	MR SAILESH PATALAY/MR. M K SRINIVASAN PLOT NO.A-19/2, & T-4/2, IDA, NACHARAM, HYDERABAD Phone- 9849913704 Pincod : 500 076 Email : mksrinivasan@forbesmarshall.com	, ,
145-10000-A	TEMPERATURE GAUGE	GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	D2/5, Mapusa Industrial Estate, Mapusa, Goa, Phone- 09326054551, Pincod : 403507, Email : sumukh@goainstruments.com,	GCC Rev.5 has been accepted in toto. , ,
145-10000-A	TEMPERATURE GAUGE	H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	32,INDUSTRIAL SUBURB YESWANTHAPUR BANGALORE Phone- 080-23370300, Pincod : 560022 Email : info@hgurusouth.com	, ,
145-10000-A	TEMPERATURE GAUGE	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai, Phone- 011-41607463, Pincod : 400016, Email : gicdelhi@general-gauges.com,	, ,
145-10000-A	TEMPERATURE GAUGE	H.GURU INDUSTRIES	Mr. G. D. Hazra/Mr. P. K. Mitra 10 B, HO-CHI-MINH SARANI, KOLKATA Phone- 033 2282 2463 / 1637 Pincod : 700071 Email : mguru@vsnl.net	, Financial limit reviewed on 05.06.2014; ,
145-10000-A	TEMPERATURE GAUGE	GOA THERMOSTATIC INSTRUMENTS PVT.LTD.	FLAT -B , GF, HILL CROWN APTS., COLLEGE ROAD, MAPUSA Phone- Pincod : 403525 Email : gtilworks@pyro-electric.in	, ,
145-10000-A	TEMPERATURE GAUGE	A.N. INSTRUMENTS PVT. LTD.	MARKETING DIVISION, 5th FLOOR, 59-B, CHOWRINGHEE ROAD, KOLKATA Phone- 24757784,22472509 Pincod : 700020 Email : anidel@bol.net.in	, ,
145-10000-A	TEMPERATURE GAUGE	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincod : 400093 Email : sales.in@baumer.com	, NAME HAS BEEN CHANGED FROM M/S WAAREE INSTRUMENTS LTD. TO M/S BAUMER TECHNOLOGIES INDIA PVT. LTD. W.E.F. 13.06.2012 ,
145-10000-A	TEMPERATURE GAUGE	PRECISION MASS PRODUCTS PVT. LTD.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 9999464663 Pincod : 382729 Email : sales@precisionmass.com	Registration of "M/s Ashcroft India Pvt. Ltd." substituted to "M/s Precision Mass Products Pvt. Ltd." as per MISCC dt. 15.02.2016 based on "Termination and business transfer agreement" submitted by supplier. , ,
145-11000-A	LEVEL GAUGE	BLISS ANAND PVT. LTD.	Mr. Vikas Anand/ Mr.RGRajan 92B & 93 B , IMT MANESAR Gurgaon Phone- 0124-4366000 TO 9 Pincod : 122001 Email : sales@blissanand.com	, ,
145-11000-A	LEVEL GAUGE	TOSHNIWAL BROTHERS PVT.LTD.	WORKS:TOSHNIWAL IND.PVT.LTD, INDUSTRIAL ESTATE MAKHUPURA, AJMER Phone- 441171 Pincod : 305002 Email : toshniwalprocess@gmail.com	, ,
145-11000-A	LEVEL GAUGE	SIGMA INSTRUMENTS CO.	Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI Phone- +919821038162 Pincod : 400078 Email : sales@sigmainstruments.co.in	, ,
145-12000-A	FLOW ELEMENT	MICRO PRECISION PRODUCTS PVT. LTD.	K.P. CHANDHOK/ATUL CHANDHOK 4, LINK ROAD, FARIDABAD Phone- 9810265688 Pincod : 121002 Email : pal@microa1.com	REGISTERED AS MS&D VENDOR W.E.F.15.11.2011 FOR FY 2011-12. , ,
145-12000-A	FLOW ELEMENT	TM TECNOMATIC SPA	MR. ANTONIO NOVIELLO/Mrs. Enrica Bazzoc VIA DELLE INDUSTRIE, 36 CREMONA Phone- 39037221574 Pincod : 26100 Email : info@tmtecnomatic.com	, ,
145-12000-A	FLOW ELEMENT	STAR-MECH CONTROLS (I) PVT.LTD.	SUSHILLOTAM, SUSHILLOTAM, 29/3A/3, SASANE NAGAR, HADAPSAR, PUNE Phone- 02026970450 Pincod : 411028 Email : marketing@starmech.net	, ,
145-12000-A	FLOW ELEMENT	INSTRUMENTATION LTD.	KANJIKODE WEST, PALALKKAD, PALAKKAD Phone- 2566127-130,2567128 Pincod : 678623 Email : icvdil@gmail.com;fa2@ilpgt.com	SICK PSU. BIFR CASE. , ,
145-13000-A	TEMP. ELEMENT	DETRIVE INSTRUMENTATION & ELECTRONICS LTD.	320, TV INDUSTIAL ESTATE, OFF.DR.A.BESANT ROAD, BEHIND GLAXO, WORLI, MUMBAI Phone- 24934125,24938403 Pincod : 400025 Email : trivtech@vsnl.com	, ,
145-13000-A	TEMP. ELEMENT	Tempsens Instrument (I) Pvt Ltd	MR. V.P.RATHI/MR. HEMANT RATHI B-188A ROAD NO.5 , M.I.A UDAIPUR Phone- 09352420069 Pincod : 313003 Email : info@tempsens.com	, ,

Package Code	Package Name	Vendor Name	Vendor Communication Address	Remarks
145-13000-A	TEMP. ELEMENT	Thermal Instrument India Pvt. Ltd.	Mr. Raghavendra M. Kulkarni 194/195, Gopi Tank Road Behind Citylight Cinema, Mahim Mumbai Phone- 09322664709 Pincode : 400016 Email : ramk@giconindia.com	Registered as per 11th MISCC-Electrical and C&I (FY 2014-15) dt. 20.09.2014. , ,
145-13000-A	TEMP. ELEMENT	TM TECNOMATIC SPA	MR. ANTONIO NOVIELLO/Mrs. Enrica Bazzocc VIA DELLE INDUSTRIE, 36 CREMONA Phone- 39037221574 Pincode : 26100 Email : info@tmtecnomatic.com	, ,
145-13000-A	TEMP. ELEMENT	TECHNO INSTRUMENTS	Abhijit Gohel/Mr. Amit Pandya Plot No. 1145/1, Uma Conventor Lane, Santej, Ta. Kalol, Gandhinagar Phone- 9909925223 Pincode : 382721 Email : amit@techno-instruments.com	, ,
145-13000-A	TEMP. ELEMENT	Baumer Technologies India Pvt. Ltd.	Mr. Shyam Warilani/Mr. V Suresh Babu 36, DAMJI SHAMJI INDUSTRIAL COMPLEX, OFF.-MAHAKALI CAVES ROAD, ANDHERI(E) MUMBAI Phone- +91 99589 25151 Pincode : 400093 Email : sales.in@baumer.com	, NAME HAS BEEN CHANGED FROM M/S WAAREE INSTRUMENTS LTD. TO M/S BAUMER TECHNOLOGIES INDIA PVT. LTD. W.E.F. 13.06.2012 ,
145-13000-A	TEMP. ELEMENT	PYRO ELECTRIC INSTRUMENTS GOA PVT.LTD.	M. D. BICHU/R. M. BICHU G.B, HILL CROWN APARTMENTS, COLLEGE ROAD, MAPUSA Phone- 9326114601 Pincode : 403507 Email : priyanka.marketing@pyro-electric.in	, ,
145-13000-A	TEMP. ELEMENT	TOSHNIWAL INDUSTRIES PVT. LTD.,	Industrial Estate, Makhupura, Ajmer, Phone- 9352009000, Pincode : 305002, Email : info@tipl.com,	GCC Rev.5 has been accepted in toto. , ,
145-13000-A	TEMP. ELEMENT	GAUGE BOURDON INDIA PVT. LTD.	194/195, Gopi Tank Road, Off Pandurang Naik Marg, Mahim Mumbai, Phone- 011-41607463, Pincode : 400016, Email : gicdelhi@general-gauges.com,	, ,
145-13000-A	TEMP. ELEMENT	GOA INSTRUMENTS INDUSTRIES PVT.LTD.,	D2/5, Mapusa Industrial Estate, Mapusa, Goa, Phone- 09326054551, Pincode : 403507, Email : sumukh@goainstruments.com,	GCC Rev.5 has been accepted in toto. , ,
145-14000-A	TRANSMITTERS	Moore Industries International Inc.	Leonard.W. Moore/ Matt Moren 16650 Schoenborn St. North Hills Phone- +1 818 830 5548 Pincode : 91343 Email : mmoren@miinet.com	INDIAN REPRESENTATIVE: CHEMTROL INDUSTRIES LTD, , ,
145-14000-A	TRANSMITTERS	PANAM ENGINEERS	Mr. Santosh Shukla 203, Jaisingh Business, Parsiwada, Sahar road, Andheri(East), Mumbai, Phone- 9892179529, Pincode : 400099, Email : santosh@panamengineers.com,	, ,
145-14000-A	TRANSMITTERS	TOSHNIWAL INDUSTRIES PVT. LTD.,	Industrial Estate, Makhupura, Ajmer, Phone- 9352009000, Pincode : 305002, Email : info@tipl.com,	GCC Rev.5 has been accepted in toto. , ,
145-14000-A	TRANSMITTERS	Endress + Hauser (India) Pvt. Ltd.,	Mr. Prakash Vaghela 215-216, DLF Tower 'A', Jasola District Centre, New Delhi, Phone- 9717593001, Pincode : 110025, Email : prakash.vaghela@in.endress.com,	For temperature transmitter only. , ,
145-14000-A	TRANSMITTERS	SBEM PVT. LTD.	MR.N.K. BEDARKAR/MR. VISHWANATH KARANDIK 39, ELECTRONIC CO.OP. ESTATE, PUNE SATARA ROAD PUNE, Phone- 912041030100 Pincode : 411009 Email : newdelhi@sbem.co.in	Reviewed in MISCC dt. 21.07.2015 for non-response in 4 consecutive tender enquiry; , Technical limit reviewed on 30.04.2014 & 12.10.2015; ,
145-14000-A	TRANSMITTERS	ABB LIMITED	MR. RAJIV GOVIL 14, MATHURA ROAD, FARIDABAD Phone- 09971085678 Pincode : 121003 Email : vipin.swami@in.abb.com	(1) A GROUP COMPANY OF ABB, NOW. (2) NAME OF VENDOR CHANGED FROM BIRLA-KENT TAYLOR LIMITED TO ABB LIMITED W.E.F. 27.06.2011 , Technical limit reviewed and changed on 05.06.2014; Technical limit further reviewed on 12.10.2015; ,
145-14000-A	TRANSMITTERS	Pune Techtrol Pvt. Ltd.	N.P.Khatan/Sudhakar Badiger S-18, MIDC Bhosari, Pune Phone- 9850560042 Pincode : 411 026 Email : ho@punetechtrol.com	Technical limit reviewed on 12.10.2015; , Manufacturing works: J-52/7, MIDC, Bhosari, Pune ,
145-14000-A	TRANSMITTERS	V. AUTOMAT & INSTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL-AREA, PH-1 NEW DELHI Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com	Technical limit reviewed on 12.10.2015; , Technical limit reviewed on 30.04.2014 ,
145-14000-A	TRANSMITTERS	YOKOGAWA INDIA LIMITED,	PLOT NO.96, ELECTRONICS CITY COMPLEX, HOSUR ROAD, BANGALORE, Phone- 080-41586000, Pincode : Email : uday.shankar@in.yokogawa.com,	Subject to submission of renewed ISO certificate & compliance to GCC; Relevant documents (ISO 9001:2008 and GCC Rev-05) furnished on 18.06.2013. , ,
145-14000-A	TRANSMITTERS	SMART INSTRUMENTS LTD, BRAZIL	Agents: Digital Electronic Ltd. 74/11 'C' Cross Road MIDC Andheri (East) MUMBAI Phone- 28208477 Pincode : 400093 Email : corp@delbby.rpgms.ems.vsnl.net.in	Technical limit reviewed on 12.10.2015; , Technical limit reviewed on 30.04.2014 ,

Package Code	Package Name	Vendor Name	Vendor Communication Address	Remarks
145-14000-A	TRANSMITTERS	NIVO CONTROLS PVT. LTD.	Mr. Praveen Toshniwal 104-115, Electronic Complex, Indore Phone- 0731-4081305 Pincode : 452010 Email : sales@nivocontrols.com	Registered in permanent category as per 11th MISCC-Electrical and C&I (FY 2014-15) dt. 20.09.2014. , Technical limit reviewed on 12.10.2015; ,
145-14000-A	TRANSMITTERS	SIEMENS LIMITED	Dr. Armin Bruck/Sandeep Mathur 130, Pandurang Budhkar Marg Worli Mumbai Phone- 0124 383 7377 Pincode : 400018 Email : ankit.varshney@siemens.com	Comm Add: Attn Mr K.K.Bedi/ Mr Sanjay Satpute, Siemens Ltd. EFIE, Plot no 6A, Sec-18, Maruti Industrial Area, Gurgaon - 122015, Ph 0124-3836250 , ,
145-14000-A	TRANSMITTERS	EMERSON PROCESS MANAGEMENT (INDIA) PVT.LTD.	Mr. Amit Paithankar/Vikram Raj Singh 206-210,BALARAMA BUILDING 2ND FLR. BANDRA EAST MUMBAI Phone- 9619121500 Pincode : 400051 Email : vikramraj.singh@emerson.com	, ,
145-14000-A	TRANSMITTERS	Honeywell Automation India Limited	Mr. Ritwij Kulkarni 917, INTERNATIONAL TRADE TOWER, NEHRU PLACE, NEW DELHI Phone- 9890200584 Pincode : 110019 Email : rajesh.chaudhary@honeywell.com	, ,
145-15000-A	TEMPERATURE SWITCH	TOSHNIWAL BROTHERS PVT.LTD.	WORKS:TOSHNIWAL IND.PVT.LTD, INDUSTRIAL ESTATE MAKHUPURA, AJMER Phone- 441171 Pincode : 305002 Email : toshniwalprocess@gmail.com	, ,
145-15000-A	TEMPERATURE SWITCH	DRESSER INDUSTRIES INC.	Mr. Nishit Patel/Mr. Anuj Verma Plot No.2306, Phase II, GIDC Chhatral Kalol Phone- 02764-233682 Pincode : 382729 Email : Nishit.patel@ashcroftindia.com	, ,
145-15000-A	TEMPERATURE SWITCH	SWITZER PROCESS INSTRUMENTS PVT. LTD.	Mr. V S Jayaprakash, No.127 & 128, SIDCO North Phase, Ambattur Estates CHENNAI Phone- 044-26252017/2018 Pincode : 600050 Email : marketing@switzerinstrument.com	Name changed from "M/s Switzer Instrument Ltd." to "M/s Switzer Process Instruments Pvt. Ltd." w.e.f. 27.07.2016; , ,
145-15000-A	TEMPERATURE SWITCH	SOR INC.	LARRY DEGARMO/Avdresh Chandra, 14685 W. 105TH STREET LENEXA Phone- 09810905139, Pincode : 66215 Email : Ldegarmo@sorinc.com, avdresh@sherman-india.com,	, ,
145-15000-A	TEMPERATURE SWITCH	INDFOS (INDIA) LIMITED	MR.L.C.VENKATRANGAN/MR.B.KANNAN New No.17, II Floor, Adwawe Towers, Dr.Sevalia Shivaji Salai, T.Nagar Chennai Phone- +91 44 24353407 Pincode : 600017 Email : delhi@indfos.com	, ,
145-16000-A	SIGHT FLOW INDICATORS	BLISS ANAND PVT. LTD.	Mr. Vikas Anand/ Mr.RGRajan 92B & 93 B , IMT MANESAR Gurgaon Phone- 0124-4366000 TO 9 Pincode : 122001 Email : sales@blissanand.com	Reassessed on 31.03.2016; , ,
145-16000-A	SIGHT FLOW INDICATORS	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com	, ,
145-16000-A	SIGHT FLOW INDICATORS	V. AUTOMAT & INTRUMENTS (P) LTD.	Mr. R. K. BASSI/Mr. PRAVEEN KUMAR F-61, OKHLA INDL.AREA, PH-1 NEW DELHI Phone- 9810005826 Pincode : 110 020 Email : sales@vautomat.com	, ,
145-16000-A	SIGHT FLOW INDICATORS	B.K.EQUIPMENTS PVT.LTD.	T. BALAKRISHNAN/S.VENKATESH 217 , ARCOT ROAD PORUR , CHENNAI Phone- 9444057761 Pincode : 600116 Email : bkequip@gmail.com	, ,
145-16000-A	SIGHT FLOW INDICATORS	SIGMA INSTRUMENTS CO.	Gopal Kannan/R Gopinath 201, ANANDRAJ INDUSTRIAL ESTATE, OFF.LBS MARG, SONAPUR LANE, BHANDUP (W) MUMBAI Phone- +919821038162 Pincode : 400078 Email : sales@sigmainstruments.co.in	Reassessed on 27.04.2016; , ,
145-16000-A	SIGHT FLOW INDICATORS	INSTRUMENTATION ENGINEERS PVT LTD	SH.N.V.RAM GOPAL/MS. N.NIHARIKA PLOTS 1,2,3, PHASE-III, IDA, JEEDIMETLA HYDERABAD Phone- 9848407365 Pincode : 500055 Email : iedelhi@ieflowmeters.com	, ,
145-23000-A	ANUBAR (DELTA TUBE)	TM TECNOMATIC SPA	MR. ANTONIO NOVIELLO/Mrs. Enrica Bazzocc VIA DELLE INDUSTRIE, 36 CREMONA Phone- 39037221574 Pincode : 26100 Email : info@tmtecnomatic.com	, ,
145-23000-A	ANUBAR (DELTA TUBE)	STAR-MECH CONTROLS (I) PVT.LTD.	SUSHILLOTAM, SUSHILLOTAM, 29/3A/3, SASANE NAGAR, HADAPSAR, PUNE Phone- 02026970450 Pincode : 411028 Email : marketing@starmech.net	, ,
145-23000-A	ANUBAR (DELTA TUBE)	DYNAFLUID VALVES AND FLOW CONTROLS (P) LTD.	Mr. Yogish M. Kulkarni Plot # 23, Udyambag, Belgaum Phone- 0831-4210386 Pincode : 590008 Email : yogish@dyna-fluid.com	, ,

Package Code	Package Name	Vendor Name	Vendor Communication Address	Remarks
145-23000-A	ANUBAR (DELTA TUBE)	SWITZER PROCESS INSTRUMENTS PVT. LTD.	Mr. V S Jayaprakash, No.127 & 128, SIDCO North Phase, Ambattur Estates CHENNAI Phone- 044-26252017/2018 Pincode : 600050 Email : marketing@switzerinstrument.com	Name changed from "M/s Switzer Instrument Ltd." to "M/s Switzer Process Instruments Pvt. Ltd." w.e.f. 27.07.2016; , ,
145-23000-A	ANUBAR (DELTA TUBE)	MICRO PRECISION PRODUCTS PVT. LTD.	K.P. CHANDHOK/ATUL CHANDHOK 4, LINK ROAD, FARIDABAD Phone- 9810265688 Pincode : 121002 Email : pal@microa1.com	, ,
145-25000-A	JUNCTION BOX	K.S.INSTRUMENTS PVT.LTD.	S Raghavan No. 72, 3rd Main, 1st Stage Industrial Suburb, Yeshwanthpur Bangalore Phone- 9880385770 Pincode : 560022 Email : sales1@ksinstruments.net	, ,
145-25000-A	JUNCTION BOX	Shrenik & Company,	Mr. Mitesh Shah/Mr. Pulin Shah 39 A/3 ,Panchratna Industrial Estate, Sarkhej-Bavla Road Ahmedabad Phone- 9825024921 Pincode : 382213 Email : sales@pustron.com, pulin@sumip.com	Registered for FRP JB's AND METAL JB's. , Technical limit reviewed on 30.04.2014; ,
145-25000-A	JUNCTION BOX	SUCHITRA INDUSTRIES	NO-2,OPP-27 AECS LAYOUT 2ND STG REJAMAHALVILAS EXTN 2ND STG BANGALORE Phone- Pincode : Email : suchitra.industriesblr@gmail.com	, ,
145-25000-A	JUNCTION BOX	FLEXPRO ELECTRICALS PVT. LTD.	Mr. Dineshbhai Zaveri C-1/ 27&37, GIDC, Kabilpore, Navsari Phone- 02637-265140,265003 Pincode : 396424 Email : flexpro@flexproltd.com	Technical limit reviewed on 12.10.2015; , ,
145-25000-A	JUNCTION BOX	AJMERIA INDUSTRIAL & ENGINEERING WORKS	JIGNESH MAHENDRA AJMERIA DENA BANK BLDG.,SHREE NAGESH INDL. ESTATE,STATION ROAD, MUMBAI Phone- 022 67973578 Pincode : 400 088 Email : ajmeria@ajmeria.net, jmajmeria@yahoo.com	Reviewed in MISCC dt. 21.07.2015 for non-response in 4 consecutive tender enquiry; , APPROVED FOR GALVANIZED AND FRP JUNCTION BOXES; Technical limit reviewed on 30.04.2014 ,
145-32000-A	INSTRUMENTS TUBE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com	, ,
145-32000-A	INSTRUMENTS TUBE FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Mochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com	, ,
145-32000-A	INSTRUMENTS TUBE FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com	, ,
145-32000-A	INSTRUMENTS TUBE FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com	, ,
145-34000-A	ROTAMETER	Flow Star Engineering Pvt. Ltd.,	MR. KHALID AKHTAR/MR. TAPAN KUMAR JANA Plot No-7 F/2, Northern India Industrial 20/3, Mathura Road FARIDABAD Phone- 9818176380 Pincode : 121005 Email : khalid@flowstar.co.in	VENDOR IS REGISTERED IN MSED (MICRO) W.E.F.30.11.2011 FOR FY 2011-12 , ,
145-34000-A	ROTAMETER	TANSA EQUIPMENTS PVT. LTD.	Mr. Vardhan Tamhankar, Unit No35/36/41,Om Anand Industrial Est. Mohanjee Sundarjee Road,Raghunath Nagar, Thane Phone- 022-25832323 Pincode : 400604 Email : tansaindia@gmail.com	, ,
145-34000-A	ROTAMETER	INSTRUMENTATION ENGINEERS PVT LTD	SH.N.V.RAM GOPAL/MS. N.NIHARIKA PLOTS 1,2,3, PHASE-III, IDA, JEEDIMETLA HYDERABAD Phone- 9848407365 Pincode : 500055 Email : iedelhi@ieflowmeters.com	, ,
145-34000-A	ROTAMETER	SCIENTIFIC DEVICES (BOMBAY) PVT LTD,	Office no. 53, Shree Manoshi Complex, Plot No. 5 & 6, Sec-3, Ghansoli (East), Navi Mumbai, Phone- 9892230623, Pincode : 400 701, Email : sdbpl@vsnl.com	, ,
145-34000-A	ROTAMETER	EUREKA INDUSTRIAL EQUIPMENTS PVT.LTD.	Mr V. K. Pandit/Mr Ashish Shaha 17-20, Royal chambers, Paud Road Pune Phone- 9370469466 Pincode : 411038 Email : sales@eurekaflow.com	, ,
145-38000-A	INSTRUMENTS PIPE FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com	, ,
145-38000-A	INSTRUMENTS PIPE FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Mochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com	, ,

Package Code	Package Name	Vendor Name	Vendor Communication Address	Remarks
145-38000-A	INSTRUMENTS PIPE FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7,SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD,GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com	, ,
145-38000-A	INSTRUMENTS PIPE FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com	, ,
145-42000-A	ULTRASONIC FLOW METERS	CHEMTROLS INDUSTRIES LTD	Mr. K. NANDAKUMAR AMAR HILL, SAKI VIHAR ROAD, POWAI, MUMBAI Phone- 022-67151261 Pincode : 400072 Email : manikandan@chemtrols.com	Exclusive distributor for the territory of India of M/s Flexim Instruments Asia Pte Ltd., Singapore; agreement validity upto 17.08.2017. , ,
145-42000-A	ULTRASONIC FLOW METERS	Rockwin Flowmeter India Pvt. Ltd.	B-24, Site-IV, Sahibabad Industrial Area Ghaziabad, Phone- 9810129687 Pincode : 201010, Email : amiya@rockwin.com	, ,
145-42000-A	ULTRASONIC FLOW METERS	FLASH FORGE PVT LTD	Mr. Gautam Makker, 503, 'A'-wing, Delphi, Orchard Avenue Road, Powai Mumbai Phone- 022-42784300 Pincode : 400076 Email : hemendrapatil@f-f.co.in	Exclusive partner for bidding of BHEL tender for M/s Endress & Hauser make Ultrasonic Flowmeters and MOU agreement valid upto 31.12.2016; , Manufacturing works at M/s Endress & Hauser, Aurangabad, Maharashtra and M/s Endress & Hauser, Bhiwandi, Thane, Maharashtra ,
145-42000-A	ULTRASONIC FLOW METERS	NIVUS GMBH	Mr. Marcus Fischer Im Taele 2, D - 75031 Eppingen Phone- 00491712233770 Pincode : Email : carolin.schuster@nivus.com	M/s Automation and Maintenance Systems approved as authorised distributor of M/s Nivus GmbH w.e.f. 01.11.2016 , ,
145-43000-A	FLOW ELEMENT - ORIFICE	STAR-MECH CONTROLS (I) PVT.LTD.	SUSHILLOTAM, SUSHILLOTAM, 29/3A/3, SASANE NAGAR, HADAPSAR, PUNE Phone- 02026970450 Pincode : 411028 Email : marketing@starmech.net	, ,
145-43000-A	FLOW ELEMENT - ORIFICE	TANSA EQUIPMENTS PVT. LTD.	Mr. Vardhan Tamhankar, Unit No35/36/41,Om Anand Industrial Est. Mohanjee Sundarjee Road,Raghunath Nagar, Thane Phone- 022-25832323 Pincode : 400604 Email : tansaindia@gmail.com	, ,
145-43000-A	FLOW ELEMENT - ORIFICE	MICRO PRECISION PRODUCTS PVT. LTD.	K.P. CHANDHOK/ATUL CHANDHOK 4, LINK ROAD, FARIDABAD Phone- 9810265688 Pincode : 121002 Email : pal@microa1.com	REGISTERED AS MS&D VENDOR W.E.F.15.11.2011 FOR FY 2011-12. , ,
145-43000-A	FLOW ELEMENT - ORIFICE	DYNAFLUID VALVES AND FLOW CONTROLS (P) LTD.	Mr. Yogish M. Kulkarni Plot # 23, Udyambag, Belgaum Phone- 0831-4210386 Pincode : 590008 Email : yogish@dyna-fluid.com	, ,
145-43000-A	FLOW ELEMENT - ORIFICE	INSTRUMENTATION LTD.	KANJIKODE WEST, PALALKKAD, PALAKKAD Phone- 2566127-130,2567128 Pincode : 678623 Email : icvldil@gmail.com;fa2@ilpgt.com	SICK PSU. BIFR CASE. , ,
145-43000-A	FLOW ELEMENT - ORIFICE	HYDROPNEUMATICS PVT. LTD.	Mr. DM Bichu G/B, Hill Crown Apts., College Road Mapusa Phone- 0832-2360364 Pincode : 403507 Email : ajayrc@hydropneumatics.co.in	, ,
145-43000-A	FLOW ELEMENT - ORIFICE	Flow Star Engineering Pvt. Ltd.,	MR. KHALID AKHTAR/MR. TAPAN KUMAR JANA Plot No-7 F/2, Northern India Industrial 20/3, Mathura Road FARIDABAD Phone- 9818176380 Pincode : 121005 Email : khalid@flowstar.co.in	, ,
145-43000-A	FLOW ELEMENT - ORIFICE	INSTRUMENTATION ENGINEERS PVT LTD	SH.N.V.RAM GOPAL/MS. N.NIHARIKA PLOTS 1,2,3, PHASE-III, IDA, JEEDIMETLA HYDERABAD Phone- 9848407365 Pincode : 500055 Email : iedelhi@ieflowmeters.com	, ,
145-44000-A	FLOW ELEMENT - NOZZLE	DYNAFLUID VALVES AND FLOW CONTROLS (P) LTD.	Mr. Yogish M. Kulkarni Plot # 23, Udyambag, Belgaum Phone- 0831-4210386 Pincode : 590008 Email : yogish@dyna-fluid.com	, ,
145-44000-A	FLOW ELEMENT - NOZZLE	HYDROPNEUMATICS PVT. LTD.	Mr. DM Bichu G/B, Hill Crown Apts., College Road Mapusa Phone- 0832-2360364 Pincode : 403507 Email : ajayrc@hydropneumatics.co.in	, ,
145-44000-A	FLOW ELEMENT - NOZZLE	INSTRUMENTATION LTD.	KANJIKODE WEST, PALALKKAD, PALAKKAD Phone- 2566127-130,2567128 Pincode : 678623 Email : icvldil@gmail.com;fa2@ilpgt.com	SICK PSU. BIFR CASE. , ,
145-44000-A	FLOW ELEMENT - NOZZLE	STAR-MECH CONTROLS (I) PVT.LTD.	SUSHILLOTAM, SUSHILLOTAM, 29/3A/3, SASANE NAGAR, HADAPSAR, PUNE Phone- 02026970450 Pincode : 411028 Email : marketing@starmech.net	, ,

Package Code	Package Name	Vendor Name	Vendor Communication Address	Remarks
145-44000-A	FLOW ELEMENT - NOZZLE	SEIKO FLOW CONTROL GMBH	Mr. Friedrich Rupprecht/ Mr. S. Subhash Zur Schleuse 5, 2000 Stockerau, Stockerau Phone- 9811047972 Pincode : Email : office@seiko-flowcontrol.com	Indian Representative: M/s Menon Associates, 118, Aurobindo Commercial Complex, New Delhi-110016 , ,
145-44000-A	FLOW ELEMENT - NOZZLE	MICRO PRECISION PRODUCTS PVT. LTD.	K.P. CHANDHOK/ATUL CHANDHOK 4, LINK ROAD, FARIDABAD Phone- 9810265688 Pincode : 121002 Email : pal@microa1.com	REGISTERED AS MSMD VENDOR W.E.F.15.11.2011 FOR FY 2011-12. , ,
145-44000-A	FLOW ELEMENT - NOZZLE	MINCO (INDIA) FLOW ELEMENTS PVT. LTD.	Mr. Raghavendra M. Kulkarni D2-49/50, Tivim Industrial Estate, Karaswada Mapusa Phone- 0832-2257059 Pincode : 403526 Email : gicflowelement@giconindia.com	, ,
145-45000-A	INSTRUMENT FITTINGS	AURA INCORPORATED	NIRAJ SHARAN/SUJIT KUMAR W-167A, GREATER KAILASH-II NEW DELHI Phone- 9810182430 Pincode : 110048 Email : niraj@aurainc.com	, ,
145-45000-A	INSTRUMENT FITTINGS	PRECISION ENGINEERING INDUSTRIES	K. SITARAM/ K. SRINIVAS 7, SIDHAPURA INDUSTRIAL ESTATE S.V. ROAD, GOREGAON(W) MUMBAI Phone- 022 42631700 Pincode : 400 062 Email : peiks@vsnl.com	, ,
145-45000-A	INSTRUMENT FITTINGS	HP VALVES & FITTINGS INDIA PVT. LTD.	S. Harichandran/P.S. Pandi B-11, Mugappair Industrial Estate, CHENNAI Phone- 044 26252537 Pincode : 600037 Email : sales@hpvalvesindia.com	, ,
145-45000-A	INSTRUMENT FITTINGS	Comfit & Valve Pvt. Ltd.	Mr. Jeetu Jain/Mr. Vinay Sosa Survey No. 23/1, Part 2, Ahmedabad-Mehsana Highway Laxmipura, Nandasan Phone- 02764-267036/37 Pincode : 382705 Email : marketing@com-fit.com	, ,
145-45000-A	INSTRUMENT FITTINGS	Arya Crafts & Engineering Pvt. Ltd.	Mr. Sanjay Brahman/Mr. Shyam Vazirani 102, Vora Industrial Estate No.4 Navghar, Vasai Road (E) Dist. Thane, Mumbai Phone- +91-250-2392246 Pincode : 401210 Email : arya@aryaengg.com	, ,
145-45000-A	INSTRUMENT FITTINGS	Perfect Instrumentation Control (India) Pvt. Ltd.	MD Hussain Shaikh/Shahanawaz Khan Gala No. 168, Loheki Chwal, 216/ 218, Maulana Azad Rd. Nagpada Junction Mumbai Phone- 91-9324383121 Pincode : 400008 Email : shahanawaz.khan@perfectinstrumentation.com	, ,
145-45000-A	INSTRUMENT FITTINGS	FLUIDFIT ENGINEERS PVT. LTD.	Mr. Abbas Bhola Potia Building No. 2, Office No. 3, 292, Bellasis Road, Mumbai Central (East) Mumbai Phone- 9920044113 Pincode : 400008 Email : ab@fluidfitengg.com	Registered as per 22nd Electrical and C&I MISCC Meeting dtd. 15.01.2014 , ,
145-45000-A	INSTRUMENT FITTINGS	VIKAS INDUSTRIAL PRODUCTS	S.R.SINGH/NAVEEN SINGH B - 2, SECTOR - 6, NOIDA Phone- +91-9810122070 Pincode : 201301 Email : naveensingh@vsnl.com	, Financial limit reviewed on 05.06.2014 ,
145-45000-A	INSTRUMENT FITTINGS	PANAM ENGINEERS	Mr. Santosh Shukla 203, Jaisingh Business, Parsiwada, Sahar road, Andheri (East), Mumbai, Phone- 9892179529, Pincode : 400099, Email : santosh@panamengineers.com,	, ,
145-45000-A	INSTRUMENT FITTINGS	Fluid Controls Pvt. Ltd.	Sophie Y. Mochhala/Mayur Rajput J.V.PATEL, I.T.I CMPD, B.MADHUKAR MARG, ELPHINSTONE ROADSTN.(WR), MUMBAI Phone- (022) 43338000 Pincode : 400013 Email : sales@fluidcontrols.com	Name changed from M/s Hyd-Air Valves Pvt. Ltd. to M/s Fluid Controls Pvt. Ltd. as per 25th MISCC-Electrical and C&I dtd. 20.02.2014 , ,
145-47000-A	ELECTROMAGNETIC FLOW METER	Electronet Equipments Pvt Ltd.	Plot No. 84, 85 & 86, Tiny Industrial Estate Kondhwa Budruk, Pune Phone- 020-2026932039 Pincode : 411048 Email : ho@eeplindia.com	, ,
145-47000-A	ELECTROMAGNETIC FLOW METER	Adept Fluidyne Pvt. Ltd.	Vinayak Gadre Plot No 4, S.No.17/1-B Kothrud Industrial Estate Pune Phone- 020 25464551 Pincode : 411038 Email : info@adeptfluidyne.com	, ,

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.

SI No.	Package Name	Vendor Name	LOCATION
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
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.



TITLE :
2X660 MW ENNORE SEZ STPP

SPECIFICATION NO. PE-TS-412-155A-A001

SECTION : I

**TECHNICAL SPECIFICATION FOR CONDENSATE
POLISHING UNIT**

SUB-SECTION: IA

REV. NO. 00

DATE :

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.

	TITLE: 2X660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-155A-A001	
		SECTION : I	
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		REV. NO. 00	DATE :

ANNEXURE III

FUNCTIONAL GUARANTEE AND LIQUIDATED DAMAGES

	TITLE:		SPECIFICATION NO. PE-TS-412-155A-A001	
	2X660 MW ENNORE SEZ STPP		SECTION : I	
	TECHNICAL SPECIFICATION FOR CONDENSATE POLISHING UNIT		SUB-SECTION: IA	
			REV. NO. 00	DATE :

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

(The term "Performance Guarantees" wherever appears in this Section shall have the same meaning and shall be synonymous to "Functional Guarantees". Similarly the term "Performance Tests" wherever appears in this Section shall have the same meaning and shall be synonymous to "Guarantee Test(s)". The term "TMCR" (Turbine maximum continuous rating) appearing in the Technical Specification shall mean 660 MW electrical power output at generator terminals (power at generator terminals as per clause indicated in this section) under 0% cycle make-up and 76 mm Hg (abs) condenser pressure unless used in conjunction with a different cycle make-up and/or a different condenser pressure.

1.00 PERFORMANCE GUARANTEES

General Requirements

- 1.01 The Bidder shall guarantee that the equipment offered shall meet the rating and performance requirements stipulated for various equipment covered in this specifications.
- 1.02 The guaranteed performance parameters furnished by the bidder in his offer, shall be without any tolerance values 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 demonstrate all the guarantees covered herein during performance guarantee/acceptance test. The various tests which are to be carried out during performance guarantee/acceptance tests are listed in the specification. The guarantee tests shall be conducted by the bidder at site in presence of BHEL / CUSTOMER on each unit individually.
- 1.04 All costs associated with the tests shall be included in the bid price.
- 1.05 In case during performance guarantee tests, 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 the BHEL / CUSTOMER and re-conduct the performance guarantee test(s) with BHEL / CUSTOMER's consent. However if the specified performance guarantee(s) are still not met but are achieved within the Acceptable shortfall limit specified in the specification, BHEL / CUSTOMER will accept the equipment/system/plant after levying liquidated damages as mention in the specification. If, however, the demonstrated guarantee(s) continue to be more than the stipulated Acceptable Shortfall Limit, even after the above 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:

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 as specified hereunder. The liquidated damages, for shortfall in performance shall be levied separately for each unit. The rates indicated are on station basis and per vessel basis respectively. The liquidated damages shall be pro-rated for the fractional parts of the deficiencies. The performance guarantees coming under this category shall be called 'Category-I' Guarantees.

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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 the payments already made.

OR

Accept the equipment/system after assessing the deficiency in respect of the various ratings, performance parameters and capabilities and recover from the contract price an amount equivalent to the damages as determined by the 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

5.00 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:

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 30 days (720 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 30 days (720 hours). No shortfall in guaranteed effluent quality will be accepted by the BHEL / customer during the service cycle.

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

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b. UNIT START UP CONDITION OR CONDENSER LEAK 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. Chemicals consumption of Acid (33% HCL) & Alkali (48%NaOH) per regeneration.
- c. 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.
- d. Vibration & parallel operation of all the pumps and blowers at the rated duty point shall be demonstrated at site.
- e. 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 the floor level in elevation. A minimum of 6 points around each equipment shall be covered for measurement. Additional measurement points shall be considered based on the applicable standards and the size of the equipment. The measurement shall be done with slow response on the A - weighting scale. The average of A-weighted sound pressure level measurements expressed in decibels to a reference of 0.0002 micro bar shall not exceed the guaranteed value. Corrections for background noise shall be considered in line with the applicable standards. All the necessary data for determining these corrections, in line with the applicable standards, shall be collected during the tests.

6.00 PERFORMANCE GUARANTEE / ACCEPTANCE TEST

6.1. General Requirements

- a) It is the responsibility of the Bidder to perform the Performance Guarantee/Acceptance test as specified in this Section. The performance tests will be performed using only the normal number of BHEL /Customer supplied operating staff for monitoring of PG test. Bidder personnel shall be used for instructional purposes or data collection and conducting the PG test at site. At all times during the Performance Tests the effluents quality from the Plant shall not exceed the Guaranteed Effluent Limits.
- b) The Bidder shall make their system ready for the performance guarantee tests.



TITLE:
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- c) All instruments required for performance testing shall be of the type and accuracy required by the code and prior to the test, the Bidder shall get these instruments calibrated in an independent test Institute approved by the TANGEDCO/BHEL. All 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 costs associated with the supply, calibration, installation and removal of the test instrumentation shall be included in the bid price. All calibration procedures and standards shall be subjected to the approval of the TANGEDCO/BHEL. The protecting tubes, pressure connections and other test connections required for conducting guarantee test shall conform to the relevant codes. Tools and tackles, thermo wells (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.
- d) The Bidder shall submit for TANGEDCO/BHEL 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 curves.
 - (vii) Instrument list consisting of range, accuracy, least count, and location of instruments.
 - (viii) Scheme showing measurement points.
 - (ix) Sample calculation.
 - (x) Acceptance criteria.
 - (xi) Any other information required for conducting the test.

The Performance / Acceptance test shall be carried out as per the agreed procedure. After the conductance of Performance test, the Bidder shall submit the test evaluation report of Performance test results to TANGEDCO/BHEL promptly but not later than one month from the date of conductance of Performance test. However, preliminary test reports shall be submitted to the TANGEDCO/BHEL after completing each test run.

e) Test Interruptions:

In the event of a test interruption resulting from an Event of Force Majeure the interrupted Performance Test must be started again and test data that were collected during the interrupted test must be ignored.

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ANNEXURE VI

MANDATORY SPARE LIST

	TITLE: 2X660 MW ENNORE SEZ STPP		SPECIFICATION NO. PE-TS-412-155A-A001	
			SECTION : I	
	TECHNICAL SPECIFICATION FOR CONDENSATE POLISHING UNIT		SUB-SECTION:IA	
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MANDATORY SPARES LIST FOR CONDENSATE POLISHING UNIT

Sr. no.	Description of Item	Unit	Quantity
	MECHANICAL		
1.0	SERVICE & REGENERATION VESSELS (FOR EACH TYPE & SIZE)		
i)	Diffuser, Distributors & Nozzle	%	10
ii)	Perforated Laterals & Under Drain Collectors	%	10
iii)	Gaskets	Set	2
iv)	Nut & Bolts	Set	1
2.0	Valves	%	20 % of each type & size
3.0	Pumps & Blowers along with Drive Motors	No.	1 no. each type & size
4.0	Ejector & Dosing Pump	No.	1 no. each type & size
5.0	Resin Trap	No.	1 no. each type & size
6.0	HORIZONTAL CENTRIFUGAL PUMP FOR EACH TYPE		
i)	Bearings	Set	2
ii)	Thrust Pads	Set	1
iii)	Shaft sleeves	Set	1
iv)	Fasteners	Set	1 set required for assembling one pump
	ELECTRICAL		
7.0	415 V Motors		
i)	Terminal plates	Nos.	10 Nos. each for small motors upto 30 KW & 4 Nos. each for more than 30 KW
ii)	Heaters	Set	2 sets
iii)	Greasing arrangements	Set	4 sets each type of motor
iv)	Motor of each type and rating	%	10% of the installed quantity or minimum 1 number whichever be higher.
v)	Bearings (DE and NDE) for each type and rating of motor	Set	4 sets

MANDATORY SPARES: List of Mandatory Spares for Electric hoists are as follows & no Mandatory Spares are applicable for Chain Pulley Blocks.

Electric Hoists		
SL NO	ITEM DESCRIPTION	QTY
1	Brake linings	2 set of each type
2	Rope guide & rope tightener	1 no. of each type
3	Limit switch	2 set of each type & size
4	Gear box / gear set	2set of each type
5	Drum Bearing	1set of each type & rating

Note: Bidder to please refer the notes of Sub-section IA of this technical specification regarding spares.

MANDATORY SPARES
CONTROL & INSTRUMENTATION
CONDENSATE POLISHING UNIT

2x660 MW ENNORE SEZ PROJECT OF TANGEDCO

MANDATORY SPARES

III. CONTROL & INSTRUMENTATION			
Sl no	Name of spares	Unit	Qty
1.0.0		INSTRUMENTATION	
(i)	Each type of lamps, PBs, ILPBs, fuse, MCB, MCCB used in the equipment/system.	Nos.	20 % of Installed of each type.
1.00.01	Measuring Instruments		
1.00.01.01	Indicators, Recorders, Electrical Metering and Skid Mounted Instruments		
(i)	Indicators, recorders and meters offered from each model for the project. These instruments shall be supplied with three sets of blank scales.	Nos.	10 % of Installed of each type/Model or a minimum of one number for each model and type, whichever is more
(ii)	For skid mounted instruments As applicable	Nos.	10% of total number of instruments for each Type and model or a minimum of one number for each model and type, whichever is more
1.00.01.02	Temperature Elements and Thermowells		

C&I Mandatory Spares are indicative in above list. These spares shall be considered as per the applicable items in main supply of respective packages. The spares shall be considered as unit wise except for any item/equipment supplied as common for both units.

Sl no	Name of spares	Unit	Qty
(i)	Thermocouple/RTD elements	Nos.	10% spare for each type and length of element furnished with thermocouple/RTD assemblies, or a minimum of one number of each type & length, whichever is more.
(ii)	Thermowells	Nos.	10% for each type of temperature sensors or a minimum of one for each type, whichever is more
1.00.01.03	Temperature, Transmitters and Electronic Transmitters (For Pressure, DP, Temp, Flow, Level), Temperature, Pressure, Flow & Level Switch, safety switches, Gauges, meters, Transducer or any other instrument etc.	Nos.	10% of total number of Instruments/transducers offered for each model and type for the project or a minimum of one number, whichever is more.

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Sl no	Name of spares	Unit	Qty
e.	Digital output module	Nos.	10% of qty Installed of each category/model or at least 2 No. of each type/model (Whichever is more)
1.00.02.02	All types of electronic modules, controllers, function modules, cards, terminal boards, relay boards, power supply cards etc for above mentioned system and other Control System/Sub- systems and any other type of PCB not covered above	Nos.	10% of qty Installed of each category/model or at least 2 No. of each type/model (Whichever is more)
1.00.02.03	Electronic Cards/modules	Nos.	10% of number for each type or minimum of 2 number for each type whichever is high.
1.00.02.04	Auto/Manual stations, set-point/bias stations etc	Nos.	10% of the number of stations offered for the project from each type or a minimum of 2 number from each model, whichever is more.
1.00.02.05	Control logic power supply fuses, MCB,MCCB, at each current rating required for the project.	Nos.	20% spare for each type/Model
1.00.02.06	Electronic cards of each type used for each type of Servers supplied with any control system	Nos.	Ten (10) percent or 2 no. (Whichever is more)
1.00.02.07	Electric to pneumatic converters of each type utilized with automatic control system using pneumatic drives	Nos.	Ten (10) percent of each type or a minimum of one of each type, whichever is more.
1.00.02.08	Plug-in type keyboard	Nos.	10 nos. of each type/model.
1.00.02.09	Control QWS	Nos.	Two No. of each type with complete accessories & monitors.
1.00.02.10	Utility/Engineering OWS	Nos.	Two No. of each type with complete accessories & monitors.
1.00.02.11	DVD/CD	Nos.	10 boxes
1.00.02.12	Data highway cable with adequate	set.	200 mts. each

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Sl.no	Name of spares	Unit	Qty
	connectors of each type		
1.00.02.13	Hard disc drive unit	Nos.	Five nos of each type
1.00.02.14	Prefab cable connectors	Nos.	10% or 5 nos (whichever is more) of each type of Installed
1.00.02.15	Cubicle power supply power supply modules	Nos.	Ten (10) percent or 5 nos (whichever is more) of Installed of each type and rating
1.00.02.16	Interposing/coupling relays.	Nos.	Ten (10) percent Installed of each type and rating
1.00.02.17	Ethernet Switches, Routers & other communication hardware	Nos.	10% of qty Installed of each type or a minimum of 2 numbers from each model, whichever is more.
1.00.02.18	Sensors with special cables, Power supply modules, Relay, Interface Module, and electronic modules used for vibration monitoring system.	Nos.	10% of qty installed or Five no. (Whichever is more) of each type)

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SI no	Name of spares	Unit	Qty	*Remarks	Unit
1.00.02.25	RJ 45 connector with box of each type	Nos.	Twenty (20) percent or 2 no. (Whichever is more)	For CAS included in clause Compressor Air System of Mech. List of mandatory spares AND For Electrochlorination , price included under clause HORIZONTAL CENTRIFUGAL PUMP FOR EACH TYPE of Mech. List of mandatory spares AND For Air Conditioning system, price included under clause Air Conditioning system of Mech. List of mandatory spares	PEM+EDN
1.00.02.26	Hooters, Buzzers, Cooling fans of each type.	Nos.	Ten (10) percent or 2 no. (Whichever is more)		PEM+EDN
1.00.02.27	Interface cables	Set	2 sets of each type/model		PEM
1.00.02.28	Power supply modules (AC to DC converters)	Nos.	10% or Five no. (Whichever is more) of each type/model		PEM
1.00.02.29	DVD/CD drive unit of each type	Nos.	5 nos.		PEM+EDN
1.00.02.30	Mouse	Nos.	20 nos. of each type/model.		PEM+EDN
1.00.03	Steam and Water Analysis System (SWAS)			Lot price has been given for items under SI no. 10.00.03	EDN
1.00.03.01	High pressure reducing elements for sample flow.	Nos.	10% spare of qty installed.		EDN
1.00.03.02	Ion exchange columns with resin as utilized with cation conductivity analysers	Nos.	Four No		EDN
1.00.03.03	Conductivity cells as utilised with conductivity monitors	Nos.	Two nos of each type		EDN
1.00.03.04	pH flow-through type cells used with pH monitors	Nos.	Two nos. of each type		EDN
1.00.03.05	Chemical reagents for all analysers	Set	12 months continuous operation of all analysers from date of taking over.		EDN
1.00.03.06	Chemical reagents for colorimetric silica analyzers	Set	12 months continuous operation of all analysers from date of taking over.		EDN
1.00.03.07	Electronic Modules	Nos.	One (1) no. for each type of Analyser.		EDN

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SI no	Name of spares	Unit	Qty	*Remarks	Unit
1.00.03.08	Pressure gauge, solenoid valves, temperature gauge, Back Pressure regulating valves, 3 way grab valves, needle valves, isolation valves, PRV, flow switch, flow indicator and temperature switch, erection hardware's, valves in SWAS.	Nos.	Two (2) no. of each type		EDN
1.00.03.09	Primary coolers/secondary coolers.	Nos.	Three (3) No of each type		EDN
1.00.04	Relay based Control Panels			PEM-For Air Conditioning system, price included under clause Air Conditioning system of Mech. List of mandatory spares EDN-Lot Price has been given	PEM+EDN
1.00.04.01	LEDs for indicating lights	Nos.	10% of qty installed.		PEM+EDN
1.00.04.02	Control circuit fuses/MCB/MCCB/Semiconductor Fuses	Nos.	300% of installed of each type, current rating.		PEM+EDN
1.00.04.03	Relays modules & contactors.	Nos.	20% spare of qty Installed of each type & rating.		PEM+EDN
1.00.05	Alarm Annunciation System			PEM-For Electrochlorination , price included under clause HORIZONTAL CENTRIFUGAL PUMP FOR EACH TYPE of Mech. List of mandatory spares AND For Air Conditioning system, price included under clause Air Conditioning system of Mech. List of mandatory spares EDN-Lot Price has been given	PEM+EDN PEM+EDN
1.00.05.01	logic modules, group card modules, power supply modules, Hooters and any other electronic module.	Nos.	20% spares of each type installed		PEM+EDN
1.00.05.02	un-engraved window boxes complete with LED etc.	Nos.	5% spares of each size installed		PEM+EDN
1.00.05.03	LEDs for annunciation facia windows and LEDs box assemblies offered for the project	Nos.	20% of qty installed		PEM+EDN
1.00.05.04	Annunciator hooter	Nos.	One (1) No. of each type		PEM+EDN

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Sl.no	Name of spares	Unit	Qty
1.00.06.11	Electronic modules of each type & rating for UPS and DC control power supply system.	Set	One set of with each set consisting of at least one number of each type of electronic module for inverters, chargers, static switch, stabiliser etc. as per approved BOM.
1.00.06.12	MCCB for UPS & 24 V DC charger panels, ACDB, DCDB.	Nos.	20 % of installed or 5 Nos of each type (whichever is more)
1.00.07	Erection hardware		
1.00.07.01	Instrument valves	Nos.	Ten (10) percent of each type & Size installed
1.00.07.02	Condensate pots of each type & Size installed	Nos.	Ten (10) percent of total number of Installed or four numbers whichever is higher .
1.00.07.03	Manifold	Nos.	Ten (10) percent of each type & Size installed
1.00.07.04	Fittings	Nos.	Ten (10) percent of each type & Size installed
1.00.08	LVS		
1.00.08.01	LEDs	Nos.	20% (Installed) spares of each type & size.
1.00.08.02	LVS Filters	Nos.	50% spare or min 6 nos.
1.00.08.03	Electronic cards of each type for LVS	Nos.	3 nos. or 20% whichever is more
1.00.08.04	Interfacing cables	Set	Two Set of each type & size.

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Sl no	Name of spares	Unit	Qty
1.00.11.01	As per Manufacturer's Recommendation for Three Years Continuous Operation or minimum quantities indicated as below (whichever is more)		
1.00.11.02	Electronic cards/Module/Mother Board /Signal Processing Unit for each type of Analyzer	Nos.	One no. of each type
1.00.11.03	Power supply module	Nos.	One no. of each type for each analyser
1.00.11.04	UV Lamp with adopter with SO2 analyser.	Nos.	One no. of each type
1.00.11.05	Light source and detector unit for SPM and NOX/SOX analyser.	Nos.	One no. of each type for each analyser
1.00.11.06	Pump for SPM Analyser	Nos.	One no. of each type
1.00.11.07	Conference hall mic.	Nos.	Two no. of each type
1.00.11.08	Conference hall speakers.	Nos.	Two no. of each type
1.00.12	HMS		
1.00.12.01	As per Manufacturer's Recommendation for Three Years Continuous Operation	Set	
1.00.12.02	Electronic cards	Nos.	One no. of each type
1.00.13	Mandatory Spares for Control valves, Power Cylinder, Control Dampers, Actuators and Accessories		
(A)	Following spares shall be furnished for control valves, Power Cylinder, Control Dampers as applicable.		
	One set of spare control valve stem packing for each control valve.		

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Sl no	Name of spares	Unit	Qty
	Two moulded rubber diaphragms for each control valve.		
	One sets of each of O-rings and rubber gaskets for each control valve.		
d)	100 percent qty. of lubricants for gaskets for each control valve on one year consumption basis.		
	2 sets of limit switches and 1 set of valve positioner for each control valve.		
f)	20 percent of position transmitter (4-20mA) for total qty. of control valve.		
g)	One (1) set of valve trims (such as plug, stem, seat ring /cage, guide bushing, stem lock pin, packing retaining ring, etc) for each control valve.		
h)	One completes actuator of each type or min 10% for each type and size whichever is more.		
i)	20 percent of Solenoid valves or min 2 no. of each type for total qty. of control valves.		

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Sl no	Name of spares	Unit	Qty
j)	20% of I to P converters, Pressure regulators.		
B)	Mandatory spares for each critical applications special control valves as specified in NIT		
C)			
a.	Soft Goods Kit Valve	1 set	
b.	Metal seat	1 set	
c.	Seat Ring	1 set	
d.	Spindle	1 set	
e.	Actuator Soft Goods kit	1 set	
i.	Feed back transmitter unit	2 Nos.	
ii.	Electronic Position Transmitter	2 Nos.	
iii.	Solenoid valves	2 Nos.	
iv.	Air filter regulators	2 Nos.	
v.	Air Lock Relay	2 Nos.	
vi.	Complete Actuator for each type and model	1 set	

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Sl no	Name of spares	Unit	Qty
1)	2nos. acoustic transducer with rear connector sealed to IP-65		
2)	2 nos. flexible high temperatures lead, 3metre long for acoustic transducer.		
3)	2 nos. acoustic s field amplifier / processor mounted in a die cast aluminum or polycarbonate box sealed to IP-65 with mounting brackets, pairs.		
4)	1 no. A/D Converter cards/field signal interface module for 32 or more channels.		
5)	1 no. Alarm relay output card.		
6)	Consumables like batteries, fuses etc. for two years operation of boiler tube leak detection system.		
1.00.15	Mandatory spares not covered above		
	Bidder to supply 10% or 1 no. (whichever is more) of each type of sensor/instrument/Analyser/instrumentation/mechanical fittings, Nucleonic & non nucleonic density transmitter etc.& for any other system of CPU package.		
1.00.16	OTHER RELATED CONTROL AND INSTRUMENTATION SYSTEMS/EQUIPMENTS		
1.00.16.01	Other SG related sub-systems		
1	Flame Monitoring System		

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	TITLE :		SPECIFICATION NO. PE-TS-412-155A-A001	
	2X660 MW ENNORE SEZ STPP		SECTION : I	
	TECHNICAL SPECIFICATION FOR CONDENSATE POLISHING UNIT		SUB-SECTION:IA	
			REV. NO. 00	DATE :

NOTES:

- i) Unless stated otherwise, a "set" or "Lot" means items required for complete replacement in one equipment of each type / size/ range.
- ii) Whenever the quantity is mentioned in "sets" the bidder has to give the item details and prices of each item.
- iii) Wherever quantity has been specified as percentage (%), it shall mean percentage (%) of the population of the item required for one unit of 660 MW in the station (project), unless specified otherwise.
- iv) 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.
- v) 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.
- vi) Wherever quantity is specified both as a percentage and a value, the Bidder has to supply the higher quantity until and unless specified otherwise.
- vii) 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.
- viii) In case, mandatory spares are not applicable as per equipment / item selected, bidder has to provide equivalent mandatory spare as per for selected equipment / item in line with list of mandatory spares.
- ix) In case mandatory 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 in line with list of mandatory spares.

THE VENDOR WARRANTS:

1. That all spares supplied will be new and in accordance with the contract document and will be free from defects in design, material and workmanship and shall further guarantee as under:
2. In case of any failure in the original component/equipments due to faulty designs, materials and workmanship, the corresponding spare parts if any, supplied will be replaced without any extra cost to the BHEL and customer unless a joint examination and analysis by BHEL and/or customer of such spare parts prove that the defect found in the original part that failed can safely be assured not to be present in spare parts.
3. The long term availability of spares to the BHEL and the customer for the full life of the equipment covered under the contract and that before going out of production of spare parts of the equipment covered under the contract, vendor and his sub-vendors shall give the BHEL and the customer at least 24 (Twenty Four) months advance notice so that the latter may order his bulk requirements of spares, if he so desires. The same provision will also be applicable to the



TITLE :
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR CONDENSATE
POLISHING UNIT**

**SPECIFICATION NO. PE-TS-412-155A-
A001**

SECTION : I

SUB-SECTION:IA

REV. NO. 00

DATE :

sub-vendors. Further, in case of discontinuance of manufacture of any spares by the vendors or his sub-vendors the vendors and his sub-vendors, will provide the BHEL and the customer, 2 (two) years in advance, with full manufacturing drawings, material specifications and technical information required by the BHEL and the customer for the purpose of manufacture of such items and also the right to manufacture such spares for their own requirements.

4. Further in case of discontinuance of supply of spares by the vendors or his sub-vendors, the vendor will provide the BHEL and the customer with full information for replacement of such spares with other equivalent makes, if so required by the BHEL and the customer.
5. Notwithstanding the above, the vendor shall be responsible for supply of spares for the lifetime of the package at reasonable prices. The prices of all future requirements of spares shall be derived from the corresponding ex-works price at which the orders for such spares have been placed by the BHEL and the customer as a part of the mandatory or long term or any other kind of spares. The base indices for calculating ex-works price shall be commissioning of last equipment under main contract.
6. The vendor will indicate the delivery period of the spares, which the BHEL and the customer may procure in accordance with this clause.
7. In case of emergency requirements of spares, the vendor would make every effort to expedite the manufacture and delivery of such spares on the basis of mutually agreed time schedule.
8. In case the vendor fails to supply the mandatory or long term or any other kind of spares on the terms stipulated above, the BHEL and the customer shall be entitled to purchase the same from the alternate sources at the risk and the cost of the vendor and recover from the vendor, the excess amount paid by the BHEL and the customer over the rates as per the contract. In the event of such risk purchase by the BHEL or the customer, the purchases will be as per the works and procurement policy of the BHEL and the customer prevalent at the time of such purchases and BHEL & the customer at his option may include a representative from the vendor in finalizing the purchases.
9. It is expressly understood that the final settlement between the parties in terms of relevant clauses of the tender document shall not relieve the vendor of any of his obligations under the provision of long term availability of spares and such provisions shall continue to be enforced till the expiry of 30 (thirty) years period reckoned from the scheduled date of completion of trial operation of the last equipment unless otherwise discharged expressly in writing by the BHEL or the customer.

	TITLE: 2X660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-155A-A001	
		SECTION : I	
	TECHNICAL SPECIFICATION FOR CONDENSATE POLISHING UNIT	SUB-SECTION:IA	
		REV. NO. 00	DATE :

ANNEXURE IX

LIST OF TOOLS & TACKLES (AS APPLICABLE)



TITLE:
2X660 MW ENNORE SEZ STPP

**TECHNICAL SPECIFICATION FOR CONDENSATE
POLISHING UNIT**

**SPECIFICATION NO. PE-TS-412-155A-
A001**

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Bidder to consider necessary tools and tackles for mechanical, electrical and control & instrument as per their system requirement. In addition, bidder to adhere relevant clauses of tender specification also. The same shall be in bidder's scope.

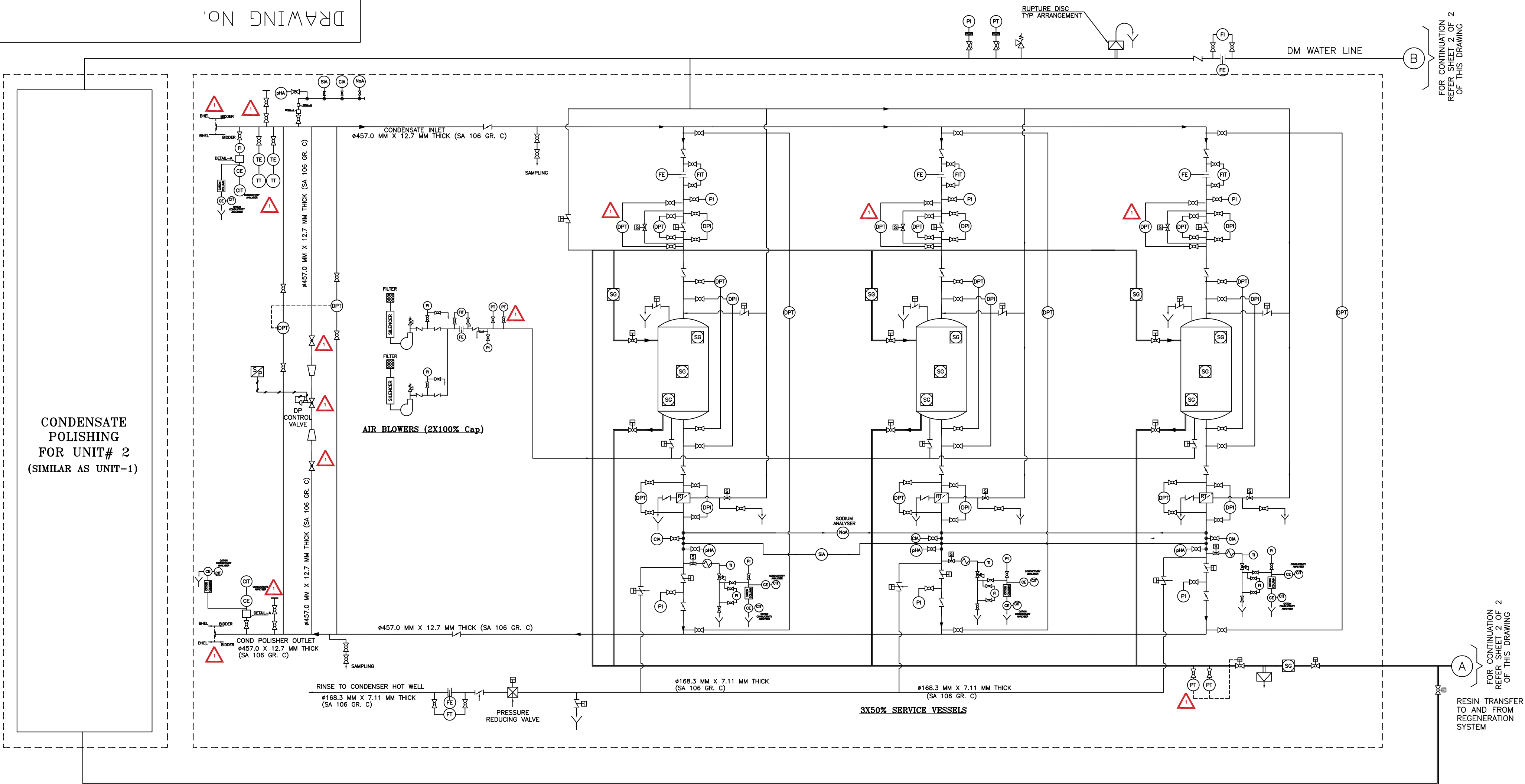
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FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM

DRAWING NO.



NOTES :

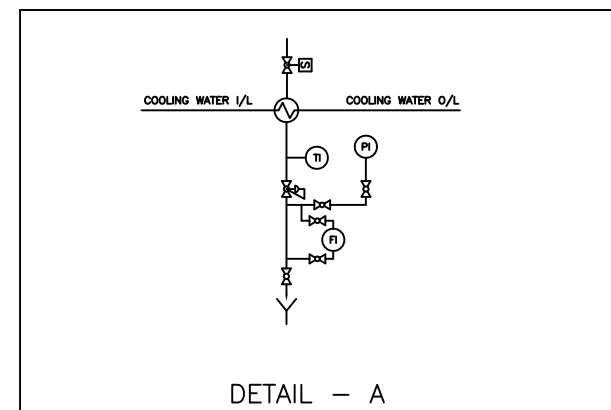
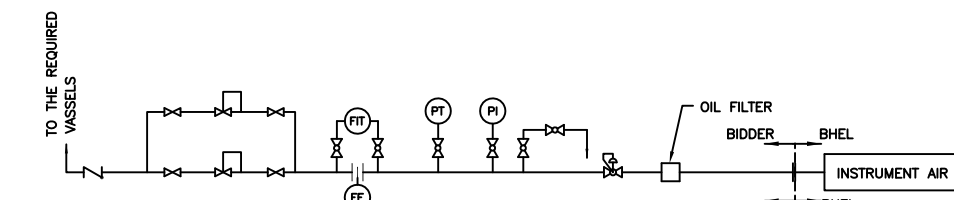
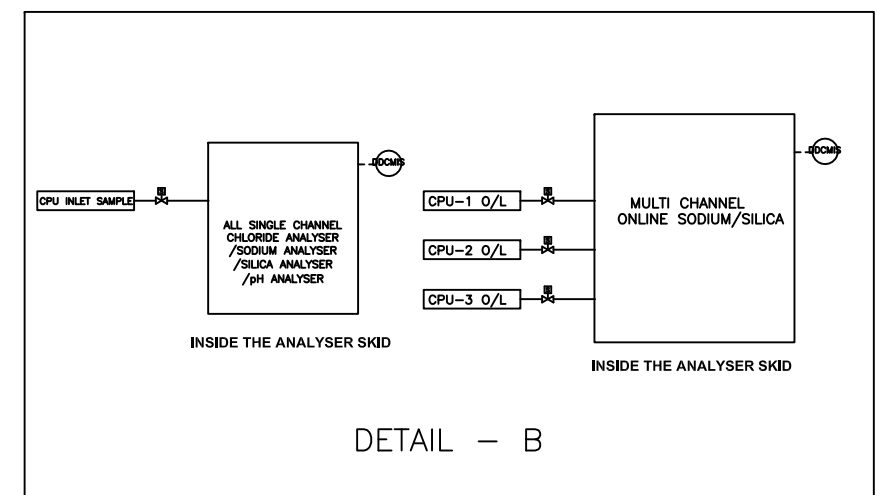
1. THE P&I DIAGRAM IS INDICATIVE AND ONLY MINIMUM REQUIREMENT OF VALVES, INSTRUMENTATION ETC. HAS BEEN SHOWN. BIDDER SHOULD FURNISH COMPLETE SCHEME IN ALL RESPECTS INCLUDING ALL INSTRUMENTS, VALVES ETC. FOR SMOOTH, SAFE, EFFICIENT, TROUBLE FREE OPERATION OF PLANT FOR BHEL/ CUSTOMER APPROVAL DURING DETAILED ENGINEERING.
2. [] INDICATES TERMINAL POINTS BETWEEN BHEL/SCCL & BIDDER:
BHEL - SCOPE OF EMPLOYER TP (TERMINAL POINT)
BIDDER - SCOPE OF BIDDER
3. SERVICE VESSELS OF SPHERICAL DESIGN IS ALSO ACCEPTABLE.
4. ALL THE INSTRUMENT ISOLATION VALVES OTHER THAN FOR ACID/ALKALI APPLICATION SHALL BE GLOBE PATTERN AND DIAPHRAGM TYPE. FOR ACID/ALKALI/REG WASTE APPLICATION TO BE PROVIDED AT SOURCE. NEAR THE INSTRUMENT 2-VALVE MANIFOLD FOR PRESSURE MEASURING INSTRUMENTS/3-VALVE MANIFOLD FOR DP MEASURING INSTRUMENTS/ 5-VALVE MANIFOLD FOR DPTS, BALL VALVE FOR FLOW INDICATORS/ANALYTICAL INSTRUMENT SHALL BE PROVIDED.
5. WHERE EVER PROVIDING 2 VALVE MANIFOLD IS NOT FEASIBLE TWO NUMBERS OF GLOBE VALVES SHALL BE PROVIDED TO MEET THE FUNCTION OF 2-VALVE MANIFOLD.
6. ACID/ALKALI/DM LINE, REG WASTE, RESIN LINES, CRU, ARU, IRU AND MIXED RESIN STORAGE VESSELS PR. INSTRUMENTS SHALL BE PROVIDED WITH DIAPHRAGM SEAL.
7. FLOW TOTALISATION SHALL BE DONE IN SOFTWARE.
8. DP CONTROL VALVE BETWEEN INLET/OUTLET OF CPU SHALL BE MODULATING TYPE DULY PROVIDED WITH PNEUMATIC ACTUATOR, MICRO-PROCESSOR BASED POSITIONER, FOS, XMT, AIR LOCK DEVICE AND SOLENOID VALVE ETC.
9. ALL SOLENOID OPERATED VALVES SHALL BE PROVIDED WITH MODULATING TYPE DULY PROVIDED WITH PNEUMATIC ACTUATOR, MICRO-PROCESSOR BASED POSITIONER, FOS, XMT, AIR LOCK DEVICE AND SOLENOID VALVE ETC.
10. ALL THE TRANSMITTERS PROCESS ACTIVATED SWITCHES ARE TO BE CONNECTED TO PLC.
11. BLANK FLANGES, COUNTER FLANGES & ISOLATION VALVES SHALL BE PROVIDED BY THE BIDDER AT THE TERMINAL POINTS WHEREVER APPLICABLE
12. ALL THE ANALYSERS SHALL BE PANEL MOUNTED.
13. ALL THE ISOLATION VALVES OF ALL THE INSTRUMENTS SHALL BE OF SS316 CONFORM TO ANSI 300# CLASS.
14. REFER SHEET 2 OF 2 OF THIS DRAWING FOR ADDITIONAL NOTES.
15. DOUBLE ROOT VALVE WILL BE PROVIDED BY BIDDER WHEN LINE PRESSURE IS MORE THAN 40 BAR.
16. LEVEL TRANSMITTERS FOR ACID/ ALKALI TANKS SHALL BE ULTRASONIC / RADAR TYPE.
17. BIDDER TO INDICATE RECOMMENDED ALARM LIST ALONGWITH CONTROL PHILOSOPHY AND INTERLOCK/PROTECTION WRITE UP IN LINE REQUIREMENT.
18. WHERE EVER THE TERMINAL POINTS HAVE BEEN MARKED BETWEEN BHEL & BIDDER IF REDUCERS/EXPANDERS ARE REQUIRED DURING DETAIL ENGS. SHALL BE PROVIDED BY BIDDER.
19. KKS TAG NOS. SHALL BE PROVIDED FOR EACH INSTRUMENTS.DRIVE/VALVE DURING DETAIL ENGINEERING BY THE BIDDER AND TAG NO. PREFIX FOR UNIT-1 SHALL BE "10" AND FOR UNIT-2 PREFIX SHALL BE "20" AND FOR COMMON SYSTEM PREFIX SHALL BE USED "90".
20. BIDDER TO INDICATE PROCESS PARAMETERS (PRESSURE, TEMPERATURE, FLOW ETC.) OF EACH AND INDIVIDUAL LINES DURING DETAIL ENGINEERING WHILE SUBMITTING THE P&ID OF CONDENSATE POLISHING UNIT.

CONDENSATE POLISHING FOR UNIT #1 (TYPICAL)

- CS CONTROL SYSTEM OCLS- OPEN CLOSE LIMIT SWITCH
- LS LEVEL SWITCH DPIT- DIFF. PRESSURE INDICATOR CUM TRANSMITTER
- TT TEMPERATURE TRANSMITTER
- PI/PG PRESSURE INDICATOR/PRESSURE GAUGE
- PT PRESSURE TRANSMITTER
- TI TEMPERATURE INDICATOR
- FI FLOW INDICATOR
- CE CONDUCTIVITY ELEMENT
- SiO2 SILICA ANALYSER
- FT FLOW TRANSMITTER
- DPI/DPG DIFF. PRESSURE INDICATOR/DIFF. PRESSURE GAUGE
- DPS DIFF. PRESSURE SWITCH
- FIT FLOW INDICATOR TRANSMITTER
- FE FLOW ELEMENT
- CT CONDUCTIVITY TRANSMITTER
- DPT DIFF. PRESSURE TRANSMITTER
- FS FLOW SWITCH
- CIT CONDUCTIVITY INDICATING TRANSMITTER
- DI DENSITY INDICATOR
- TE TEMPERATURE ELEMENT
- LI/LG LEVEL INDICATOR/ LEVEL GAUGE
- PHE pH ELECTRODE
- PHAT pH ANALYSER TRANSMITTER
- ORIFICE (Pressure Breakdown)
- SAMPLE COOLER
- SODIUM ANALYSER
- SINGLE CHANNEL CHLORIDE ANALYSER
- SILICA ANALYSER
- SINGLE CHANNEL PH ANALYSER
- TEMPERATURE GAUGE
- NON-NUCLEONIC (VIBRATION) TYPE DENSITY METER

LEGEND

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	PRIMING CHAMBER		BLOWER
	PUMP		ISOLATION GATE
	BALL VALVE		PLUG VALVE
	BUTTERFLY VALVE		DRAIN
	OVERFLOW SEAL POT/CO2 ABSORBER		RUPTURE DISC
	GLOBE VALVE		PRESSURE REDUCING VALVE
	DIAPHRAGM VALVE		CONDENSATE LINE
	MOTORISED VALVE		D.M.WATER/RAIN LINE
	PRESSURE RELIEF VALVE		RINSE WATER LINE
	NON RETURN VALVE		ACID SOLUTION LINE
	BUTTERFLY VALVE WITH GLAND SEALING		ALKALI SOLUTION LINE
	SOLENOID VALVE		RESIN TRANSFER LINE
	RESIN TRAP		FIELD MOUNTED INSTRUMENT
	SIGHT GLASS		PANEL MOUNTED INSTRUMENT
	DOUBLE ACTING PHU/CYLINDER OPERATOR		PULSATION DAMPER
	PNEUMATICALLY OPERATED VALVE		DIAPHRAGM SEAL
	Y TYPE STRAINER		OPEN CLOSED LIMIT SWITCH
	ORIFICE PLATE		OVER PRESSURE PROTECTION DEVICE
	TEMPERATURE CONTROL VALVE		



2 X 660 MW ENNORE SEZ SUPER CRITICAL TPP



TAMILNADU GENERATION & DISTRIBUTION CORPORATION LTD.



CONSULTANT: DESEIN PVT LTD, NEW DELHI.



BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

DEPT CODE	NAME	SIGN	DATE
DRN	DK		04.01.2017
DESN	MKG		04.01.2017
CHD	JP		04.01.2017
APPD	PK		04.01.2017

TITLE
P&I DIAGRAM FOR
CONDENSATE POLISHING UNIT

DRAWING No.
PE-DG-412-155-A001

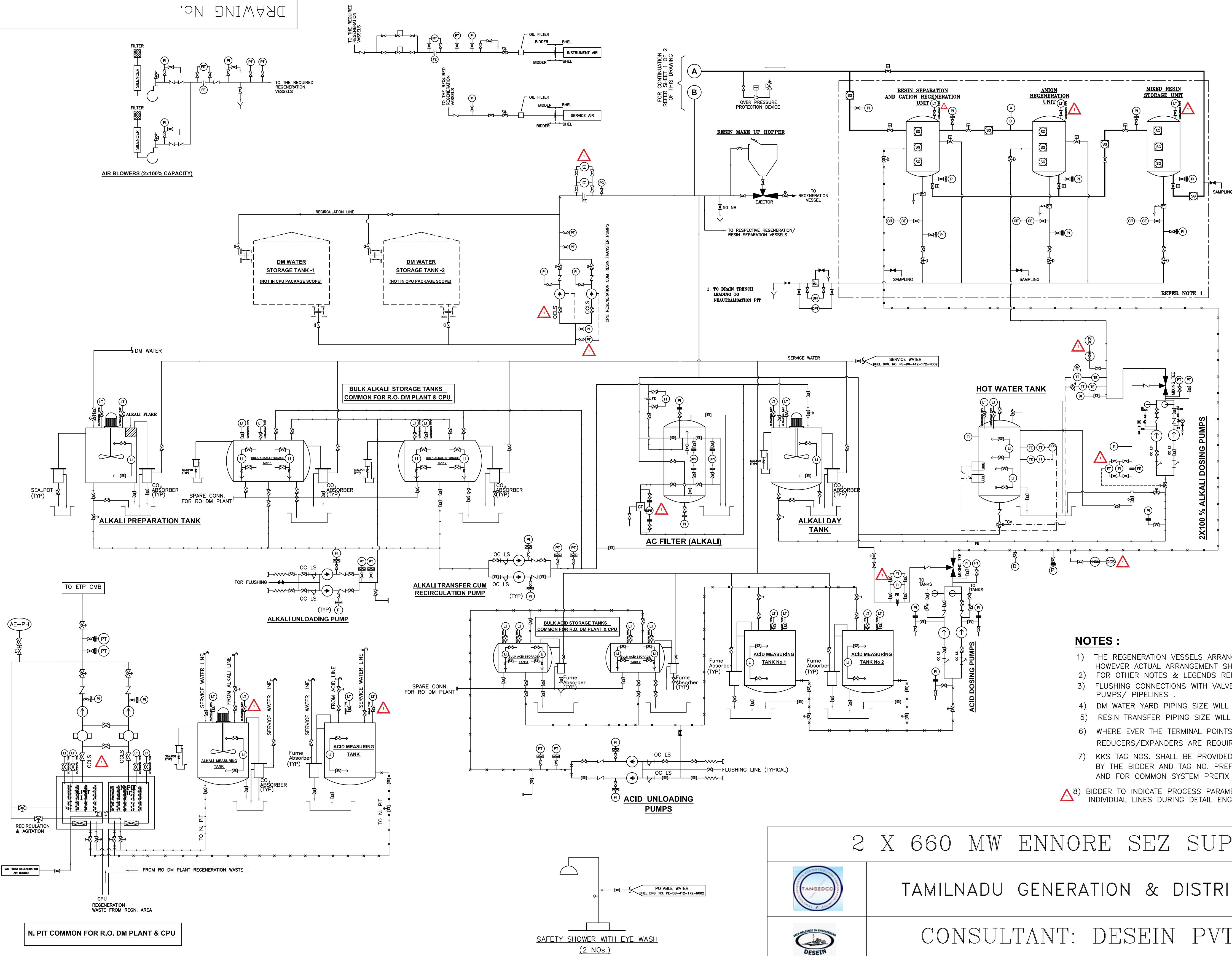
SHEET	01	OF	02	REV	1
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FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM



- NOTES :
- THE REGENERATION VESSELS ARRANGEMENT SHOWN HERE IS INDICATIVE ONLY. HOWEVER ACTUAL ARRANGEMENT SHALL BE AS PER SUPPLIER PROCESS REQUIREMENT.
 - FOR OTHER NOTES & LEGENDS REFER SHEET 1 OF THIS DRAWING.
 - FLUSHING CONNECTIONS WITH VALVES SHALL BE PROVIDED FOR ALL ACID/ALKALI/DM PUMPS/ PIPELINES .
 - DM WATER YARD PIPING SIZE WILL BE MIN. 100 NB.
 - RESIN TRANSFER PIPING SIZE WILL BE MIN. 80 NB.
 - WHERE EVER THE TERMINAL POINTS HAVE BEEN MARKED BETWEEN BHEL & BIDDER IF REDUCERS/EXPANDERS ARE REQUIRED DURING DETAIL ENGG. SHALL BE PROVIDED BY BIDDER.
 - KKS TAG NOS. SHALL BE PROVIDED FOR EACH INSTRUMENTS,DRIVE,VALVE DURING DETAIL ENGINEERING BY THE BIDDER AND TAG NO. PREFIX FOR UNIT-1 SHALL BE "10" AND FOR UNIT-2 PREFIX SHALL BE "20" AND FOR COMMON SYSTEM PREFIX SHALL BE USED "90".
 - BIDDER TO INDICATE PROCESS PARAMETERS (PRESSURE, TEMPERATURE, FLOW ETC.) OF EACH AND INDIVIDUAL LINES DURING DETAIL ENGINEERING WHILE SUBMITTING THE P&ID OF CONDENSATE POLISHING UNIT.

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TITLE
P&I DIAGRAM FOR
CONDENSATE POLISHING UNIT

DRAWING No.
PE-DG-412-155-A001

SHEET 02 OF 02 REV 1



TITLE: 2X660 MW ENNORE SEZ STPP	SPECIFICATION NO. PE-TS-412-155A-A001	
	SECTION : I	
	TECHNICAL SPECIFICATION FOR CONDENSATE POLISHING UNIT	
	REV. NO. 00	DATE :

DATASHEET – A

1.0	DESCRIPTION OF TURBO GENERATOR UNIT (TG) FOR WHICH CONDENSATE POLISHING IS TO BE PROVIDED :	
(i)	No. of units	Two (2)
(ii)	Capacity of each unit	660 MW
(iii)	Total flow in all working service vessels of each units	1548.8 Tons/hr (VWO, 1% Make Up condition) & 1581.5 Tons/hr (for All HP heaters out condition)
2.0	CONDENSATE POLISHER SERVICE VESSELS PER UNIT :	
(i)	No. of condensate polisher service vessel	Three (3X50%)
(ii)	Capacity of each condensate polisher service vessel	50% of total condensate flow per unit
(iii)	Flow through each condensate polisher service vessel per unit	790.75 Tones per hour
(iv)	Operating pressure of each condensate polisher service vessel	30 kg/cm ² (a)
(v)	Design pressure of each condensate polisher service vessel	47 kg/cm ² (a)
(vi)	Design code of each condensate polisher service vessel	ASME Sec VIII div 1 Ed-2010/ IS 2825 as applicable
(vii)	Working Temp.	55 °C
(viii)	Design temperature of service vessel, its internals and accessories	65 °C
(ix)	Type of vessels	Spherical
(x)	Material of construction	
	Shell	Carbon steel plates to SA 516 Gr. 70
(xi)	Inside protection	Inside lined with Natural Rubber [4.5 mm thick in (3) layers]
(xii)	Resin traps at the outlet of each condensate polisher service vessel & rinse outlet	SS-316 with SS 316 Internals
2.2	AIR-BLOWERS FOR RESIN MIXING (SERVICE VESSELS AREA) PER UNIT	
(i)	Number per unit	Two (2x100%)
(ii)	Type	Rotary, Centrifugal /Twin Lobe, oil free, positive displacement
(iii)	Duty	Intermittent
(iv)	Capacity and head	As required
(v)	Noise level	80 dB (A) Max. at one meter
(vi)	Pressure gauge	One per blower
(vii)	Location	Indoor
(viii)	Material of construction	Casing – Cast Iron GR FG 260 to IS 210 Lobe – Cast Iron GR FG 260 to IS 210 Shaft – Carbon Steel to EN 8
(ix)	Drive motor	Energy Efficiency Class IE-3 as per IS : 12615
3.0	EXTERNAL REGENERATION FACILITIES	
3.1	REGENERATION VESSELS	
a.	RESIN SEPARATION AND CATION RESIN REGENERATION VESSEL	
(i)	Number	One (1) no. vessel common for 2 x 660 MW Units
(ii)	Design Temperature	60°C
(iii)	Minimum Design Pressure	10 Kg/cm ² (g)
(iv)	Type	Vertical Cylindrical



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(v)	Material of construction	
	Shell	SA 516 Gr. 60 or 70 / SA 282 Gr. C
	Dished ends	SA 516 Gr. 60 or 70 / SA 282 Gr. C
(vi)	Inside protection	Inside lined with Natural Rubber [4.5 mm thick in (3) layers]
(vii)	Design code	ASME Sec VIII div 1 Ed-2010/ IS 2825 as applicable
b.	ANION RESIN REGENERATION VESSEL	
(i)	Number	One (1) no. vessel common for 2 x 660 MW Units
(ii)	Design Temperature	60°C
(iii)	Minimum Design Pressure	10 Kg/cm2 (g)
(iv)	Type	Vertical Cylindrical
(v)	Material of construction	
	Shell	SA 516 Gr. 60 or 70 / SA 282 Gr. C
	Dished ends	SA 516 Gr. 60 or 70 / SA 282 Gr. C
(vi)	Inside protection	Inside lined with Natural Rubber [4.5 mm thick in (3) layers]
(vii)	Design code	ASME Sec VIII div 1 Ed-2010/ IS 2825 as applicable
c.	MIXED RESIN STORAGE VESSEL	
(i)	Number	One (1) no. vessel common for 2 x 660 MW Units
(ii)	Design Temperature	60°C
(iii)	Minimum Design Pressure	10 Kg/cm2 (g)
(iv)	Type	Vertical Cylindrical
(v)	Material of construction	
	Shell	SA 516 Gr. 60 or 70 / SA 282 Gr. C
	Dished ends	SA 516 Gr. 60 or 70 / SA 282 Gr. C
(vi)	Inside protection	Inside lined with Natural Rubber [4.5 mm thick in (3) layers]
(vii)	Design code	ASME Sec VIII div 1 Ed-2010/ IS 2825 as applicable
d.	Resin traps at the common outlet header of regeneration vessels	SS with SS 316 Internals
e.	Accessories	Operating platforms, ladders, supports, lifting lugs (4 nos. minimum), handhold (1 no. of 150mm dia) & manhole (Minimum-2 nos. of 500mm dia) etc. For each vessel shall be provided.
	The vessels indicated against sr. no. a, b and c above is for reference only. Please note that number and type of regeneration vessels shall be as per supplier recommendation only.	
3.2	BULK ACID AND ALKALI STORAGE TANKS	
(i)	CHEMICAL TANKS	ACID STORAGE TANKS ALKALI STORAGE TANKS
(ii)	Number required	Two (2) Two (2)
(iii)	Design code	-----As per BS-2594 or equivalent-----
(iv)	Dimensions (diameter, length & thickness)	-----As per BS-2594 or equivalent-----
(v)	Location	-----Outdoor-----
(vi)	Useful capacity (each)	30 m3 20 m3
(vii)	Type and Pressure class	-----Horizontal cylindrical with dished (torishpherical) ends, atmospheric, above ground-----
(viii)	Material of construction	FRP -----Carbon steel (IS 2062 Gr A/B) with rubber lining inside -----



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**TECHNICAL SPECIFICATION FOR
CONDENSATE POLISHING UNIT**

(ix)	Protection – Inside	-----	4.5 mm thk rubber lining (in three layers 1.5 mm each)
(x)	Protection – Outside	-----	Chlorinated rubber paint DFT 500 microns.
(xi)	Concentration	30 -33 % HCl	48 % NaOH
(xii)	Accessories	Vent, overflow, Drain, fume absorber, CO2 absorber ,seal pot, sample connection ,spare connection ,Manhole etc.	
(xiii)	Pipe & flanges M.O.C.	CPVC Sch.40	
(xiv)	Valve M.O.C.	CPVC PN 10	
(xv)	Manhole, staircase, operating platforms	Provided	Provided
3.3	ACID AND ALKALI UNLOADING / TRANSFER PUMPS		
(i)	PUMPS	ACID UNLOADING /TRANSFER PUMPS	ALKALI UNLOADING /TRANSFER PUMPS
(ii)	Number required	Two (2x100%) nos. (1W+1S)	Two (2x100%) nos. (1W+1S)
(iii)	Type	-----Horizontal Centrifugal-----	
(iv)	Location	-----Outdoor-----	
(v)	Service	-----Intermittent-----	
(vi)	Pressure gauge	One per pump with Teflon diaphragm seal	
(vii)	Capacity and head	-----10 m3 / hr and 15 MWC (minimum)-----	
(viii)	Liquid to be handled	30 -33 % HCL	45-48% NaOH
(ix)	Material of construction		
	Casing	Polypropylene	Polypropylene
	Impeller	Polypropylene	Polypropylene
	Shaft	BS-970 Hardened Steel EN8	BS-970 Hardened Steel EN8
	Shaft Sleeves	Ceramic	Alloy 20
	Types of shaft sealing	Mechanical seal	Mechanical seal
(x)	Pump speed	1450 rpm	1450 rpm
(xi)	Drive motor	415V, 3Φ, 50 HZ TEFC, Energy Efficiency Class IE-3 as per IS : 12615	
(xii)	Accessories required	Coupling guard, drain plug, vent valve ,suction hoses, isolation valves, y- type strainers etc.	
(xiii)	Type of coupling between motor and pump	Flexible coupling	
(xiv)	Reinforced rubber house with coupling and isolation valve	One (1) No. of each application size 80NB, minimum 20 meter with isolation valve, Reinforced Chemical Resistant Rubber.	
(xv)	MOC for piping, valves & fittings in acid/alkali handling	For valve -CPVC PN10, For piping, flanges & fittings –CPVC Sch. 40	
3.4	CHEMICAL HANDLING, PREPARATION & DOSING SYSTEM		
a)	ALKALI TRANSFER CUM RECIRCULATION PUMPS WITH MOTOR		
(i)	Nos. required	Two (2x100%) (1 W+ 1 S)	
(ii)	Type	Horizontal, centrifugal	
(iii)	Service	Intermittent	
(iv)	Location	Outdoor	
(v)	Pressure gauge	One per pump with Teflon diaphragm seal	
(vi)	Maximum Pump Speed	1500 rpm	
(vii)	Type of Coupling between pump & motor drive	As per manufacturer’s standard practice	
(viii)	Type of Sealing	Mechanical Seal	



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(ix)	Type of Suction Strainer	Y- Type		
(x)	Concentration of working media.	5-48% Sodium Hydroxide (NaOH)		
(xi)	Capacity & head of each pump	10 m3/hr & Head as per system requirement		
(xii)	Suction condition	Flooded		
(xiii)	Materials of construction			
a.	Casing, impeller	Stainless Steel – 316		
b.	Shaft & shaft sleeve	Stainless Steel -410		
(xiv)	Drive motor	415V, 3Φ, 50 HZ TEFC, Energy Efficiency Class IE-3 as per IS : 12615		
(xv)	Accessories required	Coupling guard, drain plug, vent valve , isolation valves, etc.		
(xvi)	Type of coupling between motor and pump	Flexible coupling		
(xvii)	MOC for piping, valves & fittings in acid/alkali handling	For valve -CPVC PN10, For piping, flanges & fittings –CPVC Sch. 40		
b)	CHEMICAL TANKS	ALKALI MEASURING TANK	ALKALI PREPARATION TANK	ACID MEASURING TANK
(i)	Number required	One (1)	One (1)	Two (2)
(ii)	Type	-Vertical Cylindrical Atmospheric with dished bottom and cover at top -		
(iii)	Liquid to be handled	NaOH	NaOH	HCL
(iv)	Location	----- To be designed for outdoor duty -----		
(v)	Useful capacity (each tank)	Adequate to hold quantity of alkali required (48% NaOH) for single regeneration of a condensate polisher mixed bed with 20% overall margin.	2 m3	Adequate to hold quantity of acid required (30-33% HCL) for single regeneration of a condensate polisher mixed bed with 20% overall margin.
(vi)	Material (Shell, Dished end & top cover)	IS 2062 Gr A/B	IS 2062 Gr A/B	FRP
(vii)	Internal protection	-----Rubber lined & minimum 4.5 mm thick in three layers -----	-----Rubber lined & minimum 4.5 mm thick in three layers-----	Not Applicable
(viii)	External painting	-----Chlorinated Rubber Paint -----	-----Chlorinated Rubber Paint -----	Not Applicable
(ix)	Level indicator	Provided	Provided	Provided
(x)	Level transmitter per tank	One (1)	One (1)	One (1)
(xi)	Stirrer per tank	Slow speed stirrer driven by motor drive and reduction gear. Speed of stirrer = 200 RPM Max.	Slow speed stirrer driven by motor drive and reduction gear. Speed of stirrer = 200 RPM Max.	Not Applicable
(xii)	MOC of Agitator	SS – 316	SS – 316	Not Applicable
(xiii)	Drive motor of stirrer	Energy Efficiency Class IE-3 as per IS : 12615	Energy Efficiency Class IE-3 as per IS : 12615	Not Applicable



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(xiv)	Dissolving Basket	Provide (50-60 mesh B.S.)	Provide (50-60 mesh B.S.)	Not Applicable
(xv)	MOC of Basket	SS – 316	SS – 316	Not Applicable
(xvi)	Accessories	Fume absorbers, carbon dioxide absorber, vent, overflow, drain connection, overflow seal pot, sample connection, level transmitter, operating platform, ladders, lifting lugs (4 Nos. minimum), hand hole etc.		
c)	DOSING PUMPS	ACID DOSING PUMPS	ALKALI DOSING PUMPS	
(i)	Number	Two (2x100%) nos. (1 W+ 1 S)	Two (2x100%) nos. (1 W+ 1 S	
(ii)	Type	--Simplex positive displacement hydraulically operated diaphragm type---		
(iii)	Whether suction strainer required	----- Yes -----		
(iv)	Material of construction			
	Liquid End (Pump Head, Valves, Valve housing, valve spring etc.)	Polypropylene	SS-316	
	Diaphragm	-----PTFE-----		
	Packing	-----PTFE-----		
	Shaft	----- Hardened steel EN 8 (BS : 970)-----		
	Worm & worm wheel (if applicable)	-----Manganese Bronze -----		
	Connecting rod	-----Manganese Bronze -----		
	Cross head guide	-----Bronze -----		
(v)	Capacity & head	Capable of meeting regeneration one cation /Anion unit (with 20% margin); head as required (with 20% margin).		
(vi)	Accessories			
	Pressure/Pulsation Dampener	One per pump	One per pump	
	External safety relief valve (in addition to inbuilt safety valve)	Two (One per pump) MOC -Polypropylene	Two (One per pump) MOC- SS-316	
	MOC of safety relief valve	Poly propylene	SS-316	
(vii)	Pressure gauge	----- One per pump with Teflon diaphragm seal -----		
(viii)	Maximum pump stroke speed per minute	----- 100 -----		
(ix)	Accessories required for each pump	Coupling guard, drain plug, vent valve, isolation valves, Y-type strainers, pressure gauges, pulsation dampener etc.		
(x)	Drive motor of pump	The drive motor of each pump will be Energy Efficiency Class IE-3 as per IS : 12615		
d)	Density Meter	Acid	Alkali	
(i)	Number	One (1) at each mixing tee outlet	One (1) at each mixing tee outlet	
(ii)	Type	Density indicator (Hydrometer type)	Density indicator (Hydrometer type)	
(iii)	Indication	Local	Local	
(iv)	Location	Diluted Acid line	Diluted Alkali line	
e)	Non-Nucleonic (Vibration) Type Density Meter/transmitter	One (1) at each mixing tee outlet	One (1) at each mixing tee outlet	
f)	Flow Indicator			
(i)	Number	One in each DM water line	One in each DM water line	



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(ii)	Type	Rotameter	Rotameter
g)	Flow Switch or Flow Transmitter	One in each water line, vane actuated type or DP bellows type /As per P&ID	
3.5	ACTIVATED CARBON FILTER FOR ALKALI		
(i)	Number	One (1)	
(ii)	Type	Vertical cylindrical with dished end bottom	
(iii)	Design Pressure	Design pressure shall be the maximum expected pressure to which the vessel may be subjected plus 5% extra margin. Maximum expected pressure for vessels placed in the discharge line of pumps shall be based on the shut-off head of the pumps plus static head at pump suction or 10 kg/cm2(g) whichever is maximum	
(iv)	Capacity	10 m3/hr or Not less than the design capacity of alkali transfer cum recirculation pump	
(v)	Flow Velocity	12 m/hr (max)	
(vi)	Bed depth	1200mm activated carbon + 300 mm Gravel support	
(vii)	Pressure gauge	As per P&ID.	
(viii)	Number and Location	Two No. (One each at inlet and outlet of filter)	
(ix)	Seal	Teflon diaphragm	
(x)	Material of construction		
	Shell	Carbon steel plates to IS 2062 / SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.	
	Dish ends /Head	Carbon steel plates to IS 2002 Gr. 2A / SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.	
(xi)	Inside protection	Inside lined with Natural Rubber [4.5 mm thick in (3) layers]	
(xii)	Design code	ASME sec VIII div 1 ed.2010 / IS 2825 as applicable	
(xiii)	Influent Distributor Material	SS 316	
(xiv)	Manhole	Two (2) nos. minimum each of Davit type and 500 mm dia.	
(xv)	Sight Windows	One (1) no. in backwash space	
(xvi)	Hand hole	One (1) no. of 150 mm dia for removal of activated carbon	
(xvii)	Accessories	Operating platforms, ladders, supports, lifting lugs (4 nos. min) etc.	
3.6	ALKALI DILLUENT WATER HEATING TANK (HOT WATER TANK)		
(i)	Number	One (1)	
(ii)	Type/Capacity	Vertical Cylindrical with dished end with Electric heater / 120% of water required for regeneration.	
(iii)	Electric heater Qty.	2 nos. Electric heater (2X50%)	
(iv)	Temperature of alkali to be heated	To obtain temp. from 15 ^o C of 50 ^o C at alkali mixing feed out let within 5 hours.	
(v)	Design Pressure	Design pressure shall be the maximum expected pressure to which the vessel may be subjected plus 5% extra margin. Maximum expected pressure for vessels placed in the discharge line of pumps shall be based on the shut-off head of the pumps plus static head at pump suction or 10 kg/cm2 (g) whichever is maximum	
(vi)	Material of construction		
	Shell & dished end	SS-304 adequately insulated	
(vii)	Design code	ASME sec VIII div 1 ed.2010 / IS 2825 as applicable	
(viii)	Temperature gauge,	To be provided by the bidder (as per P&ID)	



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	Temp. transmitters	
(ix)	Burn out protection	To be provided by the bidder
(x)	Accessories	Manhole, vent, drain, sample connection, level transmitter, level gauges -2 nos. (minimum), operating platform, ladders, lifting lugs (4 Nos. minimum) etc.
3.7	CPU REGENERATION CUM RESIN TRANSFER PUMPS	
(i)	Number	Two (2x100%) nos. (1W+1S)
(ii)	Type	Horizontal, centrifugal
(iii)	Operation	Intermittent
(iv)	Liquid to be handled	DM Water
(v)	Capacity & head	As required (with 20% margin)
(vi)	Suction condition	Flooded
(vii)	Material of construction	
	• Casing & impeller	SS 316/ ASTM A 351 CF 8M
	• Shaft	SS 410
	• Wearing rings	As per manufacturer's Standard
	• Shaft sleeve material	SS 410
(viii)	Packing seal	Mechanical type
(ix)	Mechanical Seal	To be Provided by bidder
(x)	Pump Speed	Maximum 1500 rpm
(xi)	Pressure gauge	One for each pump with Teflon diaphragm seal
(xii)	Pressure dampener	One number per pump
(xiii)	Recirculation line with motor actuated butterfly valve	Provided
(xiv)	Accessories required for each pump	Coupling guard, drain plug, vent valve, isolation valves, Y-type strainers, pressure gauges, pulsation dampener
(xv)	Drive motor	The drive motor of each Pump will be Energy Efficiency Class IE-3 as per IS : 12615
3.8	AIR-BLOWERS FOR RESIN MIXING (REGENERATION AREA)	
(i)	Number	Two (2x100%)
(ii)	Type	Centrifugal/Twin lobe type, oil free, positive displacement
(iii)	Location	Indoor
(iv)	Duty	Intermittent
(v)	Capacity and head	As required
(vi)	Noise Level	80 dB (A) Max. at one meter
(vii)	Pressure gauge	One per blower
(viii)	Material of construction	Casing – Cast Iron GR FG 260 to IS 210 Lobe – Cast Iron GR FG 260 to IS 210 Shaft – Carbon Steel to EN 8
(ix)	Drive motor	The drive motor of each air blower will be Energy Efficiency Class IE-3 as per IS : 12615
4.0	NEUTRALISING SYSTEM	
4.1	NEUTRALIZATION PIT	
(i)	Number	One (1) no. Pit with two (2) compartments ,common for 2 x 660 MW Units
(ii)	Type	Necessary air grid arrangement of polypropylene construction shall be provided in each compartment for effective neutralization of the waste effluent for air agitation & venturi mixing
(iii)	Material of Construction	RCC with acid / alkali proof lining bricks
(iv)	No. of compartments	Two compartments
(v)	Capacity of each compartment	Adequate to hold 1.5 X quantity of waste effluent



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		generated during single regeneration of Condensate Polisher Mixed Beds + 1.2 X DM plant waste generation during RO-DM plant for one regeneration (170 M3)	
4.2	NEUTRALIZATION PIT DISPOSAL PUMPS		
(i)	Number	Two nos. (1 working + 1 Standby)	
(ii)	Type	Horizontal, Centrifugal Single stage with priming system	
(iii)	Capacity & head	One section of the neutralization pit in 2 hours (capacity not less than 80 m3/hr) & head as per system requirement.	
(iv)	Duty	Intermittent	
(v)	Number of priming chamber & tank	Two	
(vi)	Suction condition	Suction from priming chamber / submerged (suction from pit)	
(vii)	Pump Speed	1450 rpm	
(viii)	Drive motor	Induction motor 415V, 3 phase 50Hz, TEFC ; Energy Efficiency Class IE-3 as per IS : 12615	
(ix)	Suction condition	Negative, with priming chamber	
(x)	Material of Construction		
	Casing	2.5% Ni Cast Iron IS210 Gr. FG	
	Impeller	Stainless Steel CF 8M	
	Shaft	SS-304/SS-316/SS-410	
	Shaft coupling	SS-316	
	Shaft sleeve	SS-316	
4.3	CHEMICAL TANKS FOR N-PIT	ALKALI MEASURING TANK	ACID MEASURING TANK
(i)	Number required	One (1)	One (1)
(ii)	Type	-----Vertical Cylindrical Atmospheric-----	
(iii)	Useful capacity	Suitable to meet the requirement for neutralisation of excess acid/alkali present in the regeneration waste effluent from CPU & RO- DM plant + 20% margin	Suitable to meet the requirement for neutralisation of excess acid/alkali present in the regeneration waste effluent from CPU & RO- DM plant + 20% margin
(iv)	Material (Shell, Dished end & top cover)	IS 2062 Gr A/B	FRP
	Internal protection	-----Rubber lined & minimum 4.5 mm thick in three layers -----	Not Applicable
	External painting	-----Chlorinated Rubber Paint -----	Not Applicable
(v)	Level indicator	Provided	Provided
(vi)	Level transmitter per tank	One (1)	One (1)
(vii)	Stirrer per tank	Slow speed stirrer driven by motor drive and reduction gear. Speed of stirrer = 200 RPM Max.	Not Applicable
(viii)	MOC of Agitator	SS – 316	Not Applicable
(ix)	Drive motor of stirrer	Energy Efficiency Class IE-3 as per IS : 12615	Not Applicable
(x)	Dissolving Basket	Provide (50-60 mesh B.S.)	Not Applicable
(xi)	MOC of Basket	SS – 316	Not Applicable
(xii)	Accessories	Fume absorbers, carbon dioxide absorber, hand hole, vent, drain, sample connection, level transmitter, operating platform, ladders, lifting lugs (4 Nos. minimum) etc.	



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5.0	PIPING & VALVES	
(i)	Resin Transfer piping (full Port Ball Valves)	ASTM A 312 Gr. TP 304 Sch 40 Minimum pipe Size : NB80 Velocity : 2-3 m/s
(ii)	DM water line	ASTM A 312 Gr. TP 304 Sch 40
(iii)	Piping-Service vessel Inlet	Piping-ASTM A 106 Gr C Ball Valves – SS-(CF8M) BFV – ASTM A 216 Gr. WCB- Body SS-(CF8M) - disc.
(iv)	Piping-Service vessel Outlet	Piping – ASTM A 106 Gr. C BFV – SS-(CF8M) - Body & disc both. Ball Valves – SS-(CF8M)
(v)	Service vessel bypass piping (Globe Valves)	Piping – ASTM A 106 Gr. C Globe valve – SS316/ CF8M Globe valves of the bypass line of service vessels shall be double flanged type.
(vi)	Service vessel rinse piping	CS to ASTM A 106 Gr. C
(vii)	Effluent Transfer Piping	Piping, & Fittings shall be CPVC Sch. 40 only & valves shall be PN 10 rating.
(viii)	Acid & Alkali Regeneration piping (Diaphragm Valves)	All piping, Valves & Fittings in regeneration area shall be CPVC Sch. 40 only & valves shall be PN 10 rating.
(ix)	Acid / Alkali Transfer piping (Diaphragm Valves)	All piping, Valves & Fittings in regeneration area shall be CPVC Sch. 40 only & valves shall be PN 10 rating.
(x)	Instrument Air piping (Full Port Ball Valves)	IS 1239 (Heavy Grade) Galvanized.
6.0	VALVES	
(i)	BUTTERFLY VALVES	Butterfly valves shall be of double flanged type of low leakage rate confirming to AWWA-C-504 class 300 (min.) or EN593/ BS:5155 PN 10 (min.) Condensate polishing plant outlet butterfly valves shall be of stainless steel construction, SS-316 (for body, disc and shaft). Condensate polishing plant inlet butterfly valves shall be of Carbon Steel construction (Body & Disc-CF8M/SS-316 Respectively). All the butterfly valves shall be provided with Hand wheel or lever as per the requirements. For larger sizes i.e. 150 NB and above. Valve provided with motorized or pneumatic actuator shall be provided with a hand wheel for manual operation. All the valves shall be equipped with adjustable mechanical stop-limiting devices to prevent over travel of the valve disc in the open and closed positions. The valve operators (Hand wheel or Gear reduction unit or Motor actuator etc.) shall be designed as per relevant International Standard. All the butterfly valves shall be provided with an indicator to show the position of the disc. Flanges shall conform to ANSI B 16.5 CL300 (min.) used for Service vessel area.
(ii)	ECCENTRIC PLUG VALVE / BALL VALVE	These valves shall be used for resin transfer line. These valves shall be flanged type and of SS 316 construction.



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(iii)	DIAPHRAGM VALVE	The Diaphragm shall conform to following requirement for DM water application: i) Design standard: BS: 5156 or equivalent of required rating / class. (Minimum rating of valves shall be PN 10). ii) Type : Flanged and lined body ends, sealed bonnet, weir pattern, tight shut off type iii) Material of Construction a) Body, Bonnet : Cast iron IS 210 Gr. FG 260 or equivalent or Cast steel ASTM A-216 Gr. WCB b) Body lining : Soft natural rubber(Neoprene), ebonite, Polypropylene c) Hand wheel : Cast Iron d) Compressor : Stainless Steel e) Stem and Bush : Stainless Steel For Acid and Alkali services the valve shall be CPVC PN10/Sch 40 only.
7.0	FLANGES	
(i)	Feed water / Condensate	ASTM 105
(ii)	DM water	ASTM A105 rubber lined (for NB 65 mm to 150 mm) ASTM A 182 F 304 (for NB 50 mm and below)
(iii)	Instrument Air	ASTM A 105 galvanized

TECHNICAL DATASHEET-A FOR ELECTRIC HOIST:

Sl.no	DESCRIPTION	TECHNICAL PARTICULARS
1.0	Type	Steel wire electric hoist with electrically operated trolley
2.0	Scope (Qty., Capacity, Lift, Travel Length)	As per specification and layout requirement
3.0	Type of service	Indoor
4.0	Overload test	125% of SWL
5.0	Design Ambient temperature	50° C
6.0	General Design	As per IS: 3938 / 1983 or latest, Class-II duty
6.1	Design standards	IS: 3938, IS: 2266, IS: 4029, IS: 900, IS: 4237, IS: 694, IS: 3043, IS: 1822, IS: 2147, IS: 1554, IS: 325, IS: 15660, IS 9968 Part I etc as per latest revision
6.2	Duty class	Class II duty
7.0	Operating speed	
7.1	Hoisting speed	3 MPM
7.2	Trolley speed	6 MPM
8.0	Type of transmission	Through Electric motor and gear box.
9.0	Wire Rope	
9.1	Construction / core	6 x36 construction, steel core/Fibre core



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9.2	Code	IS:2266
9.3	Number of falls	Min. 4
9.4	Factor of safety	Not less than 5
10.0	Load Hook and block	NORMALISED HOOK ONLY
10.1	Type of load hook	Plain shank trapezoidal section with safety latch.
10.2	Load hook Code	IS: 15560
10.3	Load hook Material	As per IS:15560
10.4	Hook suspension	Thrust bearing
10.5	Material of block suspension	Fabricated from steel plate, Material: IS: 2062
11.0	Gearing	
11.1	Type	Spur / Helical
11.2	Gear/ pinion material	as per IS 3938
11.3	Lubrication	Oil splash/ grease lubricated
11.4	Bearing type	Antifriction Ball / Roller
12.0	Trolley drive	
12.1	Wheel	Single flange taper thread
12.2	Wheel conform to (Std. / code)	IS: 3938
12.3	Wheel material	C55Mn75/ En-8/ En-9. (Max hardness 200 BHN)
12.4	Bearing type	Antifriction Ball / Roller
12.5	Trolley type	Rolled structural steel with side plates extended beyond wheel flanges to protect wheels.
12.6	Hardness	Max hardness 200 BHN
13.0	SHEAVE	
13.1	Material	Fabricated from steel plate. IS: 2062 Gr. A or Gr. B / as per IS: 3938
13.2	Bearing type	Antifriction Ball / Roller.
14.0	BRAKE (HOIST and TROLLEY)	
14.1	Type	DCEM brakes disc type (fail to safety).
14.2	Capacity	As per IS 3938.
14.3	Number	One number for each motor.
15.0	ROPE DRUM	
15.1	Material	Cast iron, cast steel or mild steel.



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15.2	Flange / Flangeless	Flanged	
15.3	Type of groove	As per manufacturers standard to suit the layout requirement.(Shall be decided during detail engineering)	
17.0	TYPE OF DSL		
17.1	CT travel	PVC Shrouded bus bar conductor type DSL	
18.0	MOTORS		
18.1	Type	Sq. Cage induction, TEFC, S4 duty, 40% CDF.	
18.2	Number of start	300 starts / hr	
18.3	Voltage , Phase and Frequency	415V ±10%, 3 phase, 4 wire, 50 Hz	
18.4	Class of insulation	Class "F" and temperature rise limited to class B.	
18.5	Type of enclosure	TEFC	
18.6	Degree of protection provided for enclosure	IP-54/55 (indoor/outdoor)	
18.7	Margin	10% over maximum continuous load demand	
19.0	LIMIT SWITCHES	Hoisting	Trolley
19.1	Type	Snap action, self actuating type	Lever type
20.0	Control panel	* Fabricated from Cold rolled sheet steel not less than 2.5mm for front & rear & 2mm for side, top & bottom portion with gland plate of 3mm thick. * Degree of protection shall be IP 54. * Power on indicating lamps shall be provided * Panel illumination lamps operated by door switch. * 2 nos earthing terminals on panel. * 20 % spares terminals (clip on type) shall be provided. * Power and control terminals (clip on type) shall be on separate channels. * Gland plate shall be double brass compression type.	
20.1	Qty	1 No.	
21.0	Pendent Push buttons	Up /down / forward / Reverse push buttons. Indicative marking for easy operation shall be provided.	
22.0	Power cables	1.1 KV grade XLPE power cables shall have compacted aluminium conductor for cables including 10 sq. mm and above and copper conductor for cables below 10 sq.mm, XLPE insulated, PVC inner-sheathed (as applicable), armoured, FRLS PVC outer-sheathed conforming to IS: 7098. (Part-I).	
23.0	Control cable	Control cable shall be multi core, minimum 2.5 sq.mm cross section, stranded copper conductor, PVC insulated, inner PVC sheathed / galvanized steel wire armored and outer sheath made of FRLS PVC compound. In situation where accuracy of measurement or voltage drop in control circuit, warrant, higher cross sections as required	



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		shall be used. 4 sq.mm copper conductors shall be used for CT circuits, all other specification remaining same. In 4 sq.mm conductor impose unacceptable high burden on CTs, higher cross section of conductor shall be used.
24.0	Flexible trailing cable	1.1 KV grade Trailing cables shall have tinned copper (class 5) conductor, insulated with heat resistant elastomeric compound based on Ethylene Propylene Rubber (EPR) suitable for withstanding 90°C continuous conductor temperature and 250 deg C during short circuit, inner-sheathed with heat resistant elastomeric compound, nylon cord reinforced, outer-sheathed with heat resistant, oil resistant and flame retardant heavy duty elastomeric compound conforming to IS 9968
25.0	Control Voltage	110 V

B) MANUAL HOIST (CHAIN PULLEY BLOCK):

DATA SHEET-A

- | | | | |
|---------|--|---|---|
| 1.00.00 | Type | : | Hand operated chain pulley block |
| 2.00.00 | Area | : | As per scope sheet attached |
| 3.00.00 | Design | : | IS: 3832, IS: 2429, IS 15560, IS 210, IS 4367, IS 6216, IS: 4460. (All standards shall be of latest revision) |
| 4.00.00 | Duty Class as per IS:3832 | : | Class –II |
| 5.00.00 | Hoisting Mechanism | | |
| a) | Type | : | Hand operated gear transmission |
| b) | Type of gear | : | Spur / Helical |
| c) | Load Chain | : | |
| | i) Type | : | Link type |
| | ii) Material | : | Alloy steel grade 80 as per IS: 6216 |
| | iii) Conforms to (Std./Code) | : | IS: 6216 |
| d) | Hand Chain | : | |
| | i) Type | : | Link type |
| | ii) Material | : | Mild steel (grade 30) as per IS 2429 Part I |
| e) | Load Hook & Hook Block | : | |
| | i) Type of load hook | : | Plain shank- Trapezoidal section |
| | ii) Load hooks conform to / Material | : | IS: 15560 |
| | iii) Type of hook suspension | : | Swivelling |
| | iv) Type of make of bearing of hook suspension | : | Thrust ball bearing |



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- f) Gears/pinion :
- i) Type : Spur
- ii) Material : Alloy steel / carbon steel (Material confirming to IS 3832)
- iii) Type of bearing used : Antifriction ball bearing / Roller
- g) Sprockets
- i) Type of bearings used : Antifriction ball bearing / Roller
- h) Method of lubrications Used
- i) Bearings : Grease
- ii) Gearing & Pinions : Grease
- iii) Sprockets : Grease
- i) Brakes
- i) Type : Ratchet and pawl arrangement along with screw and friction disc type
- 6.00.0 Trolley & Bridge Drive
- a) Trolley
- i) Type : Geared (Manually operated)
- ii) Material of frame : Rolled structural steel (IS:2062 Grade A or B)
- b) Drive Chain
- i) Type : Link type
- ii) Material : Steel Gr.30
- c) Trolley Wheel
- i) Number of pairs of wheel : Two/four
in each trolley/bridge
- ii) Flange : Single flanged
- iii) Wheel material : Heat Treated Carbon steel/low alloy steel/graded cast iron (Material confirming to IS 3832)
- iv) Type of bearings need : Antifriction
- d) Gears
- i) Type : Spur / helical
- ii) Material : Alloy/ Carbon steel (Material confirming to IS 3832)
- iii) Type of bearings used : Antifriction
- e) Method of lubrication for
- i) Bearings : Grease
- ii) Sprockets : Grease
- f) Load chain wheel
- i) Material : SG iron/ Steel casting/IS 3832
- g) Hand chain wheel
- i) Material : SG iron/ Steel casting/Grey iron Casting./IS 3832

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	SPECIFIC TECHNICAL REQUIREMENTS (C&I)	
1. The control of CPU shall be DDCMIS based which shall be in BHEL's scope. DDCMIS panels, OWS, Local control panel, GIU, UPS, Printers shall be provided by BHEL. 2. The Contractor shall provide complete Instrumentation for control, monitoring and operation of entire CPU. The requirements given are to be read in conjunction with detailed technical specification enclosed in the specification. Further in case of any discrepancy in the requirement noted by the bidder in the specification, the same will be brought to the notice of BHEL in the form of pre- bid clarification. In absence of any pre-bid clarification, the more stringent requirement as per BHEL's interpretation shall be complied by the bidder during contract stage without any commercial implication to BHEL. 3. The instrumentation to be provided for CPU shall be as per the technical specification document / drawings wherever provided for the respective systems as a minimum requirement for bidding purpose. However for completeness of the system and its associated equipment, Bidder shall also provide all the necessary instruments to the process requirement even if not indicated in the given technical Specification document /drawings. During detail engineering if any additional instruments are required for safe & reliable operation of plant, bidder shall supply the same without any technical, commercial and delivery implication to BHEL. 4. The make/model of various instruments/items/systems shall be subject to approval of owner/purchaser during detailed engineering stage. No commercial implication in this regard shall be acceptable. 5. 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 at the time of supply. 6. All field instruments shall be weatherproof, drip tight, dust tight and splash proof suitable for use under outdoor ambient conditions prevalent in the subject plant. All field-mounted instruments shall be mounted in suitable locations where maximum accessibility for maintenance is achieved. The enclosures of all electronic instruments shall conform to IP-65 unless otherwise specified and an anticorrosive paint shall be applied to the field mounted enclosures / instruments. All the field instruments shall also be provided with SS tag nameplate and double compression type Nickel-plated brass cable gland. Gaskets, Fasteners, Counter and mating flange shall also be included wherever required with the field instruments.		

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7. The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifold and all the other accessories required for mounting/ erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The proposal shall include the necessary cables, flexible conduits, junction boxes and accessories for the above purpose. Double root valves shall be provided for all pressure tapping where the pressure exceeds 40 Kg / Cm². 8. All the instruments/drives shall be terminated on JB's in field. JB's shall be in Bidder's scope. Bidder to consider minimum 10 nos. of JB's. 9. All local gauges, transmitters and switches shall be mounted on suitable enclosures, racks subject to owner's approval. The same shall be in Bidder's scope. All transmitters shall be HART compatible. 10. All the instruments indicated in P&ID are minimum requirement and it is mandatory to use sensors/signals/measurements with 2 out of 3 logic for critical control & protection (Analog & Binary). Application/service and sensors with 1 out of 2 logic for all other control & interlock (Analog & Binary) application/service. Dual sensors shall be provided for instruments required for auto starting of LT driven pumps or LT driven pump tripping due to very low level of water/discharge pressure very low. Dual measurement shall be employed for the measurements used for analog control functions. 11. All the instruments/ sensors/transmitters/switches meant for redundant applications shall have completely separate and independent impulse pipes/ root valves etc. No redundant instrument shall share a single process tapping. There will be separate and independent tapping for every individual instrument. 12. RTD's shall be of duplex type. Temperature transmitters are envisaged for RTD for monitoring services/application only. 13. Instrument installation shall be as per the attached Instrument Installation Drawing. 14. All motorised valves of 200NB or more than 200NB size shall be provided with integral motorized bypass valves on all process lines. 15. All motorised actuator shall be provided with conventional actuators with integral starter for ON/OFF valves. Non-contact type electronic 2- wire		

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position transmitters shall be provided for all inching type motorised valves. The detailed specification is attached elsewhere in the specification. 16. Valve end position (Open & Close) shall be monitored for the manual critical valves, wherever provided. 17. Bidder to comply with codes and standards as mentioned in the specification. 18. Bidder must offer general tools and tackles and special calibration instruments required during start-up, trial run, operation and maintenance of the system. 19. All approval/Inspection are to be carried out by Owner or owner appointed agency only. 20. Bidder shall provide erection hardware as per installation drawings. 21. Bidder to provide mandatory spares as per mandatory spares list attached elsewhere in the specification. 22. Bidder to perform tests of C&I items/instruments/systems as per Quality plans/type test attached in the specification. 23. Power Supply Requirement: Power supply for instruments, analysers etc. shall be provided at a single point which shall be decided during detail engineering. Further any electrical distribution shall be in bidder's scope. Any other voltage requirement for instruments, analysers etc. to be arranged/derived by bidder by providing suitable control transformer. 24. All cables terminated in the terminal block, power distribution scheme instruments shall be ferruled. Ferruling shall be double cross ferruling (i.e.) so source and destination addresses shall be marked on both sides of the tube ferruling. 25. Scope of Instrumentation cables (Screened Control Cables), Fibre Optic cable & Control cables shall be as per Electrical Cable scope matrix in Electrical portion of specification. 26. Each pneumatic device requiring air supply and intended for field mounting shall include a filter regulator air set with gauge, to owner's approval. 27. Bidder's presence is required for 3 Man days (Excluding travel time) at EDN Bangalore during FAT of DDCMIS for certifying correctness & completeness of implementation of Control logic. Intimation to attained FAT shall be informed		

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in 2 days advance. All the expenses like boarding, lodging and travel, Air fare etc. shall be in bidder's scope. 28. Contractor's C&I representative shall be present at BHEL-PEM for 3 man-days, for preparation of Control scheme of CPU. All the expenses like boarding, lodging and travel, Air fare etc. shall be in bidder's scope. 29. Bidder's presence is required for 15 Man days (in three visit) at site during commissioning of DDCMIS for assistance related to process correctness. Three visit with total 15 Man days (Excluding travel time) in which one visit shall be of 5 Man days each. All the expenses like boarding, lodging and travel, Air fare etc. shall be in bidder's scope. 30. Bidder to ensure participation of their senior personnel and experts in discussions with Owners and other equipment bidders during various stages of contract implementation as required by the Owner.		

CUSTOMER SPECIFICATION REQUIREMENT

Open and Close limit switch feed backs of valves are to be connected to DCS for remote viewing and for interlocks and protection.

Remote and local indications of various parameters to the process requirement shall be provided. (The same can be decided during detailed engineering)

The instruments shall be offered as per the process requirement for complete auto operation.

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.

Flow transmitters for each stream of CPU are to be provided for monitoring the performance and accountability

The bidder shall furnish required list and type of instruments during detail



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engineering subject to the approval of owner.

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.

- 1.A panel mounted cation conductivity indicator shall be interlocked to prevent advancing of the automatic sequence until the rinse down is complete.
- 2.A differential pressure switch installed between the influent and effluent headers shall on a high signal cause an annunciator alarm.
- 3.Panel mounted cation conductivity indicators shall be provided to monitor the polishing system influent and effluent streams as well as the discharge of each service vessel.
- 4.On Plant DDCMIS failure, it shall be possible to operate the valves by means of manual operation of solenoid valves also.