

**1X800 MW TSGENCO KOTHAGUDEM TPS
STAGE –VII, PALONCHA**

VOLUME: II B & III

**TECHNICAL SPECIFICATIONS
FOR
CONDENSATE POLISHING UNIT**

SPECIFICATION NO.: PE-TS-410-155A-A001



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



TITLE:
**TECHNICAL SPECIFICATION FOR
 CONDENSATE POLISHING UNIT
 1X800 MW TSGENCO KOTHAGUDEM TPS
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SPEC NO: PE-TS-410-155A-A001
VOLUME: II-B
SECTION: A
REV NO: 00 **DATE:**

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**SECTION – A
SCOPE OF ENQUIRY**



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1. SCOPE OF INQUIRY/ INTENT OF SPECIFICATION

- 1.1 The specification is intended to cover design, engineering, manufacture, fabrication, assembly, inspection and testing at vendor's & sub-vendor's works, painting, mandatory spares along with spares for erection, startup and commissioning as required, forwarding, proper packing, shipment and delivery at site, unloading, handling & transportation at site, Erection & Commissioning, trial run, on FOR site basis, preparation & submission of "As Built" drawings, Performance guarantee test at site and handing over of Condensate Polishing Units and external regeneration system as per the details in different sections / volumes of this specification for **1X800 MW TSGENCO KOTHAGUDEM TPS,STAGE-VII, PALONCHA.**
- 1.2 The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve them of the responsibility of providing such facilities to complete the supply, erection and commissioning of Condensate Polishing Units and external regeneration system.
- 1.3 It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to 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.
- 1.4 The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing.
- 1.5 The general terms 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 to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.
- 1.6 While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under Vol-III of the specification. In absence of any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of BHEL/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 BHEL/ Customer as and when brought to their notice either by the bidder or by BHEL/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication.
- 1.7 Deviations, if any, should be very clearly brought out clause by clause in the enclosed schedule; otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification.
- 1.8 In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.
- 1.9 Unless specified otherwise, all through the specification, the word contractor shall have same meaning as successful bidder/vendor and Customer/Purchaser/Employer will mean BHEL and/or Customer (TSGENCO: Telangana State Power Generation Corporation Ltd.) including their consultant (Development Consultants Pvt. Ltd.) as interpreted by BHEL in the relevant context. Bidder to refer GCC/SCC for more clarity.
- 1.10 The equipment covered under this specification shall not be dispatched unless the same have been finally inspected, accepted and dispatch release issued by BHEL/Customer.
- 1.11 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.
- 1.12 Pre-bid meeting shall be held before bid submission. Bidder to ask all their queries in pre-bid meeting.



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SECTION – B
PROJECT INFORMATION



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PROJECT SYNOPSIS AND GENERAL INFORMATION

1.00.00 INTRODUCTION

The proposed 1x800 MW Kothagudem Thermal Power Station (KTPS), Stage-VII, Unit-12 would be set up by Telangana State Power Corporation Ltd. (TSGENCO) at Kothagudem, Telangana. The proposed Power Plant will be installed adjacent to the existing D colony of Kothagudem Thermal Power Station, at Kothagudem.

The Bidder shall acquaint himself by a visit to the site, if felt necessary, with the conditions prevailing at site before submission of the bid. The information given here in under is for general guidance and shall not be contractually binding on the Owner. All relevant site data /information as may be necessary shall have to be obtained /collected by the Bidder.

2.00.00 APPROACH TO SITE

Site is located in the existing D Colony of Kothagudem Thermal Power Station, which is at a distance 30 km from temple town of Bhadrachalam and 300 km from Hyderabad by road. The Nearest railway station is Bhadrachalam Road (Known as Kothagudem) at a distance of 12 km. Kothagudem- Bhadrachalam National Highway branches off to the power station site near village Paloncha.

3.00.00 LAND

Land is primarily required for the main plant & auxiliaries (BTG) and balance of plant (BOP) like ash handling, coal storage, cooling tower, switchyard etc., which is available within the existing plant boundary.

The existing colony is to be dismantled, and the land of about 137 acres will be used for the main plant building, water facilities, switchyard, coal handling etc. The raw water reservoir will be located adjacent to the existing raw water reservoirs.

230 acres of land required for Ash Dyke will be procured. Land is available for staff colony, which is to be constructed by the EPC contractor.

4.00.00 SOURCE OF COAL

100% Imported and Blended coal (50% imported + 50% indigenous) will be used. Indigenous coal shall be sourced from Suliyari coal mines, Madhya Pradesh.



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5.00.00 SOURCE OF WATER

Source of water (total quantity of water is 2192 m³/hr) is Godavari River near Burgampahad & water will be pumped through existing GRP pipe line (of length approx. 26 km).

6.00.00 ASH DISPOSAL AREA

Ash shall be dumped in the ash dump area which will be about 9 km from plant. The ash dyke area of 230 acres is adequate for 1x800 MW unit as per MOEF norms.

7.00.00 SALIENT DESIGN DATA

7.01.00 Meteorological data of site is given below:-

Elevation above MSL : 89 m

Monthly highest temperature : 44.9 °C

Monthly lowest temperature. : 12.9 °C

Rainfall

Average.: 1031 mm

Max. : 100 mm/ hr

Mean Wind speed : 5.8 kmph

Relative Humidity

Max : 82%

Min : 35%

Seismic Zone : Zone-III as per IS- 1893 (Part-IV)

[Climatological data of Khammam is attached for reference].



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TREATED WATER QUALITY

(DESIGN ANALYSIS OF CLARIFIED WATER)

[After addition of 50 ppm Alum, 20 ppm Lime ,1 ppm Polyelectrolyte and 5 ppm Chlorine on 100% purity basis]

DESIGN ANALYSIS OF CLARIFIED WATER:

CONSTITUENTS	As	CONTENT
Calcium	CaCO ₃	128.9 ppm
Magnesium	CaCO ₃	53.52 ppm
Sodium	CaCO ₃	73.44 ppm
Potassium	CaCO ₃	1.02 ppm
Iron in Soln.	Fe	0.1 ppm
Hydrogen (FMA)	CaCO ₃	- ppm
TOTAL CATIONS (except iron)	CaCO₃	256.88 ppm
Bicarbonate	CaCO ₃	143.4 ppm
Carbonate	CaCO ₃	0.53 ppm
Hydroxide	CaCO ₃	0.02 ppm
Sulphate	CaCO ₃	59.85 ppm
Chloride	CaCO ₃	50.82 ppm
Nitrate	CaCO ₃	1.21 ppm
Phosphate	CaCO ₃	- ppm
Fluoride	CaCO ₃	1.05 ppm
TOTAL ANIONS	CaCO₃	256.88 ppm
Reactive Silica	SiO ₂	10 ppm
Total Suspended Solid	CaCO ₃	15 ppm (overload condition)
Conductivity at 25 deg C		450 Microsiemens/cm (max)
pH value at 25 ^o C	-	7.62
Turbidity		Not to exceed 15 NTU (max)

Note:- The COC of CW system has been considered as 5.0.



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SECTION – C1
SPECIFIC TECHNICAL REQUIREMENT- MECHANICAL



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1.0 GENERAL

1.1 The Condensate Polishing Units with a common external regeneration system and associated accessories shall conform to the technical specification for **1X800 MW TSGENCO KOTHAGUEDEM TPS,STAGE-VII, PALONCHA.**

2.0 DESIGN CONDITIONS FOR CONDENSATE POLISHING PLANT

The Condensate Polishing Plant is designed for the condensate flow corresponding to VWO (valve wide open) condition at 1%make up.

3.0 BRIEF DESCRIPTION OF THE SYSTEM

The proposed condensate plant shall treat the entire condensate of the turbine generator of 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 & system requirements.

The condensate polisher service vessels shall be located in the TG hall of corresponding unit. The resins shall be transferred to and from the common regeneration facility by sluicing through a pipeline hydraulically.

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)

Following are in bidder's scope of supply:

Broad scope of supply (mechanical) for this package is detailed below and as indicated in relevant portion of this specification.

A. SERVICE VESSEL AREA FACILITY

- 1) Three (3X50%) service vessels for 800 MW unit.
- 2) Each Condensate polisher vessels shall be complete with condensate inlet and outlet connections, connections for resin transfer to and from the vessels, bed support-cum-under drain system, inlet water distributors, air distribution arrangement for resin mixing, all fittings and appurtenances etc. as specified and as required.
- 3) One no External resin traps at the outlet of each of the polisher vessel, designed for in-place manual back washing.
- 4) Condensate inlet and outlet headers with pipe connections to the condensate polisher vessels.
- 5) Resin transfer lines of stainless steel construction between the external regeneration facilities to the condensate polisher vessels along with all necessary supports, anchors etc for 800 MW unit.
- 6) Rinse water outlet header of each condensate-polishing unit 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 either a pressure reducing valve (reducing the pressure 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.
- 7) All necessary valves and fittings for the installations with actuators necessary for their remote operation. These shall include suitable fool proof arrangement to prevent accidental over pressurization of the resin transfer pipeline and regeneration facilities connected to it which are designed for pressure much lower than that of the polisher service vessels.
- 8) A common drain header for the condensate polisher service vessels of unit up to the condenser hot well.



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- 9) All necessary drains, vents and sampling points, with valves as specified and as required.
- 10) Gland sealing water piping for the valves in the rinse water line.
- 11) Two nos. (1W + 1S) 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) Two (2) nos.(2x100%), Rinse Recirculation pumps, each complete with electrical drive motor and all other accessories as required.
- 13) Complete Instrumentation and Control for automatic operation.
- 14) Instruments racks for mounting pressure & flow transmitters, pressure switches, conductivity analyzers etc. for each of condensate polisher mixed beds.
- 15) Emergency bypass between the condensate influent and effluent headers with a modulating butterfly type control valve, along with wafer type butterfly isolation valves (resilient material seated, to ensure bubble tight shut off) on the upstream and downstream side of the control valve. The control valve shall be of 1x100% configuration to achieve proper control under all operating conditions. Isolation valve shall be provided with geared operators for manual operation. In addition to control valve one no. manual valve of similar capacity in the bypass of control valve shall be provided as per P&ID For Condensate Polishing Unit.
- 16) Five (5) complete charges of resins (cation + anion + inert (if applicable)) along with 1 charge for resin make up hopper shall be provided.
- 17) One no specific Conductivity Analyzer at condensate inlet header, one at condensate outlet header, and one each at outlet of each condensate polishing vessel for the unit.
- 18) One no cation Conductivity Analyzer at condensate outlet header, and one each at outlet of each condensate polishing vessel for the unit.
- 19) One no pH Analyzer at condensate inlet header, one at condensate outlet header and one each at outlet of each condensate polishing vessel for the unit..
- 20) One no multichannel silica analyzer at outlet of the three service vessels & common outlet header. Total no of multichannel silica analyzers for the unit shall be one.
- 21) One no multichannel sodium analyzer at outlet of the three service vessels & common outlet header. Total no of multichannel sodium analyzers for the unit shall be one.
- 22) 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, air sets, and other fittings, required to complete the system.
- 23) All valves, which are subjected to the pressure of service vessel, shall be considered as high pressure valves. Rest shall be considered as low pressure valves.
- 24) All the piping, valves, fitting, accessories etc. used in service vessel area shall be 300# class minimum.
- 25) All the minimum instrumentation required as per P&ID For Condensate Polishing Unit.

B. REGENERATION SYSTEM

- 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 complete with all accessories.
 - 2) One no Anion resin regeneration vessel with all accessories
 - 3) One no Mixed resin storage vessel complete with all accessories.



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- 4) All vessels must be complete with vents, drains, piping & valves for air scrubbing, back-washing & regeneration process.
- 5) All internals, fittings and appurtenances for these vessels.
- 6) Common waste effluent header with one resin trap designed for in place manual backwashing.
- 7) The type of vessels indicated above (at S.No 1, 2, and 3) shall be as per supplier process requirement. However design requirement shall be as per tender specification.
- 8) Resin make-up hopper complete with water ejector system for resin make up. The resin make-up hopper tank shall be sized to handle up to 150 liters of as received new resin per single injection or maximum attrition loss whichever is higher.
- 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 snubber, acoustic hood, relief valve etc all mounted on a single base.
- 10) Two (2X100%) nos. DM water pumps (Located near DM water storage Tank) for resin transfer, regeneration, chemical preparation & dilution with electric motor drives for water supply for regeneration, chemical preparation, dilution, etc. and resin transfer from the service vessel to the regeneration area & vice-versa.
- 11) One no. resin trap at common discharge line of CPU regeneration vessel.
- 12) All integral pipe works, valves, internals, fittings, hangers, supports and appurtenances etc for these vessels.
- 13) Two (2) sets of safety equipment comprising PVC protection suits with hoods, rubber boots, face visors and thick PVC gauntlets shall also be provided. One number personnel water drench shower/safety shower and eye bath in regeneration area shall be provided by the bidder.
- 14) Bidder to included one no toilet block having facilities for Ladies & Gents as per attached Space available for CPU Regeneration area(Vide ref. Dwg. No. PE-DG-410-155A-A003).

II. ALKALI PREPARATION FACILITY

In order to facilitate erection at site alkali 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 minimized by the use of pipe headers wherever possible. The bidder may also supply and install these 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 storage tank complete with carbon dioxide absorber, overflow seal, integral pipe works, valves, instrumentation and all other accessories required.
- 2) One number alkali solution preparation tank. The tank shall consist of slow speed agitator driven by motor, carbon dioxide absorber, overflow seal, dissolving basket, integral pipe works, valves and all other required accessories.
- 3) One no. hot water tank with 2x50% electrical heating coil for heating of alkali diluent water, in a tank of mild steel rubber lined construction complete with integral pipe works, valves, instrumentation and all other accessories required shall be provided.
- 4) Two (2) nos. (1W+1S) alkali transfer cum recirculation pumps. These pumps shall take suction from the alkali preparation tank and alkali storage tank. These pumps shall be provided with a pulsation dampener at the outlet header of each pump along with necessary valves & instrumentation & accessories as required.
- 5) One (1) no. Activated carbon filter for alkali complete with internals, integral pipe works, valves and all other accessories as required.
- 6) One carbon trap at the outlet of ACF
- 7) One no. hose station for transfer of alkali. The hose station shall have two (2) nos. each 80 mm NB rubber hose connection.



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- 8) Two (2) nos. (1W+1S) alkali unloading pumps along with necessary valves & instrumentation & accessories as required..These pumps shall take suction from the unloading tankers.
- 9) All interconnecting piping, valves and fittings & instrumentation as required to complete the system.

III. Acid and Alkali Dosing System

All the equipments for dosing of acid, alkali solutions are rated to provide a maximum dosing rate of 20% in excess of that required from process calculations. Similarly all the tanks shall be sized to store one regeneration requirement with 20% excess requirements.

The Acid and Alkali dosing systems shall be skid mounted and shall consist of at least following equipment's:

- 1) Two (2) nos. (1W+1S) acid unloading/transfer pumps along with necessary valves & instrumentation & accessories as required. These pumps shall take suction from the unloading tankers.
- 2) One (01) number acid storage tanks complete with fume absorbers, overflow seal, integral pipe works, valves, instrumentation and all other accessories required.
- 3) One (01) number acid measuring tanks complete with fume absorbers, overflow seal, integral pipe works, valves, instrumentation and all other accessories required.
- 4) Two (02) numbers (1W+1S) Positive displacement type metering pumps for acid dosing with electric motor drive, pulsation dampener & safety relief valve at the outlet header of each pump along with all other required accessories.
- 5) One (1) no Alkali measuring (day) tank including slow speed agitator driven by motor complete with carbon dioxide absorber, overflow seal, integral pipe works, valves, instrumentation and all other accessories required.
- 6) Two (02) numbers (1W+1S) Positive displacement type metering pumps for alkali dosing with electric motor drive, pulsation dampener & safety relief valve at the outlet header of each pump along with all other required accessories.
- 7) One no. hose station for transfer of acid. The hose station shall have two (2) nos. each 80 mm NB rubber hose connection.
- 8) DM 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, and a mixing tee where the chemicals get injected into the water stream.
- 9) 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.
- 10) 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) The waste water from the external regeneration facility is led to the N.Pit.
- 2) Two (2) nos (1W+1S) N.Pit disposal pumps along with necessary valves & instrumentation & accessories as required.
- 3) One (1) no Alkali tank for N-Pit including slow speed agitator driven by motor complete with carbon dioxide absorber, overflow seal, integral pipe works, valves, instrumentation and all other accessories required.
- 4) One (01) no acid tank for N-Pit complete with fume absorbers, overflow seal, integral pipe works, valves, instrumentation and all other accessories required.
- 5) Two (2) nos pH Analyser at effluent discharge header, shall be in the scope of bidder.



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D. PIPING

All the piping as listed below & indicated in P&ID for Condensate Polishing Unit shall be in bidder's scope. The below indicated pipes shall be designed, supplied, erected, laid and tested by the bidder. Elbows, tees, flanges Hangers and supports, embedment plates with lugs etc required for the below given piping shall also be provided by the bidder.

- 1) Minimum OD 457.0 X 12.7 mm thick service vessel inlet header confirming to CS ASTM A 106 Gr-C.
- 2) Minimum OD 457.0 X 12.7 mm thick service vessel outlet header confirming to CS to ASTM A 106 Gr-C.
- 3) 150 m of minimum OD 168.3 x 7.11 mm thick rinse water outlet piping from service vessel to condenser hotwell confirming to CS to ASTM A 106 Gr-B.
- 4) Rinse recirculation piping confirming to CS to ASTM A 106 Gr-C
- 5) 360 m of minimum 100 NB resin transfer piping confirming to SS 304 Sch 10S (minimum).
- 6) 360 m of minimum 100 NB DM water piping for the CPU Service Vessel Area to regeneration area confirming SS 304 Sch 10S (minimum). In addition to it, all the distribution of the same inside the CPU Service Vessel Area for unit shall be in bidder's scope.
- 7) 200 m of minimum 150 NB DM water piping from CPU DM water pumps (Located near DM water storage Tank) to CPU regeneration building confirming to SS 304 Sch 10S (minimum). In addition to it, all the distribution of the same inside the CPU regeneration area shall be in bidder's scope.
- 8) 700m of minimum 150 NB effluent transfer piping for the N-pit confirming to CSRL.
- 9) Minimum 50 NB of piping handling alkali and alkali solution confirming to CPVC Sch 80 .The distribution of the same inside the CPU regeneration area shall be in bidder's scope.
- 10) Minimum 50 NB of piping handling acid service confirming to CSRL IS 1239 Part 1 Heavy Grade/CSRL IS 3589 Part II .The distribution of the same inside the CPU regeneration area shall be in bidder's scope.
- 11) Piping for the instrument & service air confirming to SS 304 Sch 40S for size equal to & less than 50 NB and SS 304 Sch 10S for size equal to & more than 65 NB. The distribution of the same inside the CPU regeneration area and CPU service vessel area shall be in bidder's scope.
- 12) Minimum 65 NB of DM pump recirculation piping confirming to SS 304 Sch 10S (minimum).shall be in bidder's scope.
- 13) All piping within each of the above skids/equipment shall be in bidder's scope.
- 14) DM water piping from each of DM water storage tanks to CPU DM water pumps for resin transfer, regeneration, chemical preparation & dilution (including re circulation lines connected to DM water storage tanks).
- 15) DM water piping from each CPU DM water pumps for resin transfer, regeneration, chemical preparation & dilution to service vessel area and to required facilities in regeneration area shall be in bidder's scope.
- 16) Service water piping, instrument air piping, service air piping, potable water piping, etc. as applicable as per the Terminal Points shall be in bidder's scope.
- 17) All piping between the CPU regeneration area and the skids for alkali preparation facility and acid & alkali dosing system shall be designed, supplied, erected & tested by the bidder and shall be in bidder's scope. The demineralized water piping to the required CPU regeneration area facilities, acid & alkali piping from storage tanks to respective acid & alkali skids in the CPU regeneration area, alkali piping from alkali solution preparation facility to the alkali dosing skid, and dilute acid & alkali solution piping from the acid & alkali dosing skids to the required CPU regeneration vessels & other facilities in the CPU regeneration area shall be in bidder' scope.



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E. ADDITIONAL REQUIREMENT

- 1) Operating platforms, ladders, supports and other structural works for each vessel and tanks 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.

Start-up and commissioning spares are in bidder's scope of supply.

Start-up and Commissioning spares are those which would be required during equipment or system testing, start-up and commissioning. All spares used until the plant is finally handed over by the bidder to the customer come under this category. All start-up and commissioning spares as required shall be provided by the bidder without any additional cost to the BHEL and customer. Bidder to provide spares as per their system requirement without any commercial and delivery implication to BHEL/Customer during detailed engineering. List of spares shall be furnished by BIDDER along with the offer.

Bidder shall be responsible for the ready and timely availability for all the startup and commissioning spares as required during various stages of testing, cleaning and commissioning up to handing over of each unit of the total plant.

An adequate stock of start-up spares shall be available at the site such that the start-up and commissioning of the equipment/systems, Performance guarantee test and handing over the equipment/ systems to the customer will be carried out without hindrance and delay. All start-up spares which remain unused after the taking over of the plant shall remain the property of the customer.

- 4) Mandatory spares. (Refer attached, Annexure-V/Section-C1).
- 5) 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.
- 6) Bidder shall consider 12 m static head + 10% margin in addition to the losses in straight and bend in pipes and valves etc. while selection of pump head during detailed engineering.
- 7) All the first fill and one Year's topping requirements of consumable such as greases, oil, lubricants, servo fluids/control fluids, gases and etc. which will be required to put the equipment covered under the scope of specifications, into successful commissioning / initial operation and to establish completion of facilities shall be furnished by the bidder. Suitable standard lubricants as available in India are desired. Efforts should be made to limit the variety of lubricants to minimum.
- 8) MCC shall be located in CPU regeneration area. All regeneration vessels and chemical dosing facilities shall be located in Building. Bulk chemical storage tanks, unloading and transfer pumps shall be located open to sky. However control panels and MCC shall be located in building in regeneration area.
- 9) 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.
- 10) 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.



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- 11) Engineering for this project is being carried out in 3D environment at BHEL end. Name of engineering platform on which BHEL is doing the project IS Smart Plant Suite. This is being done to have automated interface checking and thereby minimising rework at site. Hence bidder, in their own interest, is requested to prepare all layout drawings using 3D Modelling software. These drawings will also be made available to BHEL in soft for checking interface with other agencies in consolidated layout drawings. Bidder's inability to prepare drawing using 3D Modelling software will not be criterion for evaluation of their bid.
- 12) 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.
- 13) 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.
- 14) 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.
- 15) 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".
- 16) Necessary approach (platform) shall be provided for all the Pneumatic Valves & Flow Orifice Plates. Necessary drawing/documents, indicating the same, shall be provided by successful bidder during contract stage.
- 17) All the transmitters (Pressure, Temperature, Flow, Level, Differential Pressure etc.), which are used in system for interlock & protection shall be redundant. The same shall be indicated in P&ID by successful bidder after award of contract.
- 18) Instruments, analyzers etc. used in system should sustain operating & design parameters of system. In case operating & design parameters of instruments, analysers are less than system's parameters, then necessary arrangement/accessories shall be provided by bidder for safe operation.
- 19) Space available for CPU service Vessels area & CPU Regeneration area(Vide ref. Dwg. No. PE-DG-410-155A-A002 & PE-DG-410-155A-A003) are attached in Section-C1 of this specification. Bidder to accommodate their equipment within the space provided.
- 20) 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.
- 21) Bidder to take care for cooling/ lubrication of the pumps being supplied by the bidder under this technical specification. If service water pressure requirement is more than available pressure, bidder to consider two (2) nos. cooling pump for package.
- 22) Any statutory requirement / clearance required for the packages from government / local body shall be in bidder's scope.

5.0 SCOPE OF SUPPLY (ELECTRICAL)

Complete electrical as per specification and details indicated in Section C2 (Specific Technical Requirement Electrical) and D2 (General Technical Requirement Electrical).

6.0 SCOPE OF SUPPLY (C&I)

Complete C&I as per specification and details indicated in Section C3 (Specific Technical Requirement C&I) and D3 (General Technical Requirement C&I).



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7.0 SCOPE OF SUPPLY (CIVIL)

Total Civil is in BHEL's Scope of work, however 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 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".

8.0 SCOPE OF SERVICES

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

- (i) Erection and Commissioning.
- (ii) Arrangement of all instruments, reagents, monitoring gadgets for monitoring, pre-commissioning, carrying out trial run & commissioning and Performance guarantee test.
- (iii) Monitoring gadgets, instruments and equipments required for maintenance.
- (iv) All personnel required during maintenance and Performance guarantee test.
- (v) Trial run for requisite period.
- (vi) Performance Guarantee Test.
- (vii) Painting shall be as specified in ANNEXURE- IV 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 & delivery implication to BHEL & Customer.
- (viii) Final touch up paint at site.
- (ix) Presence of Bidder at BHEL-EDN-Banglore during FAT of DDCMIS as per Cl.No.-6/Section-C3 (C&I)

9.0 TERMINAL POINTS

9.1 CONDENSATE POLISHING PLANT - SERVICE VESSEL AREA

- (i) Service vessel inlet – (OD 457.0 X 12.7 mm thick, CS to ASTM A 106 Gr-C) - Single piping connection near service vessel area, As per attached Composite piping Layout below 8.5 m Dwg.No. PE-DG-410-100-M032
- (ii) Service vessel outlet – (OD 457.0 X 12.7 mm thick, CS to ASTM A 106 Gr-C) - Single piping connection near service vessel area, As per attached Composite piping Layout below 8.5 m Dwg.No. PE-DG-410-100-M032
- (iii) Rinse water outlet- Rinse water outlet piping (minimum OD 168.3 x 7.11 mm, CS to ASTM A 106 Gr.B) till condenser hot well for unit is in the scope of bidder.
- (iv) 25 NB connection of Instrument air supply at 5 to 7 kg/cm² (g) – At 5 meter distance from service vessel area. However distribution and piping inside service vessel area shall be in bidder's scope.
- (v) 50 NB connection of Service air supply at 5 to 7 kg/cm² (g) – At 5 meter distance from service vessel area. However distribution and piping inside service vessel area shall be in bidder's scope. If service air required is more than provided by BHEL, bidder to provide necessary compressors or blowers and associated valves, piping, fittings, flanges, instruments etc. to meet the system requirement.

9.2 EXTERNAL REGENERATION AREA

- (i) DM Water Supply – From the outlet nozzle of the DM water storage tanks to the pump suction (DM water pumps for resin transfer, regeneration, chemical preparation & dilution) shall be in the scope of bidder.



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- (ii) DM Pump Recirculation Lines – From DM water pumps for resin transfer, regeneration, chemical preparation & dilution header to DM Water storage tanks recirculation nozzle/inlet nozzle shall also be in the scope of bidder.
- (iii) 25 NB Instrument air supply at 5 to 7 kg/cm² (g) – At 5 meter distance from the regeneration area. However distribution and piping inside CPU regeneration area shall be in bidder's scope.
- (iv) 25 NB Service air supply at 5 to 7 kg/cm² (g) - At 5 meter distance from regeneration area. However distribution and piping inside CPU regeneration area shall be in bidder's scope. If service air required is more than provided by BHEL, bidder to provide necessary compressors/blowers and associated valves, piping, fittings, flanges, instruments etc. to meet the system requirement.
- (vi) Service water connection (25 NB connections) at 5 meter distance from regeneration building. Piping inside regeneration area for mentioned services will be in bidder's scope.

10.0 EXCLUSIONS

10.1 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. Also 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 embedment 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.

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 and effluent disposal piping etc.) are in bidder's scope. Maximum height of the pipe trestle between CPU regeneration area and service vessel area may be considered as 13.0M.

10.2 Instrument air & service air up to terminal points.

10.3 All chemicals.

10.4 Air conditioning, ventilation & fire fighting facilities.

10.5 Other exclusions are mentioned in the electrical & C&I parts of this specification.

11.0 QP AND SUB VENDOR APPROVAL

11.1 QP requirements are specified as **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.

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

11.3 Indicative sub vendor list is enclosed as ANNEXURE-II. However any additional sub vendor shall be subjected to BHEL and Customer approval during detailed engineering stage without any commercial & delivery implication to BHEL. The Final sub vendor list shall subject to BHEL and Customer approval during detailed engineering stage without any commercial & delivery implication to BHEL.

12.0 PERFORMANCE GUARANTEE TEST

The Performance guarantee test shall be as per Annexure-VI/Section-C1.

13.0 DESIGN/ CONSTRUCTION

In addition to the requirements of Section C & D the following shall also be complied under scope of this specification.



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The P&I diagram is enclosed herein in this section for bidders 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.

14.0 DRAWING/DOCUMENTS REQUIREMENT

After award of LOI, following minimum drawing/documents shall be submitted by the bidder for BHEL and 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.

For the Drawings/Documents Submission Procedure, please refer **Annexure-III**. The submission of soft copy or hard copy of the drawing/document whichever is later will be considered as final date of submission of the drawing/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.

Bidder to note that the drawings to be submitted by bidder in the event of award of contract shall be as per the below given drawing/document list. Bidder to note that any additional drawings/documents requirement during detailed engineering shall be provided by bidder without any technical, commercial and delivery implications to BHEL. Bidder confirmed drawings submission schedule as follows:

- a. Drawing/documents submission schedule: First submission of basic drawings/ documents – (Please refer MDL for list of basic drawing/documents & submission schedule).
- b. The rest of the drawings/documents shall be submitted within three months from the date of approval of P&ID and Process Design & Sizing Calculation in CAT-II.
- c. Every revised submission incorporating comments – within 10 days.

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

(a) List and schedule of drawings/documents to be submitted after award of contract:-

MASTER DRAWING LIST(MDL)				
S.No.	Drawing/Document No.	Drawing/Document Title	No. of weeks for drawing/document submission after placing LOI/PO	Paper Size of Dwg/Docs.
1.0	PE-V2-410-155A-A001*	P& I DIAGRAM OF CONDENSATE POLISHING UNIT	4	A1
2.0	PE-V2-410-155A-A002*	EQUIPMENT LAYOUT OF CONDENSATE POLISHING UNIT (SERVICE VESSEL AREA)	4	A1
3.0	PE-V2-410-155A-A003*	EQUIPMENT LAYOUT OF CONDENSATE POLISHING UNIT (REGENERATION AREA)	4	A1
4.0	PE-V2-410-155A-A004*	PROCESS DESIGN AND SIZING CALCULATIONS , DATA SHEET OF RESIN VESSEL THICKNESS AND PRESSURE DROP CALCULATIONS FOR CPU	4	A4
5.0	PE-V2-410-155A-A005*	SUB-VENDOR LIST AND INSPECTION CRITERIA	4	A4
6.0	PE-V2-410-155A-A006*	OPERATION & CONTROL PHILOSOPHY FOR CPU ALONG WITH CONTROL SYSTEM CONFIGURATION DIAGRAM	6	A4



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7.0	PE-V2-410-155A-A007	CIVIL ASSIGNMENT DRAWING OF CONDENSATE POLISHING UNIT (SERVICE VESSEL AREA)	8	A1
8.0	PE-V2-410-155A-A008	CIVIL ASSIGNMENT DRAWING OF CONDENSATE POLISHING UNIT REGENERATION AREA)	8	A1
9.0	PE-V2-410-155A-A009	PIPING LAYOUT (REGENERATION AREA)	10	A1
10.0	PE-V2-410-155A-A010	PIPING LAYOUT (SERVICE VESSEL AREA)	10	A1
11.0	PE-V2-410-155A-A011	ELECTRICAL LOAD DATA	10	A4
12.0	PE-V2-410-155A-A012	GA DRAWING OF SERVICE VESSELS FOR CPU	10	A1
13.0	PE-V2-410-155A-A013	QAP FOR SERVICE VESSEL	10	A4
14.0	PE-V2-410-155A-A014	GA DRAWING OF PRESSURE VESSELS FOR CPU	10	A1
15.0	PE-V2-410-155A-A015	QAP FOR PRESSURE VESSELS	10	A4
16.0	PE-V2-410-155A-A016	GA DRAWING OF ATMOSPHERIC TANKS FOR CPU	10	A1
17.0	PE-V2-410-155A-A017	QAP FOR ATMOSPHERIC TANKS	10	A4
18.0	PE-V2-410-155A-A018	TECHNICAL DATA SHEET OF HORIZONTAL / VERTICAL CENTRIFUGAL PUMPS	10	A4
19.0	PE-V2-410-155A-A019	TECHNICAL DATA SHEET FOR METERING PUMPS	10	A4
20.0	PE-V2-410-155A-A020	TECHNICAL DATA SHEET OF BLOWERS	10	A4
21.0	PE-V2-410-155A-A021	TECHNICAL DATA SHEET FOR MOTOR	10	A4
22.0	PE-V2-410-155A-A022	QAP FOR HORIZONTAL / VERTICAL CENTRIFUGAL PUMPS WITH MOTOR	10	A4
23.0	PE-V2-410-155A-A023	QAP FOR METERING PUMPS WITH MOTORS	10	A4
24.0	PE-V2-410-155A-A024	QAP FOR BLOWERS WITH MOTORS	10	A4
25.0	PE-V2-410-155A-A025	TECHNICAL DATA SHEET FOR HIGH PRESSURE VALVES	10	A4
26.0	PE-V2-410-155A-A026	TECHNICAL DATA SHEET FOR LOW PRESSURE VALVES	10	A4
27.0	PE-V2-410-155A-A027	QAP FOR VALVES	10	A4



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28.0	PE-V2-410-155A-A028	TECHNICAL DATA SHEET FOR INSTRUMENTS	10	A4
29.0	PE-V2-410-155A-A029	TECHNICAL DATA SHEET FOR ANALYZERS	10	A4
30.0	PE-V2-410-155A-A030	TECHNICAL DATA SHEET FOR HEATER AND RESIN	10	A4
31.0	PE-V2-410-155A-A031	VALVE SEQUENCE CHART	10	A3
32.0	PE-V2-410-155A-A032	INSTRUMENT SCHEDULE	12	A3
33.0	PE-V2-410-155A-A033	VALVE SCHEDULE	12	A3
36.0	PE-V2-410-155A-A036*	CABLE TRAY/TRENCH & CONDUIT ROUTING AND EARTHING LAYOUT DIAGRAM FOR CONDENSATE POLISHING UNIT (REGENERATION AREA)	12	A1
37.0	PE-V2-410-155A-A037*	CABLE TRAY/TRENCH & CONDUIT ROUTING AND EARTHING LAYOUT DIAGRAM FOR CONDENSATE POLISHING UNIT (SERVICE VESSEL AREA)	12	A1
38.0	PE-V2-410-155A-A038	DATASHEET OF RESIN TRAP, CARBON TRAP, ACF, AGITATOR	12	A4
39.0	PE-V2-410-155A-A039	GA OF BATTERY BANK AND CHARGER	12	A4
40.0	PE-V2-410-155A-A040	QAP / ICL FOR CPU (FOR BALANCE OF ITEMS)	12	A4
41.0	PE-V2-410-155A-A041	ERECTION PROCEDURE	16	A4
42.0	PE-V2-410-155A-A042	YARD PIPING LAYOUT	16	A1
43.0	PE-V2-410-155A-A043	CABLE SCHEDULE FOR CONDENSATE POLISHING UNIT	16	A3
44.0	PE-V2-410-155A-A044	PERFORMANCE GUARANTEE TEST PROCEDURE FOR CONDENSATE POLISHING UNIT	20	A4
45.0	PE-V2-410-155A-A045	ENGINEERING BOQ	20	A4
46.0	PE-V2-410-155A-A046	O&M MANUAL FOR CONDENSATE POLISHING UNIT	24	A4

Note- The drawing/document marked as (*) shall be considered as basic drawings/documents. In addition to above bidder to refer Section-C2 & C3 for documents related to Electrical & Control & instrumentation respectively.

(b) Bidder to note that drawings/documents submission shall be through web based Document Management System. Bidder would be provided access to the DMS for drawings/documents 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



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- Internet speed – 2 mbps (Minimum preferred)
- 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>

15.0 SPARES

- i) All the 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.
- ii) The quality plan and the inspection requirement finalized for the main equipment will also be applicable to the corresponding spares.

VENDOR WARANTS-

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 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.
- iii) The vendor will indicate the delivery period of the spares, which the BHEL and the customer may procure in accordance with this clause.
 - iv) 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.
 - v) 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



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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.

- vi) 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.

16.0 MINIMUM IMPORTED ITEMS

1. Resins.

17.0 Bidder to furnish 4 sets of techno-commercial bid including following documents/information (For Electrical and C&I please refer the respective section of the specification).

- Detailed process write up of the system offered for information (meeting the specification requirement for information purpose only).
- Deviation if any in the enclosed Schedule of deviation with cost of withdrawal only with mention of specification clause for which deviation is being asked. (Stamped & Signed)
- Compliance certificate.(Stamped & Signed)
- Schedule of Declaration. (Stamped & Signed)
- Electrical Load data in BHEL format (Stamped & Signed)
- Price Schedule duly filled in. (Stamped & Signed)
- List of Startup & commissioning spares, if any. (Stamped & Signed)
- Following guaranteed chemical consumption required per regeneration per vessel (in kg) to be furnished in sealed envelope. (Stamped & Signed)
 1. Acid (30% HCL) consumption per vessel per regeneration
 2. Alkali (48 % NaOH) consumption per vessel per regeneration.

18.0 SITE VISIT BEFORE SUBMISSION OF OFFER.

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.



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ANNEXURE-I

QUALITY PLAN



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CONDENSATE 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 (High 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	



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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. Bidder will perform hydro test at 1.5 times of design pressure of entire Condensate Polishing Plant at site after commissioning of all the equipments in presence of Customer/BHEL. Format of record will be through protocol, subject to BHEL/Customer acceptance.
11. Hydro test will be conducted before rubber lining.
12. Proof of Design (P.O.D.)
 - 12.1 P.O.D. test certificates shall be furnished by the bidder for all applicable size-ranges and classes of Butterfly valves supplied by him in the presence of Customer's representative.
 - 12.2 All valves that are designed and manufactured as per AWWA-C-504 shall be governed by the relevant clauses of P.O.D test in AWWA-C-504. For Butterfly valves designed and manufactured to EN-593 or equivalent, the P.O.D. test methods and procedures shall generally follow the guidelines of AWWA-C-504 in all respect except that Body & seat hydro test and disc-strength test shall be conducted at the pressures specified in EN-593 or the applicable code. Actuators shall also meet requirements of P.O.D. test of AWWA-C-504.



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ANNEXURE-II

SUB-VENDOR LIST (INDICATIVE)



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SR No.	Items	Approved Vendor	Place / Location	Remarks
1	SERVICE VESSELS	R&C	MUMBAI	
		ISGEC	YAMUNANAGAR	
		ANUP ENGG.	AHMEDABAD	
		FABTECH	PUNE	
		SPARK ENGINEERS	PUNE	
		ISHAN EQUIPMENTS	BARODA	
		PROGEN	CHENNAI	
2	PRESSURE VESSELS (REGENERATION VESSELS, DILUTION HOT WATER TANK, ACF)	SHREE THANDAVA LAKSHMI INDUSTRY	VIZAG	
		SRI RAMAKRISHNA ENGINEERING	VIZAG	
		SYSCON ENGINEERS	AMBERNATH	
		CHEM PROCESS SYSTEM	SANAND	
		FABTECH PROJECTS & ENGINEERS LTD.	PUNE	
		SV FABRICATORS	NAVI MUMBAI	
		JASMINO POLYMERTECH	TOLOJA	
		RISHI INDUSTRIES	BAHALGARH	
		PROGEN	CHENNAI	
		ISHAN EQUIPMENTS	VADODHARA	
		CRYSTAL ENGG.	HOSUR	
		UNIVERSAL HEAT EXCHANGERS	COIMBATORE	
		ATS CHEM	SALEM/HOSUR	
		R & C	MUMBAI	
ISGEC	YAMUNANAGAR			
ANUP ENGG	AHMEDABAD			
3	ATMOSPHERIC TANK (BULK ACID, BULK ALKALI & MEASURING TANKS)	PAALSUN ENGINEERS	CHENNAI	
		SHREE THANDAVA LAKSHMI INDUSTRY	VIZAG	
		S V FABRICATORS	NAVI MUMBAI	
		SYSCON ENGINEERS	AMBERNATH	
		JASMINO POLYMERTECH	TANOJA	
		TITAN ENGG	DURGAPUR	
		RISHI INDUSTRIES	BAHALGARH	
		CHEM PROCESS SYSTEM	SANAND	
		PROGEN	CHENNAI	
		ISHAN EQUIPMENTS	VADODARA	
		CRYSTAL ENGG.	HOSUR	
		UNIVERSAL HEAT EXCHANGERS	COIMBATORE	
ATS CHEM	SALEM / HOSUR			
4	AIR FILTER REGULATOR	PLACKA	CHENNAI	
		SHAVO NORGAN	MUMBAI/BANGALORE	
5	ACTIVATED CARBON	INDUSTRIAL CARBON	ANKLESHWAR	
		VVD & SONS	TUTICORIN	
		GLOBAL ABSORBENT PVT LTD	KOLKATA	
6	AIR BLOWERS	SWAN PNEUMATIC	NOIDA	
		EVEREST TRANSMISSION	NEW DELHI	
		KAY INTERNATIONAL	NEW DELHI / SONEPAT	
		EVEREST BLOWER	BAHADURGARH	
		KULKARNI POWER TOOLS	SHIROL	
7	METERING PUMPS	VK PUMPS	NASIK	
		MILTON ROY INDIA	CHENNAI	
		SWELLORE	AHMEDABAD	
		POSITIVE METERING		
8	AGITATOR	REMI PEOCESS PLANT & M/C	MUMBAI	
		FIBRE & FIBRE	MUMBAI / SILVASA	
		STANDARD ENGINEERS	MUMBAI	



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9	HORIZONTAL CENTRIFUGAL PUMPS (RUBBER LINED)	KISHOR PUMPS	PUNE	
		SU MOTORS	MUMBAI	
10	NON METALLIC HORIZONTAL CENTRIFUGAL PUMPS	ENGINEERS COMBINE	THANE	
		ANTICORROSIVE	VALSAD	
11	MISC. PUMP VERTICAL TURBINE	KBL	PUNE	
		M&P	PUNE	
		WPIL	GHAZIABAD	
		JYOTI PUMPS	VADODRA	
		VOLTAS	PUNE	
12	RESIN TRAP ELEMENT FOR SERVICE AREA	JHONSONS SCREEN	AUSTRALIA	
13	UNDER BED NOZZLE FOR CPU VESSEL	JONSONS SCREEN	AUSTRALIA	
14	RESIN	ROHM & HASS	FRANCE / USA	
		BAYERS	GERMANY.	
		PUROLITE	USA/UK	
		LANXES	GERMANY	
15	PREFILTER (Filter Element + Casing)	PALL / GRAVER		
16	HEATER	ESCORTS	FARIDABAD	
		RACOLDS	FARIDABAD	
17	Horizontal/Vertical Centrifugal Pump	KBL	Kirolskarwadi	
		M&P	Pune	
		Flowmore	Ghaziabad	
		Sulzer pumps india ltd.	Navi mumbai	
		Worthington	Ghaziabad	
		Bharat pumps & compressors ltd	Allahabad	
		Flowserve India Controls Pvt. Ltd.	Coimbatore	
		Jyoti ltd.	Vadodara	
	Vertical Centrifugal Pump	Kishore Pump	Pune	
		Sam Turbo	Coimbatore	
		KSB	Pune	
		Best and Crompton	Chennai	
		Voltas	Mumbai	
		V-Flo Pumps & Systems Co. Ltd.,	Beijing, China	
18	Strainers (Y-Type & Basket Type)	MULTITEX FILTRATION ENGINEERS LIMITED,	Noida	NTPC/MSE approved sub-vendors.
		Sarojini Enterprises	Kolkata	
		Otoklin Filters	Mumbai	
		BHATIA ENGINEERING CO.	Delhi	
		JAYPEE INDUSTRIES PVT. LTD.	Delhi	
		FILTRATION ENGINEERS (I) PVT. LTD.	MUMBAI	
		OTOKLIN GLOBAL BUSINESS LIMITED	Mumbai	
		SUNGOV ENGINEERING PVT. LTD.	Delhi	
		Grand Prix	Faridabad	
19	Fittings	M.S. Fittings	Kolkata	NTPC approved sub-vendors and BHEL list
		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			



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20	MS/GI ERW Pipes	SAIL	Rourkela	NTPC approved sub-vendors and BHEL list
		Jindal	Ghazibad/Hissar	Upto 300 NB ERW Pipes as per IS 1239/3589
		Surya Roshni	Bahadur Garh	Upto 400 NB ERW Pipes as per IS 1239/3589 and SAW as per IS 3589
		TATA Tube	Jamshedpur	Upto 150 NB ERW Pipes as per IS 1239
		PSL	Chennai/Vizag/Kutch/Daman	Spiral Weld SAW as per IS 3589
		Lalit Profile	Thane	Spiral Weld SAW as per IS 3589
		Samshi Pipes Industries	Vadodara	Spiral Weld SAW as per IS 3589
		Mukut Pipes	Rajpura	Longitudinal SAW (Single side weld) as per IS 3589
		Indus Tubes	G B Nagar	Upto 300 NB ERW Pipes as per IS 1239/3589
		Mann Ind	Indore	Spiral Weld SAW as per IS 3589
		Surendra Engg	Rajpura	Spiral Weld SAW as per IS 3589
		Pratibha Pipes & Structure Pvt Ltd	Thane	Spiral Weld SAW as per IS 3589
		JCO Gas Pipe	Chindwara	Spiral Weld SAW as per IS 3589
		Nukat Tanks and Vessels	Tarapur	Longitudinal SAW (Single side weld) as per IS 3589
		DADU Pipes	Sikandrabad	Upto 300 NB ERW Pipes as per IS 1239/3589
		Good Luck Tubes	Sikandrabad	
		Advance Steel Tubes	Sahibabad	
		Bihar Tubes	Sikandrabad	
		Hi Tech Pipes	Sikandrabad	
			Ratnamani	Kutch/Ahmedabad/Chhatral
	Maharashtra Seamless	Raigad	200-500 NB ERW Pipes as per IS 3589	
	Welspun	Anjar/Bharuch	Upto 400 NB ERW Pipes as per IS 1239/3589 and SAW as per IS 3589	
21	Seamless Pipes	ISMT	Ahmednagar/Baramati	NTPC approved sub-vendors.
		Maharashtra Seamless	Raigad	
22	S.S. Pipes (For small Quantity 500 m)	REMI	Mumbai	NTPC approved sub-vendors and BHEL list
		Ratmani	Ahmedabad	
		Apex Tubes	Behror	
		Choksi	Ahmedabad	
23	CI Gate/ Globe/NRV/SRV	H.Sarkar	Howrah	SIZE UPTO 300NB & PR.CL.
		A.V. VALVES LTD	Agra	
		Leader	Jalandhar	
		SURYA VALVES AND INSTRUMENTS MFG CO.	Chennai	FOR GV UPTO 450NB, GLV UPTO 300NB AND CHECK VALVES UPTO 350NB.
		ATAM VALVES PVT. LTD.	JALANDHAR	(1) CARBON IRON GATE VALVES: 65 NB TO 450 NB (UPTO PN-16.0) (2)



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				CARBON IRON GLOBE VALVES & NON RETURN VALVES: 65 NB TO 150 NB (UPTO PN- 16.0)
		FLUIDLINE VALVES COMPANY PVT.LTD.	Mumbai	1. CI Gate- CL125 & up to 900 NB, 2. CI Globe- CL125 & up to 450 NB, 3. CI SCNRV- CL125 & up to 600 NB.
		G.M. DALUI AND SONS PVT.LTD.	Howrah	
		KBL	Kondhapuri	Additionally approved for FM approved Gate valve 50-250 NB
		Bankim	Kolkata	
		VENUS PUMPS AND ENGG. WORKS	Kolkata	1) CI GATE VALVE SIZES 65NB-800NB .2) CI GLOBE VALVE FOR SIZES 65NB-400 NB AND 3) CI SCNRV FOR SIZES 65 NB -600 NB.
24	GM valve	A.V. VALVES LTD	Agra	
		ATAM VALVES PVT. LTD.	Mumbai	GUN METAL GATE/GLOBE/NRV: 15 NB TO 50 NB (UPTO PN-16.0) & 15 NB TO 50 NB (UPTO #150)
		Leader	Jalandhar	
		VALTECH INDUSTRIES		GUN METAL SCREWED END TYPE , SCREWED IN BONNET , OUT SIDE SCREW & YOKE TPE , PN 16 , SIZES UPTO 50.
		SANT VALVES PVT. LTD.	Jalandhar	UP TO SIZE 100-NB ONLY.
25	Motorised Valve	Same make as sl no 17		Actuator by AUMA, Bangalore/Limitorque, Faridabad/ India
26	HIGH PRESSURE BUTTERFLY VALVE / CONTROL VALVE	DeZURICK (Upto 400 NB)	USA	
		TYCO (UPTO 450 NB)	USA	
		BRAY	USA	
		JAMESBURRY	USA	
27	BALL VALVE (HIGH PRESSURE)	VELAN	CANADA	
		BRAY	USA	
28	DIAPHRAGM VALVE (MANUAL / PNEUMATIC) UPTO 80 NB	WEIR BDK	HUBLI	
		CRANE FLOW PROCESS	SATARA	
29	CONTROL VALVE	IL-PALGHAT	PALAKAD	
		DRESSER VALAVE INDIA PVT. LTD.	COIMBATORE	
		FISHER CONTROLS	UK/USA	
		DRESSER MESONILAN	FRANCE	
		CONTROL COMPONENT INC	USA	
		MIL CONTROLS	ALWAYE	
		FISHER XOMOS		
		FORBES MARSHELL	PUNE	
		DeZURIK-COPIES VULCAN LTD.		
FORESS ENGG. INDIA LTD.				
		INSTRUMENTATION LTD.		



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30	JUNCTION BOX	BALIGA LIGHTING EQUIP	CHENNAI	
		K.S INSTRUMENTS	BANGALORE	
		MANISHA ENTERPRISE	PUNE	
		DEVI POLY	CHENNAI	
		FLEXPRO ELECTRICALS PVT LTD	GUJRAT	
		SHRENIK & COMPANY	AHMEDABAD	
		AJMERA INDUSTRIAL & ENGINEERING WORKS	MUMBAI	
		SUCHITRA INDUSTRIES	BANGALORE	
31	Solenoid Valve	Rotex	Baroda	NTPC approved sub-vendors (No PEM-C & I list is avl in PMD)
		Avcon	Mumbai	
		Asco	Chennai	
		SMC	Noida	
		Nucon	Hyderabad	
32	PLC Based Panels	SIEMENS	Nasik	NTPC/PEM-C & I approved vendors
		SCHNEIDER	Nasik	
		ROCKWELL	Sahibabad	
		GE Intelligent Platform	BANGALORE	
		Honeywell Automation India Limited ,	Pune	
		ABB	Bangalore	
33	Battery (Ni Cd for PLC)	Amco saft	Bangalore	NTPC approved sub-vendors
		HBL Power System	Hyderabad	
		SAFT	France/Sweden	
34	Motor	Marathon,	kolkata	For HT and LT motor
		Crompton Greaves	Ahmednagar	For HT and LT motor
		NGEF	Bangalore	Upto 15 KW
		ABB	Bangalore/Faridabad	Upto 200 KW
		Siemens	Mumbai	For HT and LT motor
		Jyoti	Baroda	For LT motor only
		LHP	Solapur	Upto 120 KW
		BHEL	Bhopal	For HT motor only
		Bharat Electric (BHEL)		For LT motor only
		Bharat Bijlee	Mumbai	Upto 160 KW(For LT motor only)
KEC	Bangalore/Hubli	Upto 90 KW		
35	Battery (maintenance free for PLC/ Fire Alarm Panel)	EXIDE	Kolkata	NTPC approved sub-vendors
		HBL Power System	Hyderabad	
		AMAR RAJA	Tirupati	
36	Steel Plate, Structural Steel and section for Fire water storage tank	SAIL		NTPC approved sub-vendors.
		Essar Steel		
		TISCO		
		RINL		
		Jindal		
		Lloyd		
		Ispat		
Indian Iron & Steel Co. Ltd				
37	Pressure Gauge/DP Gauge	Gluck (I) Manufacturing Co	Mumbai,	NTPC/PEM C & I approved sub-vendors
		H Guru	Rishra/Muzaffarpur/Bangalore	
		AN Instruments	Kolkata	
		ASHCROFT INDIA PVT LTD.	GIDC Chhatral Kalol	
		FORBES MARSHALL (HYD) LTD.	HYDERABAD	
		GAUGE BOURDON INDIA PVT. LTD.	Mumbai,	
		H.GURU INSTRUMENTS (SOUTH INDIA) P. LTD	BANGALORE	
		WIKA	Pune	
		Manometer India	Mumbai,	
		Baumer Technologies India Pvt. Ltd.	VAPI	
		GIC(Gauges Bourdon)	Panvel	
38	Pressure/DP/Vacuum Switch	Indfoss	Ghaziabad	NTPC approved sub-vendors(No PEM-C &
		SOR	USA	



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		Dressor	USA	I list is avl in PMD)
		Delta control	UK	
		Trafag	Ranipet	
		GIC(Gauges Bourdon)	Panvel	
		ASHCROFT INDIA PVT LTD.	USA/GERMANY	
		Switzer	Chennai	
39	Level Switch (Float/Displacer)	DK Instruments	Kolkata	NTPC approved sub-vendors
		Levcon	Kolkata	
		Sigma	Mumbai	
		V-Automat	New Delhi	
		SBEM	Pune	
40	Level Indicator	Flow Star	Faridabad	NTPC approved sub-vendors (No PEM-C & I list is avl in PMD)
		Scientific Devices	Mumbai	
		Gauges Bourden	Panvel	
		SBEM	Pune	
		Pune Techtrol	Pune	
		Levcon	Kolkata	
		Sigma	Mumbai	
		V-Automat	New Delhi	
41	OWS/PC	HP/Compaq /Dell/HCL/IBM/Lenovo	-	NTPC approved sub-vendors.
		42	Printer	HP/Cannon/Epson/Xeror/IBM/Lexmark
43	UPS	HITACHI-HIREL	Gandhinagar	NTPC approved sub-vendors
		APC	Bangalore	
		Delta	Gurgaon	
		Emerson	Mumbai	
		DB Power	Pune	
44	Control / Power Cable	Aplab	Mumbai	NTPC/PEM-Elect approved sub-vendors.
		Cords Cable	Bhiwadi	
		Radiant Cables	Hyderabad	
		PolyCab	Daman	
		KEI	Bhiwadi	
		Nicco	Kolkata	
		Ravin Cables	Pune	
		Incab	Pune	
		HVPL	Faridabad	
		Torrent cable	Nadiad	
		Havells	Alwar	
		Paramount	Khushkhhera	
		SRI Ram Cables	Bhiwadi	
		Thermocables	Hyderabad	
		Torrent cable	Nadiad	
Universal Cables	SATNA			
Gemscab	Bhiwadi			
Delton	Faridabad			
45	Battery Charger for PLC/Diesel Engine	Chloride Power	Kolkata	NTPC approved sub-vendors.
		Chabbi	Jalgaon	
		AMAR RAJA	Tirupati	
		Statcon	Noida	
		HBL Power System	Hyderabad	
		Dubas	Bangalore	
46	Battery (lead acid for diesel engine)	Caldyne	Kolkata	NTPC approved sub-vendors.
		EXIDE	Kolkata	
47	Fibre Optic Cable	Birla Ericsson	Rewa	NTPC approved sub-vendors.(No PEM-Elect/C & I list is avl in PMD)
		Finolex	Pune/Goa	
		Aksh Fibre	Bhiwadi	



TITLE:
**TECHNICAL SPECIFICATION FOR
 CONDENSATE POLISHING UNIT
 1X800 MW TSGENCO KOTHAGUDEM TPS
 STAGE -VII, PALONCHA**

SPEC NO: PE-TS-410-155A-A001

VOLUME: II-B

SECTION: C1

REV NO: 00

DATE:

48	TRANSMITTER	HONEYWELL AUTOMATION INDIA LIMITED	NEW DELHI	
		SMART INSTRUMENT LTD.	MUMBAI	LD-301 & T-301 TRANSMITTER FROM M/S SMART EQUIPMENTS BRAZIL.
		V.AUTOMAT & IST. P. LTD.	NEW DELHI	Displacement Type Transmitter. Pressure and DP Transmitter
		ABB LIMITED	FARIDABAD	PRESSURE TRANSMITTER, DP TRANSMITTER and TEMP TRANSMITTER
		ENDRESS + HAUSER (I) PVT LTD	NEW DELHI	For Temperature Transmitter Only
		MOORE INDUSTRIES INTERNATIONAL INC	California USA	INDIAN REPRESENTATIVE: CHEMTROL INDUSTRIES LTD, ,
		NIVO CONTROLS PVT LTD	Indore	For capacitance type only
		PUNE TECHTROL PVT LTD	PUNE	For capacitance type level transmitter only
		EMERSON PROCESS MANAGAMENT INDIA PVT LTD	MUMBAI	
		YOKOGAWA INDIA LIMITED	BANGALORE	
		TOSHINWAL INDUSTRIES PVT LTD	AJMER RAJASTHAN	
		SBEM	PUNE	For capacitance type level transmitter only
		SIEMENS LTD.	MUMBAI	
49	Paint (common items)	Shalimar		
		ICI		
		Asian		
		Berger		

NOTE:

Bidder to note that sub-vendors shall be as per above Sub-Vendor list enclosed in this Specification and:

- I. Any additional Sub Vendor (not specified in the list) shall subject to BHEL, & Customer/Consultant, approval during detailed engineering without any delivery/ commercial implications to BHEL & Customer/Consultant.
- II. All the finally selected Sub vendor shall be subject to BHEL, & Customer/Consultant approval during detailed engineering without any delivery/ commercial implications.
- III. Credentials required for finally selected/ proposed Sub-vendor shall be provided by the bidder. Non-acceptance of any Sub-Vendor by Customer/Consultant & BHEL shall not have any commercial & delivery implication to BHEL & Customer/Consultant.
- IV. Bidder shall submit all the Quality plans/ Check list during detail engineering for Customer/Consultant & BHEL approval. All comments as given by Customer/Consultant & BHEL shall be taken care by bidder without any commercial & delivery implication.
- V. The inspection category will be intimated after award of contract by Customer/Consultant & BHEL. However, the same will be adhered by the bidder without any commercial and delivery implication to Customer/Consultant & BHEL.



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1X800 MW TSGENCO KOTHAGUDEM TPS
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ANNEXURE III

DRAWING DOCUMENTS SUBMISSION PROCEDURE

- Bidder shall submit soft copy/hard copy/CD ROMs of all the finally approved drawings and O&M Manuals as required by Customer/Customer consultant/BHEL-site/BHEL-PEM. The exact number of hard copies/CD ROMs of these documents to be submitted shall be notified to the bidder at the time of detailed engineering and bidder shall submit the same without any commercial/delivery implications to BHEL/Customer.
- All the drawing documents along with the O&M manual (of all the revisions) are necessarily to be submitted in soft copies in addition to hard copies.
- Bidder to submit soft copies of all the drawing and document along with quality plans for BHEL review and approval.
- Editable copy of all the drawings and documents shall be provided.
- The date of submission of drawing documents shall be considered as the date of submission of hard and soft copies whichever is later.
- All the drawings shall be prepared on computer auto cad and other documents (like datasheet etc.) on MS office software. Bidder not complying to the requirement shall not be considered. For the execution of the contract regular meeting (generally once in 15 days or as per project requirement) is required.
- Vendor to come for meeting with the concerned dealing persons as per BHEL or customer requirement in a short notice.
- Bidder to submit instrument schedule, cable schedule and valve schedule in MS- Excel format during detailed engineering.
- Bidder to also furnish the auto cad copy/MS-Excel/MS-word (as applicable) of the following documents after award of contract. However any other auto cad copy/MS-Excel/MS-word of any other document as per the insistence of BHEL and customer will also be submitted by the bidder without any delivery and commercial implication to BHEL and customer.
 - P&IDs.
 - Equipment lay out of the service vessel area and regeneration area.
 - Equipment Cable tray layout for service vessel area and regeneration area
 - Equipment earthing layout service vessel area and regeneration area
 - Civil scope drawings.
 - Piping lay out drawing for Service vessel area, regenerative area and yard piping layout.
 - Valve schedule
 - Instrument schedule
 - Cable Schedule

ii) Other requirements

- 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.
- 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.
- 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. However, in case changes are necessitated due to any constraints at customer end, delay in review/ approval of such revised drawing beyond one month will be to customer's account.



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DISTRIBUTION SCHEDULE

S. No	Description	TSGENCO										M/S DCPL, KOLKATA			Equipment Vendor	Remarks	
		Director Projects	Director Technical	CE/Civil Thermal Projects Hyd.	CE/ TPC-I, Hyd	CE/ O&M/ KTPS	SE/ Civil KTPS	SE/E&M / KTPS	DE Constr. KTPS	Kolkata	HYD	KTPS	Kolkata	HYD			KTPS
A	Letter Of Intent or Contract Documents	1	1	1	S	1	2	2	1	1	1	1	1	1	1	2	
B	Vendor Drawings																
1.	Preliminary	1	1	1	2	1	1	2	2	12	1	1	-	-	S		
2.	Return preliminary with comments	-	-	1	2	1	1	1	1	S	1	1	-	-	1		
3.	Final and any revision thereof																
	a. Civil	1	1	6+1T	1	1	6+1T	1	1	2+1T	1	1	1	1	S		
	b. E&M	1	1	1	6+1T	1	1	6+1T	1	2+1T	1	1	1	1	S		
C.	Design Drawings																
1.	Preliminary																
	a. Civil	1	1	2	1	1	2	1	1	4	1	1	1	1	S		
	b. E&M	1	1	1	2	1	1	2	1	4	1	1	1	1	S		
2.	Released for construction																
	a. Civil	1	1	2	1	1	6	1	1	1	1	1	2	2	S		
	b. E&M	1	1	1	1	2	1	6	1	1	1	1	2	2	S		
3.	Return marked 'As built'																
	a. Civil	-	-	1	-	-	1	-	-	1	1	1	S	1	1		
	b. E&M	-	-	-	1	-	-	1	-	1	1	1	S	1	1		
4.	As built drawings																
	a. Civil	-	-	1+1T	-	2+1T	5+1T	-	1	1+1T	-	1	1	1	S		
	b. E&M	-	-	1	2+1T	2+1T	-	5+1T	1+1T	1+1T	-	1	1	1	S		



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S. No	Description	TSGENCO										M/S DCPL, KOLKATA			Equipment Vendor	Remarks	
		Director Projects	Director Technical	CE/Civil Thermal Projects Hyd.	CE/TPC-I, Hyd	CE/O&M/ KTPS	SE/Civil KTPS	SE/E&M / KTPS	DE Constr. KTPS	Kolkata	HYD	KTPS					
D	Progress Report Monthly																
1.	Equipment vendor	1	1	1	2	1	1	2	1	1	1	1	1	1	1	1	S
2.	M/s DCPL, Kolkata	1	1	2	2	1	1	2	1	1	1	1	1	1	1	1	Nil
E	Test & Inspection Reports																
1.	Equipment manufacturer																
a.	Civil	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	S
b.	E&M	1	1	-	2	1	1	-	1	1	1	1	1	1	1	1	S
2.	M/s DCPL, Kolkata	1	1	-	2	1	1	-	1	1	1	1	1	1	1	1	-
F	Instruction Manuals/Data Books																
1.	Equipment manufacturer																
a.	Civil	1	1	1+1T	1	1	1	6+1T	1	1	1	1	1	1	1	1	S
b.	E&M	1	1	-	3+1T	1	1	-	6+1T	2	1	1	1	1	1	1	S
2.	M/s DCPL, Kolkata	1	1	-	10+1T	1	1	-	15+1T	-	1	1	1	1	1	1	Nil
G	M/s DCPL, Kolkata Criteria	1	1	1	8+1T	1	1	1	2	1	1	1	1	1	1	1	S
H	Design Calculations	1	1	1	8+1T	1	1	1	2	1	1	1	1	1	1	1	S
I	Final consulting Engineering Report	1	1	1	10	1	1	1	2	1	1	1	1	1	1	1	Nil

S – Source, T – Transparency & Soft Copy on CD,

TSGENCO : Telangana State Power Generation Corporation Limited

Director, Projects, Hyd : Director/ Projects, TSGENCO, Vidyut Soudha, Hyderabad – 500 082

NOTES:

- The above schedule of submission does not include Docs/Drgs. of quality assurance/inspection and delivery/dispatches.
- All documents & drawings shall be in English and in metric units.



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REV NO: 00

DATE:

ANNEXURE-IV

PAINTING SPECIFICATION

ANNEXURE-IV

**TECHNICAL SPECIFICATION
FOR
PROTECTIVE LINING AND PAINTING**

TECHNICAL SPECIFICATION
FOR
PROTECTIVE LINING AND PAINTING

C O N T E N T S

<u>CLAUSE NO</u>	<u>DESCRIPTION</u>	<u>PAGE NO.</u>
1.00.00	INTENT OF SPECIFICATION	1
2.00.00	CODES & STANDARDS	1
3.00.00	GENERAL REQUIREMENTS	2
4.00.00	EQUIPMENT, MATERIAL AND SERVICES TO BE FURNISHED BY THE BIDDER	4
5.00.00	COATING PROCEDURE AND APPLICATION	7
6.00.00	TEST REQUIREMENTS	8
7.00.00	INFORMATION / DATA REQUIRED	12

TECHNICAL SPECIFICATION**FOR****PROTECTIVE LINING AND PAINTING****1.00.00 INTENT OF SPECIFICATION**

1.01.00 This specification addresses the requirements of all labour, material, and appliances necessary with reference to preparations for lining / painting, application as well as finishing of all lining / painting for all mechanical and electrical equipment, piping and valves, structures etc. included under the scope of this Package.

1.02.00 The Bidder shall furnish and apply all lining, primers including wash primers if required, under-coats, finish coats and colour bands as described hereinafter or necessary to complete the work in all respects.

2.00.00 CODES & STANDARDS

2.01.00 The Bidder shall follow relevant Indian and International Standards wherever applicable in cleaning of surface, selection of lining material / paints and their application. The entire work shall conform to the following standards / specifications (latest revision or as specified).

- a) SSPC SP 10 / NACE 2 / : Near White Blast Cleaning
- b) SSPC PA 2 : Measurement of dry film Coating Thickness with magnetic gauges.
- c) ASTM D 4541 : Method for pull off strength using portable Adhesion Tester.
- d) NACE RP 0274 – 2004 : High-Voltage Electrical Inspection of Pipeline Coatings
- e) NACE SP 0188 – 2006 : Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates

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1x800 MW Kothagudem TPS**

**EPC Bid Document
e-PCT/TS/K/02/2014-15**

- f) NACE RP 0169 – 2002 : Control of External Corrosion on Underground or Submerged Metallic Piping Systems
- g) AWWA C 210 – 2007 : Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
- h) IS 3589:2001 Annexure B : Steel Pipes for Water and Sewage Specification.
- i) AWWA C222-2000 : Polyurethane Coating for the Interior and Exterior of Steel Water Pipe and Fittings.
- j) IS 13213 : 2000 : Polyurethane Full Gloss Enamel (Two pack)

3.00.00 GENERAL REQUIREMENTS

- 3.01.00** The steel surface preparation prior to actual commencement of coating shall conform to SSPC SP 10 / NACE 2 / Sa2½ (near white metal) with sand blasting.
- 3.02.00** The contractor shall submit a detailed written description in the form of a manual covering coating equipment, procedures, materials inspection test, and repair etc. to Owner/Consultant for approval.
- 3.03.00** The contractor shall also provide copies of test reports from NABL approved laboratory (like National Test House, Kolkata) in support of the paint/primer materials to be used shall conform to the specification requirement.
- 3.04.00** The contractor shall also provide certificates from paint/primer manufacturer mentioning the batch numbers, date of manufacture and shelf life etc. of the materials to be used. In addition to that Manufacturing Quality Plan (MQP) and Field Quality Plan (FQP) shall also be submitted prior to commencement of supply of material and field application.
- 3.05.00** Paint/coating application work at site shall be done either by paint manufacturer or by their authorized applicator. The authorized applicator shall have proper training & certification from manufacturer. Applicator shall possess all the necessary specialized equipment and manpower experienced in similar job.

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EPC Bid Document
e-PCT/TS/K/02/2014-15

- 3.06.00 Applied coating shall be tested for dry film thickness, holiday (electrical inspection for continuity) and adhesion as per relevant standard such as SSPC PA 2, NACE RP 0274 and ASTM D 4541.
- 3.07.00 If necessary, the material may be heated and applied by airless spray / plural component spray system.
- 3.08.00 Manufacturer's specific recommendation, if any, shall be followed during application of lining / paints.
- 3.09.00 In areas where there is danger of spotting automobiles or other finally finished equipment or building by wind borne particles from paint spraying, a Purchaser approved method shall be adopted.
- 3.10.00 The colour scheme of the entire Plant, covered under this specification shall be approved by the Purchaser in advance before application.
- 3.11.00 All indoor and outdoor piping, insulated as well as uninsulated will have approved colour bands painted on the pipes at conspicuous places throughout the system, as approved by Purchaser.
- 3.12.00 Inside surfaces of vessels / tanks shall be protected by anticorrosive paints or rubber lining as required / specified elsewhere in the specification. External surfaces of all vessels / tanks shall be protected by anti corrosive painting.
- 3.13.00 For vessels / tanks requiring lining and epoxy painting all inside surface shall be blast cleaned using non-siliceous abrasive after usual wire brushing.
- 3.14.00 Natural rubber lining shall be provided on the inside of vessels / tanks as required / specified elsewhere in the specification, in three layers resulting in a total thickness not less than 4.5 mm.
- 3.15.00 Surface hardness of rubber lining shall be 65 +/- 5 deg. A (shore).
- 3.16.00 After the lining is completed, the vessels / tanks shall not be subjected to any prolonged exposure to direct sunlight in course of its transportation, erection etc. They shall not be stored in direct sunlight. No further lining or burning shall be carried out on the vessel, after application of the lining.

3.17.00 All lining projecting outside of the vessel shall be protected adequately from mechanical damages during shipment, handling storage etc.

3.18.00 Suitable warnings, indicating the special care that must be taken with respect to these lined vessels shall be stenciled on their outside surface with the letters at least 12 mm high.

3.19.00 All insulated piping shall have aluminium sheet jacketing.

4.00.00 EQUIPMENT, MATERIAL AND SERVICES TO BE FURNISHED BY THE BIDDER

4.01.00 After erection at site, the outside surfaces of all equipment having a shop coat shall be given further priming coat and finished coats of paint as detailed in following clauses. However, if the painting system is such that the shop coat and primer coat to be applied at site are not compatible, then shop coat has to be removed from the surface of equipment before application of primer coat with prior blasting.

All factory finished paints shall be touched up at site as required.

All uninsulated piping shall be finished with final paintings after use of proper wash primer and primer. Aluminium sheet jacketed piping need not be painted. Colour bands of Purchaser's approved shade shall however be applied on jacketed piping near walls or partitions, at all junctions, near valves and all other places as instructed by the Purchaser. All structures shall be painted with approved paint.

4.02.00 Surface Preparation

4.02.01 Unless mentioned otherwise, all rust and mill scale shall be removed by blasting to Sa 2-1/2 Swiss Standard before applying the primer.

4.02.02 Special care shall be taken to remove grease and oil by means of suitable solvents like Trichloroethylene or Carbon Tetrachloride.

4.02.03 The minimum degree of surface preparations for all equipment, piping, fittings, valves, structures etc. shall be "Near White" according to Steel Structure, Painting Council-SSPC-SP-10 before application of any primer/paint.

4.03.00 Painting

- 4.03.01 Specification for application of paints for external surfaces protection of vessels / tanks / equipment / piping / fittings / valves etc. to be installed indoor shall be as follows :
- a) Surface preparation shall be done either manually or by any other approved method.
 - b) Primer Coat shall consist of one coat (minimum DFT of 50 microns) of chlorinated rubber based zinc phosphate.
 - c) Intermediate Coat (or Under Coat) shall consist of one coat (minimum DFT of 50 microns) of chlorinated rubber based paint pigmented with Titanium Dioxide.
 - d) Top Coat shall consist of one coat (minimum DFT of 50 microns) of chlorinated rubber paint of approved shade and colour with glossy finish.
 - e) Total DFT of paint system shall not be less than 150 microns.
- 4.03.02 Specification for application of paints for external surfaces protection of vessels / tanks / equipment / piping / fittings / valves etc to be installed **outdoor** shall be as follows :
- a) Surface preparation shall be done by means of sand blasting, which shall conform to Sa 2-1/2 Swiss Standard.
 - b) Primer Coat shall consist of one coat (minimum DFT of 100 microns) of epoxy resin based zinc phosphate primer.
 - c) Intermediate Coat (or Under Coat) shall consist of one coat (minimum DFT of 100 microns) epoxy resin based paint pigmented with Titanium Dioxide.
 - d) Top Coat shall consist of one coat (minimum DFT of 75 microns) of epoxy paint of approved shade and colour with glossy finish. Additional one coat (minimum DFT of 25 microns) of Finish Coat of polyurethane shall be provided.
 - e) Total DFT of paint system shall not be less than 300 microns.
- 4.03.03 Specification for application of paints for external surfaces protection of steel pipes and fittings which are **buried underground / laid inside a hume pipe & or submerged Under Water and laid under Pipe Trenches** (in road/rail/pipe or trench crossings) shall be as follows :

External surface of the pipe, fittings, specialties etc. handling raw water/clarified water/filter water shall be painted with one coat of two part chemically cured polyurethane primer of min 50 micron dry film thickness followed by three or maximum four coats of two part solvent less polyurethane to build up coating of dry film thickness of 2000 micron including primer coat.

- 4.03.04 Specification for application of paints for **internal surface protection of large diameter pipes** (sizes above 600 mm NB and above) if any, shall be as follows :
- a) All Internal surfaces of steel pipes, fittings, specialties etc. buried underground or located within pipe trenches shall be given epoxy coating to protect them from (except for drinking water service, where the compatible painting shall be so selected to meet relevant quality standards) corrosion.
 - b) Internal surface of the pipe should be coated with one coat of two part epoxy primer with not less than 50 micron DFT (dry film thickness) followed by two part polyamide cured solvent less epoxy.
 - c) The minimum dry film thickness (DFT) of internal lining shall be 600 micron.
- 4.03.05 Specification for application of paints for protection of **internal surfaces of DM Water Storage Tank(s)** shall be as follows :
- a) Primer - One coat of epoxy primer containing high level of Zinc Phosphate anticorrosive pigment. Total Dry Film Thickness (DFT) of primer shall not be less than 125 microns.
 - b) Finish Paint - Three (3) coats Polyamine HB Epoxy Paint. Total Dry Film Thickness (DFT) of finish paint shall not be less than 125 microns per coat.
 - c) Total thickness of primer and paint should not be less than 500 microns.
- 4.03.06 All motors, local push button stations, cable racks, structures used for supports etc. are to be painted with acid proof paint.
- 4.03.07 The following surfaces shall not be painted - stainless steel, galvanized steel, aluminum, copper, brass, bronze and other nonferrous materials.
- 4.03.08 No painting or filler shall be applied until all repairs, hydrostatic tests and final shop inspection are completed.

4.03.09 All machined surfaces shall have two (2) coats of water repellent grease after thorough cleaning.

5.00.00 COATING PROCEDURE AND APPLICATION

5.01.00 Surface Preparation :

Pipe shall be blast cleaned by sand. The cleanliness achieved prior to application shall be in accordance with the requirement of SSPC SP 10 / NACE 2 / Sa2½ of ISO 8501 (near white metal)

- a) The blast pattern or profile depth shall be 40 to 100 micron and shall be measured by dial micrometer.
- b) Before sand blasting is started or during blasting or coating, temperature of the pipe surface should be more than 3°C above dew point temperature. Blast cleaned surface should be primed within 4 hours and shall be protected from rainfall or surface moisture and shall not be allowed to flash rust. If the rust occurs, the surface again to be prepared by sand blasting or wire brushing.

5.02.00 Application of Epoxy Coating

- a) Coating shall be applied when
 - i) When the pipe surface temperature shall be atleast 3°C above dew point temperature.
 - ii) The temperature of mixed coating material and the pipe at the time of application shall not be lower than 10°C or greater that 50°C.
- b) Material preparation shall be in accordance with manufacturer's recommendations.
- c) Application of epoxy coating system :

The epoxy coating system shall be applied as per recommendation of the manufacturer and shall be applied by airless spray / plural component spray machine. For more than one coat, the second shall be applied with the time limits as recommended by the manufacturer.

5.03.00 Application of PU Coating

- a) PU coating shall be applied when the pipe surface temperature atleast 3°C above dew point temperature (when R.H is more than 85%).
- b) Material preparation and application shall be done as per manufacturer recommendation.

6.00.00 TEST REQUIREMENTS :

6.01.00 Measurement of dry film thickness

Measurement of dry film thickness of coating : Coating thickness shall be in the range of $\pm 20\%$ and as per SSPC PA 2.

6.01.01 Apparatus / Instrument:-

The instrument used for dry film thickness may be Type 1 pull of gauges or Type 2 electronic gauges.

6.01.02 Procedures:-

- a) Number of measurements:
For 100 square feet (9.29 square meters), five (5) spots per test area (each spot is 3.8 cm) in diameter. Three gauge readings per spot (average becomes the spot measurement).
- b) If the structure is less than 300 square feet, each 100 square feet should be measured.
- c) If the structure is between 300 and 1000 sq ft, select 3 random 100 square feet test areas and measure.
- d) For structure exceeding 1000 square feet, select 3 random 100 square feet testing areas for the first 1000 sq ft and select 1 random 100 square feet testing area for each additional 1000 square feet
- e) Coating thickness Tolerance: Individual reading taken to get a representative measurement for the spot are unrestricted (usually low or high readings are discarded). Spot measurements (the average of 3 gauge readings) must be within 80% of the minimum thickness and 120% of the maximum thickness. Area measurement must be within specified range.

6.02.00 Electrical Inspection (Holiday) Test

- 6.02.01 All the coated / lined pipes shall be tested with an approved high voltage holiday detector preferably equipped with an audio visual signaling device to indicate any faults, holes, breaks or conductive particles in the protective coating.
- 6.02.02 The applied output voltage of holiday detector shall have a spark discharge of thickness equal to at least twice the thickness of the coating to assure adequate inspection voltage and compensate for any variation in coating thickness. The electrode shall be passed over the coated surface at approximately half the spark discharge distance from the coated surface only one time at the rate of approximately 10 to 20m/min. The edge effect shall be ignored. Excessive voltage shall be avoided as it tends to induce holiday in the coated surface thereby giving erroneous readings.
- 6.02.03 While selecting test voltages, consideration should be given to the tolerance on coating thickness and voltage should be selected on the basis of maximum coating thickness likely to be encountered during testing of a particular pipe.
 The testing voltage shall be calculated by using following formula. (as per NACE 0274 : 2004)
- Testing Voltage $V = 7900 \sqrt{T} \pm 10$ percent where T is the average coating thickness in mm.
- 6.02.04 Any audio visual sound or spark leads to indicate pinhole, break or conductive particle.
- 6.03.00 Adhesion Pull off Test :**
- After holiday the coated surface is subjected to adhesion pull off test as per ASTM D 4541.
- 6.03.01 Apparatus / Instrument: Adhesion tester consists of three basic components:
 A hand wheel, a black column containing a dragging indicator pin and scale in the middle and a base containing three legs and a pulling "Jaw" at the bottom and also dollies.
- 6.03.02 Prepare the test surface :
- Once test area is selected, test area shall be free of grease, oil, dirt, water. The area should be flat surfaces and large enough to accommodate the specified number of replicate test.
- 6.03.03 Prepare Dolly (Test Pull Stub) :

The dolly is a round, two sided aluminium fixture. Both sides of the dolly looks same, however, one side sloped on top surface while flat on bottom surface. As the surface of the dolly is polished aluminium, roughen the same using a coarse sand paper.

6.03.04 Select an adhesive:

Use araldite, a 100% solid epoxy adhesive. This adhesive requires at least 24 hours at room temperature to cure.

6.03.05 Attach the dolly to the surface.

- a) Using a wooden stick, apply an even layer of adhesive to the entire contact surface area of the dolly.
- b) Carefully remove the excessive adhesive by using a cotton swab. Allow the adhesive to fully cure before performing the adhesion test.
- c) Attach the dolly to the coated surface and gently push downward to displace any excessive adhesive.
- d) Push the dolly inward against the surface, then apply tape across the head of the dolly.

6.03.06 Adhesion Test Procedure

- a) Attach the adhesion tester to the dolly by rotating the hand wheel counter clockwise to lower the jaw of the device.
- b) Slide the jaw completely under the head of the dolly. Position the three legs of the instruments so that they are sitting flat on the coated surface.
- c) Slide the dragging indicator pin on the black column to zero by pushing it downward.
- d) Firmly hold the base of the instrument in one hand and rotate the handwheel clockwise to raise the jaw of the device that is attached to the head of the dolly. The dragging indicator pin will move upward on the black column as the force is increased and will hold the reading. Apply the tension using a moderate speed. Continue to increase the tension on the head of the dolly until (a) the minimum PSI/MPa/Kg/cm² required by project specification is exceeded and the test is discontinued, (b) the maximum PSI/MPa/Kg/cm² of adhesion tester has been achieved and dolly is still attached, (c) The force applied by the adhesion tester causes the dolly to dislodge.

e) Read the scale and record the adhesion value.

6.04.00 Coating Repair

Defective Coating shall be repaired in accordance with the following subsections.

6.04.01 Surface Preparation:

Accessible areas of pipe requiring coating repairs shall be cleaned to remove debris and damaged coating using surface grinders or other means. The adjacent coating shall be feathered by sanding, grinding or other method. Accumulated debris shall be removed by blowing with contaminant free air or wiping with clean rags.

6.04.02 Areas not accessible for coating repair such as interior surfaces of small diameter pipe shall be reprocessed and recoated.

6.04.03 Coating Application :

The coating system shall be applied to the prepared areas in accordance with procedure.

6.04.04 Repair Inspection :

Repaired portion shall be electrically inspected using a holiday detector.

6.05.00 Welded Field Joints

6.05.01 Preparation :

The weld joints shall be cleaned so as to be free from mud, oil, grease, welding flux, weld spatter and other foreign contaminants. The cleaned metal surfaces of the weld joint shall then be blasted or abraded using rotary abrading pads. The adjacent liquid Epoxy / PU coating shall be feathered by abrading the coating surface for a distance of 25 mm.

6.05.02 Electrical Inspection :

After curing the coating system applied to the welding joints shall be holiday tested. Any holidays indicated by the detector shall be marked with chalk to identify the area of repair.

7.00.00 INFORMATION/DATA REQUIRED

The Bidder shall submit complete list of paints and primers proposed, giving detail information, such as, chemical composition, drying time etc. and also unit rates for application of each type of paint along with supply shall be furnished.

NOTE-

Bidder to note that the paint shade shall be informed/finalized during detailed engineering. The same shall be complied by bidder without any price & delivery implication to BHEL & Customer.



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ANNEXURE-V

LIST OF MANDATORY SPARES



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S.No.	Equipment/Package Name	Quantity
1	Spares for Horizontal Centrifugal Pumps	
1.1	Shaft	1 No.
1.2	Shaft Sleeve	2 Nos.
1.3	Impeller	1 No.
1.4	Impeller locking nut and bolt	4 Nos.
1.5	Impeller wear ring	4 Nos.
1.6	Casing wear ring	4 Nos.
1.7	Oil Seal	4 Nos.
1.8	Oil Deflector	3 Nos.
1.9	Oil Ring	3 Nos.
1.1	Gland Packing	4 Nos.
1.11	Lantern Ring	3 Nos.
1.12	Mech Seal Assembly	1 No.
1.13	Stationary/Carbon Packing and O "Ring for Mechanical Seal"	3 Sets
1.14	Oil Level Gauge	3 Nos.
1.15	Coupling	2 Nos.
1.16	Rubber Bush for Coupling	2 Nos.
1.17	O Rings " "	2 Sets
1.18	Suction Strainers Element	3 Nos.
1.19	Bearing for Pump Motor	2 Sets
2	Spares for Vertical Type Centrifugal Pumps (at Neutralising Pit)	
2.1	Complete Bowl assembly	1 Set
2.2	Impeller (s)	1 Set
2.3	Shafts	1 Set
2.4	Casing wearing (s)	1 Set
2.5	Impeller wear ring (s)	1 Set
2.6	Shaft Sleeves	2 Sets
2.7	Shaft Couplings	1 Set
2.8	Shaft nuts & keys	1 Set
2.9	Lantern rings	1 Set
2.1	Bell mouth liner	1 Set
2.11	Bearings	1 Set
2.12	Pump motor coupling	1 Set
3	Spares for Agitators	
3.1	Gear Box Unit Complete	1 No.
3.2	Bearing for Gear Box Unit	1 Set
3.3	Coupling complete (Motor/Gear box and gear box/agitator)	1 Set
3.4	Coupling Bolts	1 Set
3.5	Coupling shim pack (if applicable)	4 Sets
3.6	Oil seals	4 Sets
4	Spares for Valves	
4.1	i) Diaphragm valves	10% of total quantity used for each type and size with minimum no. two (2) for each type, size and rating.



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	ii) Spare Diaphragm for above	10% of total quantity used for each type and size with minimum no. two (2) for each type and size.
4.2	i) Non return valves (NRV)	2 nos. of each size & type
4.3	Gate/Globe/Ball valves/plug valve/needle valve	
	i) Up to 4"	10% of total quantity used for each type and size with minimum no. two (2) for each type and size.
	ii) Above 4"	1 no. each type and size.
4.4	Butter fly valve	
	i) Up to 4"	10% of total quantity used for each type and size with minimum no. two (2) for each type and size.
	ii) Above 4"	1 no. each type and size
5	Spares for Filter Media/ ION Exchange Resins	
5.1	Media for Activated Carbon Filters	10% of total quantity
5.2	Resins for each type of exchangers	10% of total quantity
5.3	Ejectors	Two (2)nos. of each type including chlorination application.
6	Spares for Air Blowers	
6.1	Impeller with shaft	1 Set
6.2	Bearings	1 Set
6.3	Oil seals	5 Sets
6.4	Filter	1 Set
7	Pneumatic Control Valve	
7.1	Pneumatic Diaphragm for Diaphragm actuated valve	2 Nos. for each type of Actuator
7.2	Gland Packing	1 set for each type of Control Valve
7.3	Plug, Seat, Cage, Stem etc.	1 set for each type of Control Valve
7.4	Retainer Ring, Seal Ring etc.	1 set for each type of Control Valve
7.5	Gasket	2 Sets. for each type of Control Valve
7.6	Position Transmitter complete set	10% of total quantity used in the system for each type and model.
7.7	Control Valve E/P Positioner complete Set	10% of total quantity used in the system for each type and model.
7.8	Complete Set of Solenoid Valve for Pneumatic type On/Off Valve	2 Nos. for each type & ratings
7.9	Solenoid Coil for Pneumatic type On/Off Valve	5 Nos. for each type & ratings
7.1	Position Limit Switch for Pneumatic type On/Off Valve	10 Nos. for each type & ratings
8	C&I Items	
8.1	Transmitters/ Gauges/Switches etc. along with relevant accessories	10% of total or at least two (whichever is higher) for Each type along with accessories.
8.2	Temperature Element (RTD/Thermocouple) with thermo well	10% of each type, range and immersion length. Minimum 5 nos.
8.3	Furnace Temperature Probe	Thermocouple 1 no.
9	Electrical Items	
10	Motor	
10.1	HT Motor (other than BFP Motor)	
10.1.1	Driving End Bearing	1No. (or 1Set as applicable) for each type and rating of Motor
10.1.2	Non-Driving End Bearing	1No. (or 1Set as applicable) for each type and rating of Motor



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10.1.3	Cooling Fan Internal & External	1Set for each type and rating of Motor
10.1.4	Bearing Temperature Gauge Driving & Non-Driving End	1Set for each type and rating of Motor
10.1.5	Phase-Segregated Terminal Box	1Set for each type and rating of Motor
10.1.6	Neutral End Terminal Bushing with Fasteners	1No. for each type and rating of Motor
10.1.7	RTD for Bearing Temperature	1No. for each type and rating of Motor
10.1.8	Motor Space Heater	1No. for each type and rating of Motor
10.1.9	Complete Set of Coupling	1Set for each Application
10.2	415 Volt Motor (above 30KW Rating upto 200KW)	
10.2.1	End Shield Cover Driving & Non-Driving End	1Set for each type and rating of Motor
10.2.2	Driving End & Non-Driving End Bearing	1Set for each type and rating of Motor
10.2.3	Cooling Fan	1No. for each type and rating of Motor
10.2.4	Motor Space Heater	1No. for each type and rating of Motor
10.2.5	Motor Terminal Block	1No. for each type and rating of Motor
10.2.6	Complete Set of Coupling	1Set for each Application
10.3	415 Volt Motor (Upto 30KW Rating)	
10.3.1	Driving End & Non-Driving End Bearing	3Set for each type and rating of Motor
10.3.2	Cooling Fan	2No. for each type and rating of Motor
10.3.3	Motor Terminal Block	5No. for each type and rating of Motor
10.3.4	Complete Set of Coupling	1Set for each Application
10.4	D C Motors	
10.4.1	Carbon brushes	10 sets each type
10.4.2	Brush assemblies	2 sets each type
10.4.3	Terminal blocks	2 sets each type
10.4.4	Heaters	2 sets each type
10.4.5	Pulleys	2 sets each type
10.4.6	Bearings (DE and NDE) for each type and rating of motor	4 sets



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ANNEXURE-VI

PERFORMANCE GUARANTEES



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1.01.0 PERFORMANCE GUARANTEES, PERFORMANCE/ACCEPTANCE TESTS & LIQUIDATED DAMAGES FOR SHORTFALL IN PERFORMANCE

1.02.0 The Bidder shall guarantee that the equipment offered shall meet the ratings and performance requirements stipulated for various equipment covered in this specification. The guarantees are categorised as:

- a. Those which attract liquidated damages, as listed below (Category-"A"). The Bidder shall furnish signed declarations in the manner prescribed in the bid proposal schedules for these guarantees.
- b. Those which do not attract liquidated damages, as listed below (Category-"B"). This guarantee list indicated in this section is not exhaustive and the Owner reserves the right to call upon the Bidder to demonstrate any parameter, operation, etc. of any equipment as specified and as required to meet the duty conditions.

1.03.0 The guaranteed parameters shall be without any tolerance values. The Bidder shall demonstrate all the guarantees covered in various volumes and sections of this specification during Performance/Acceptance test. In case during tests it is found that the equipment/system has failed to meet the guarantees, the Contractor shall carry out all necessary modification to make the equipment/system comply with guaranteed requirements. However, if the Contractor is not able to demonstrate the guarantees, even after the modifications, the Owner will at his discretion :

- i. Reject the equipment and recover the payment already made or accept the equipment only after levying liquidated damages as identified in this section for those guarantees which are covered under **Category "A"**.

OR

- ii. Reject the equipment and recover the payment already made or accept the equipment only after assessing and deducting from the contract price an amount equivalent to the deficiency of the equipment/system as assessed by the Owner, for those guarantees which are covered under **Category "B"**.

1.04.0 All guaranteed parameters shall necessarily be quoted by the Bidder based on the established proven results obtained from similar units in successful operation. Evidence for this shall necessarily include the test codes used, acceptance test results, accuracies of various instruments used for the performance test, details of tolerances, if allowed, etc. While quoting the guaranteed parameters, the Bidder shall keep in view the requirements specified in the specification especially regarding the reliability, operability and maintainability of the equipment proposed. The Owner reserves the right to evaluate the parameters quoted by the Bidder based on his experience and published material available.

1.05.0 The liquidated damages shall be calculated prorata for the fractional parts of the unit unless stated otherwise.

1.06.0 The turbine generator, boiler, auxiliaries, and all other plant equipment and system shall perform continuously without the noise level (individual or collectively) exceeding the values specified in respective equipment specification over the entire range of output and operating frequencies.

1.07.0 Performance/Acceptance Tests

1.07.01 The performance/acceptance tests for various equipment and systems shall be carried out as specified under the respective equipment specifications and those specified below shall be specifically applicable. All the guarantees shall be tested together as far as practicable.

1.07.02 In case of systems with stand-by equipment the liquidated damages for non-performance will be levied for normal operating number of equipment only. However, for this purpose all the equipment including standby equipment shall be tested and average values arrived at.

1.07.03 For instrument inaccuracies during PG Test, refer subsequent clauses of this section.

1.07.04 For Total Auxiliary Power Consumption, the transformers listed under the respective clauses, shall be taken together for purposes of guarantee and not individually.



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2.01.00 SCHEDULE OF GUARANTEES WHICH ATTRACT LIQUIDATED DAMAGES [CATEGORY-A]

NOT APPLICABLE

2.02.00 SCHEDULE OF GUARANTEES WHICH DO NOT ATTRACT LIQUIDATED DAMAGES FOR VARIOUS EQUIPMENT WHICH INCLUDE BUT ARE NOT LIMITED TO THE FOLLOWING [CATEGORY-B]:

2.02.00 CONDENSATE POLISHING UNIT (CATEGORY-B)

2.02.01 The design flow (through working vessels) for each condensate polishing plant shall be the corresponding condensate flow of TG unit at VWO (Valve wide open) condition at 1% cycle make-up.

2.02.02 During Normal Operation, the following dissolved solids concentration and conditions shall be used as a basis of design for the condensate polishing system. The ionic concentrations indicated below are as such.

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

Note : 1. Silica value shall be 7 ppb in case the temperature of the condensate is 50 deg C & above.

* Bidder to derive Total dissolved solids at influent from the influent contaminants stated above.

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

2.02.03 During start up conditions, quality of the influent may deteriorate to –

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

Note : 1. Silica value shall be 7 ppb in case the temperature of the condensate is 50 deg C & above.

* Bidder to derive Total dissolved solids at influent from the influent contaminants stated above.

Useful service run under this condition shall be 48 hours before regeneration.



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- 2.02.04 Under condenser tube-leakage condition, the plant shall be designed for 2000 ppb TDS in addition to the normal influent contaminants stated in as specified at clause no 2.02.02 of this Sub-section above. The cation and anion load in 2000 ppb TDS shall be based on the circulating water analysis furnished as section B of the specification. Under such condition, both sodium content and silica content of the effluent shall be limited to less than 20 ppb. Useful service run between regeneration under the Startup conditions and under condenser tube leakage condition shall not be less than 48 hours each.
- 2.02.05 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.
- 2.02.06 The bed cross section shall be such that the velocity of condensate through it, shall not exceed 1.75 meters/min 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 the mixed resin bed in the condensate polisher service vessels shall not be less than 1100 mm.
- 2.02.07 At the design flow rate, the pressure drop across the polisher service vessels with clean resin bed shall not exceed 2.0 bar.. 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 will be restricted to 3.5 bar including the pressure drop across effluent resin traps.
- 2.02.08 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 40-48% lye or as flakes. For calculations regeneration temperature should be taken as 25 Deg. C.

In no case, the regeneration levels cannot be lower than the values indicated below:

- a) Cation resin : 125 kg of 100% HCl per cubic meter of resin
- b) Anion resin : 160 kg of 100% NaOH per cubic meter of resin.
- 2.02.09 Each rinse water outlet header of condensate polishing unit shall be provided with a pressure reducing station with isolating valves, suitably designed to enable the water entry to the both condenser's hot well which is operating under vacuum. Each pressure reducing station shall consist of either 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.
- 2.02.010 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:-
- | | | |
|----------------------------|---|-----|
| 1. Carbon Steel pipe | : | 100 |
| 2. CI pipe/ductile Iron | : | 100 |
| 3. Rubber lines steel pipe | : | 120 |
| 4. Stainless steel pipe | : | 100 |
- 2.02.011 Pump recirculation with a regulating valve shall be provided for all the pumping system.
- 2.02.012 Each Pump shall be guaranteed for capacity, total dynamic head and power consumption.
- 2.02.013 All blowers shall be guaranteed for head and power consumption.
- 2.02.014 Each Condensate Polisher Mixed Bed will have a rated continuous treated water output capacity of not less than design value. Each Condensate Polisher Mixed Bed Unit shall be regenerated once after every 240 hours of continuous service run during normal operation.
- 2.02.015 Net output from each of Condensate Polisher Mixed Beds shall be not less than design volume of treated water for the design water analysis as exhibited in cl. no. 2.02.02, 2.02.03 & 2.02.04. In case water analysis is different from the design values, guaranteed quantity shall be calculated as indicated elsewhere in this Specification and guarantee shall be applicable on this calculated quantity.



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2.02.016 Chemical consumption of the Condensate Polisher Mixed Bed as indicated by the Bidder shall be guaranteed against the regeneration level employed and resin volume provided without any tolerance.

2.02.017 Qualities of treated water from Condensate Polisher Mixed Bed shall be as per treated water analysis as exhibited in cl. no. 2.02.02, 2.02.03 & 2.02.04.

2.02.018 Liquidate Damages (LD) for Non Achievement of Specific Performance:

The performance Guarantee parameters for Condensate Polishing System have been indicated in above clauses.

No negative tolerance in respect flow, head and other performance guarantee parameters are acceptable to the Purchaser. In case, any equipment of Condensate Polishing System is not able to achieve the performance guarantee parameters during the Performance Guarantee Tests, Bidder shall make necessary modifications or replace the Equipment/ Plant or any part. If even after rectification, the Equipment/Plant is not able to achieve the guaranteed performance parameters, the Purchaser shall have right to reject the Equipment/Plant. In such case, the Bidder shall pay back the total amount paid to them with reference to the Equipment/Plant (with all taxes and duties as applicable) to the Purchaser.



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DATA SHEET-A



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1.0	DESCRIPTION OF TG UNIT FOR WHICH CONDENSATE POLISHING IS TO BE PROVIDED :	
(i)	No. of units	One (1)
(ii)	Capacity of unit	800 MW
(iii)	Total flow in all the service vessels of units	1648.061 t/hr (VWO, 1% Make Up 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	825 Tones per hour
(iv)	Operating pressure of each condensate polisher service vessel	37.0 kg/cm ² (a)
(v)	Design pressure of each condensate polisher service vessel	49.5 kg/cm ² (g)
(vi)	Design code of each condensate polisher service vessel	ASME sec VIII div 1 (Latest edition)
(vii)	Design Temp.	60 °C
(viii)	Type of vessels	Spherical
(ix)	Material of construction	
	Shell	Carbon steel plates to SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
	Head	Carbon steel plates to SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
(x)	Inside protection	Inside lined with Natural Rubber [4.5 mm thick in (3) layers]
2.1	RINSE RECIRCULATION PUMPS PER UNIT	
(i)	Number	Two (2x100%)
(ii)	Type	Horizontal, centrifugal
(iii)	Operation	Intermittent
(iv)	Capacity & head	As required
(v)	Suction condition	Flooded
(vi)	Material of construction	
	• casing, impeller	SS 316
	• Shaft	SS 410
	• shaft sleeve material	SS 410
(vii)	Packing seal	Mechanical type
(viii)	Pump Speed	Maximum 1500 rpm
(ix)	Accessories required for each	Common base plate, coupling guards, drain plug, vent valve, suction hoses, isolation valves, Y-type strainers etc.
(x)	Pressure dampener	One number per pump
2.2	AIR-BLOWERS FOR RESIN MIXING (SERVICE VESSELS AREA)	
(i)	Number per unit	Two (2x100%) with acoustic enclosure.
(ii)	Type	Rotary, Twin Lobe, oil free, positive displacement



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(iii)	Duty	Intermittent
(iv)	Capacity and head	As required
(v)	Pressure gauge	One per blower
(vi)	Capacity and head/Noise Level	As required/80 dB (A) Max. at one meter
(vii)	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
3.0	EXTERNAL REGENERATION FACILITIES	
3.1	REGENERATION VESSELS	
a.	RESIN SEPARATION AND CATION RESIN REGENERATION VESSEL	
(i)	Number	One (1) no. vessel
(ii)	Design Temperature	60°C
(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. (Min.8 kg/cm2(g).)
(iv)	Material of construction	
	Shell	Carbon steel plates to SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
	Head	Carbon steel plates to SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
(v)	Inside protection	Inside lined with Natural Rubber [4.5 mm thick in (3) layers]
(vi)	Design code	ASME sec VIII div 1 (Latest edition)
b.	ANION RESIN REGENERATION VESSEL	
(i)	Number	One (1) no. vessel.
(ii)	Design Temperature	60°C
(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. .(Min.8 kg/cm2(g).)
(iv)	Material of construction	
	Shell	Carbon steel plates to SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
	Head	Carbon steel plates to SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
(v)	Inside protection	Inside lined with Natural Rubber [4.5 mm thick in (3) layers]
(vi)	Design code	ASME sec VIII div 1 (Latest edition)
c.	MIXED RESIN STORAGE VESSEL	
(i)	Number	One (1) no. vessel.
(ii)	Design Temperature	60°C
(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. .(Min.8 kg/cm2(g))
(iv)	Material of construction	
	Shell	Carbon steel plates to SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
	Head	Carbon steel plates to SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
(v)	Inside protection	Inside lined with Natural Rubber [4.5 mm thick in (3) layers]



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(vi)	Design code	ASME sec VIII div 1 (Latest edition)	
3.2	BULK ACID AND ALKALI STORAGE TANKS		
(i)	CHEMICAL TANKS	ACID STORAGE TANKS	ALKALI STORAGE TANKS
(ii)	Number required	One(1)	One(1)
(iii)	Design code	As per BS : 12285 However minimum thickness of each acid and alkali storage tank will be 10 mm.	
(iv)	Location	-----Outdoor-----	
(v)	Useful capacity	Adequate to hold the quantity of acid required for 30 days of operation.	Adequate to hold the quantity of acid required for 30 days of operation.
(vi)	Type	--Horizontal cylindrical with dished ends, atmospheric, above ground-----	
(vii)	Material of construction	Shell-SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70. Dish end – SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.	
(viii)	Internal painting / lining	Inside lined with Natural rubber (4.5 mm thick in three layers)	
(ix)	Concentration	30 -33 % HCl	48 % NaOH
(x)	Accessories for each tank	Fume absorbers (for acid storage tank), carbon dioxide absorber (for alkali storage tank), manhole, vent, overflow, drain, sample connection, operating platform, ladders, lifting lugs (4 nos. minimum) etc.	
3.3	ACID AND ALKALI UNLOADING / TRANSFER PUMPS		
(i)	PUMPS	ACID UNLOADING/TRANSFER PUMPS	ALKALI UNLOADING PUMPS
(ii)	Number required	Two (2x100%)	Two (2x100%)
(iii)	Type	-----Horizontal Centrifugal-----	
(iv)	Location	-----Outdoor-----	
(v)	Capacity and head	-----10 cum / hr and 10 mlc-----	
(vi)	Liquid to be handled	30 -33 % HCL	48% NaOH
(vii)	Material of construction of wetted parts of pumps		
(viii)	Casing, Impeller	Polypropylene	Stainless Steel (SS) – 304
(ix)	Shaft	Hardened carbon steel EN8	Stainless Steel -410
(x)	Reinforced rubber hosed	Two nos of size 80 NB	Two nos of size 80 NB
(xi)	Accessories required for each pump	Coupling guard, drain plug, vent valve, suction hoses, isolation valves, y- type strainers etc.	
(xii)	Pressure Dampener	-----One per pump-----	
(xiii)	Type of shaft sealing	Mechanical Seal	
3.4	CHEMICAL HANDLING, PREPARATION & DOSING SYSTEM		
a)	ALKALI TRANSFER PUMPS		
(i)	Nos. required	Two (2x100%)	
(ii)	Type	Horizontal, centrifugal	
(iii)	Service	Intermittent	
(iv)	Concentration of working media.	5-48% Sodium Hydroxide (NaOH)	
(v)	Capacity & head	10 M3/hr, 10 MWC	
(vi)	Suction condition	Flooded	
(vii)	Pressure Dampener	One per pump	
(viii)	Type of shaft sealing	Mechanical Seal	
(ix)	Materials of construction		
1)	Casing, impeller	Stainless Steel – 304	



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2)	Shaft	Stainless Steel -410		
(ix)	Accessories required for each pump	Coupling guard, drain plug, vent valve, suction hoses, isolation valves, y- type strainers etc.		
b)	CHEMICAL TANKS	ALKALI PRARATION TANK	ALKALI MEASURING TANK	ACID MEASURING TANK
(i)	Number required	One (1)		
(ii)	Type	-----Vertical Cylindrical Atmospheric, with dished ends -----		
(iii)	Useful capacity	Adequate to hold the quantity of acid & alkali required for single regeneration of a condensate polisher mixed bed + 20% margin		
(iv)	Type of fluid to be handled	40-48% Sodium Hydroxide	30-33% Hydrochloric Acid.	
(v)	Materials of construction	Shell-SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70. Dish end – SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.		
(vi)	Vent, Overflow, drain connection	Required		
(vii)	Stirrer	Slow speed stirrer driven by motor drive and reduction gear. Speed of stirrer = 200 rpm max Material of Construction of each stirrer and agitator = Stainless Steel – 316.	NA	
(viii)	Dissolving Basket per tank	----- (50-60 mesh B.S.)----- Material of Construction of each Dissolving Basket = Stainless Steel 316.	NA	
(ix)	Accessories	Fume absorbers, carbon dioxide absorber, manhole, vent, drain, sample connection, level transmitter, operating platform, ladders, lifting lugs etc.		
(x)	Internal painting / lining	Inside lined with Natural rubber (4.5 mm thick in three layers)		
c)	DOSING PUMPS	ACID DOSING PUMPS	ALKALI DOSING PUMPS	
(i)	Number	Two (2x100%)	Two (2x100%)	
(ii)	Type	Positive displacement hydraulically operated diaphragm type with stroke adjustment.		
(iii)	Duty	Continuous and suitable for parallel operation		
(iv)	Range of operation (%)	0-100		
(v)	Whether suction strainer required	----- Yes -----		
(vi)	Accessories			
(vii)	Pressure Dampener	One per pump	One per pump	
(viii)	External safety relief valve (in addition to inbuilt safety valve)	Two (Polypropylene)	Two (SS:316)	
(ix)	Maximum pump stroke speed per minute	----- 100 -----		
(x)	MATERIAL OF CONSTRUCTION			
(xi)	Liquid End (Pump Head, Valves, Valve housing, valve spring etc.).	polypropylene	SS316	
(xii)	Diaphragm	P.T.F.E		
(xiii)	Packing	P.T.F.E		
(xiv)	Shaft	----- Hardened steel EN 8 (BS:970)-----		
(xv)	Worm & worm wheel(if applicable) Manganese Bronze.....		
(xvi)	Connecting rod Manganese Bronze.....		



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(xvii)	Cross head guide Bronze.....																						
(xviii)	Capacity & Head	Capable of meeting regeneration of one cation/Anion and one mixed bed unit; head as required (with 20% margin).																						
(xix)	Accessories required for each pump	Coupling guard, drain plug, vent valve, isolation valves, Y- type strainers, pressure gauges, pulsation dampener etc.																						
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. (Min.8 kg/cm2(g).)																						
(iv)	Design Temperature	60°C																						
(v)	Capacity	Not less than 10 m3/hr																						
(vi)	Velocity	Not more than 15 m/hr																						
(vii)	Bed depth	1200mm activated carbon + 300mm Gravel support (Min)																						
(viii)	Material of construction																							
	Shell	Carbon steel plates to IS 2062 / SA 515 Gr. 60 or 70																						
	Head	Carbon steel plates to IS 2002 Gr. 2A / SA 515 Gr. 60 or 70.																						
(ix)	Inside protection	Inside lined with Natural Rubber [4.5 mm thick in (3) layers]																						
(x)	Design code	ASME sec VIII div 1 / IS 2825 (Latest edition)																						
(xi)	Influent Distributor Material	SS 316																						
(xii)	Manhole	Two (2) nos minimum each of Davit type and 500 mm dia.																						
(xiii)	Sight Windows	One (1) no. in backwash space																						
(xiv)	Hand hole	One (1) no. of 150 mm dia for removal of activated carbon																						
(xv)	Accessories	Manhole, vent, drain, sample connection, level transmitter, operating platform, ladders, lifting lugs (4 Nos minimum) etc.																						
(xvi)	Filter Media																							
a)	Type	Activated carbon																						
b)	Characteristics of Activated Carbon	<table border="1"> <tr> <td>Grade</td> <td>: Suitable Grade.</td> </tr> <tr> <td>Bulk Density</td> <td>: Not less than 400 kg/m³.</td> </tr> <tr> <td>Particle Density wetted in water</td> <td>: 1.3-1.4 gm/cc.</td> </tr> <tr> <td>Effective size, mm</td> <td>: 0.8-0.9 mm.</td> </tr> <tr> <td>Uniformity Coefficient</td> <td>: 1.5-1.6.</td> </tr> <tr> <td>Mean particle dia</td> <td>: 1.2-1.4 mm.</td> </tr> <tr> <td>Total surface area</td> <td>: Not less than 850 m²/gm.</td> </tr> <tr> <td>Iodine no.</td> <td>: Minimum 850.</td> </tr> <tr> <td>Carbon content</td> <td>: Not less than 90%.</td> </tr> <tr> <td>Moisture content</td> <td>: 5% (max).</td> </tr> <tr> <td>Ash content</td> <td>: 8% (max).</td> </tr> </table>	Grade	: Suitable Grade.	Bulk Density	: Not less than 400 kg/m ³ .	Particle Density wetted in water	: 1.3-1.4 gm/cc.	Effective size, mm	: 0.8-0.9 mm.	Uniformity Coefficient	: 1.5-1.6.	Mean particle dia	: 1.2-1.4 mm.	Total surface area	: Not less than 850 m ² /gm.	Iodine no.	: Minimum 850.	Carbon content	: Not less than 90%.	Moisture content	: 5% (max).	Ash content	: 8% (max).
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Iodine no.	: Minimum 850.																							
Carbon content	: Not less than 90%.																							
Moisture content	: 5% (max).																							
Ash content	: 8% (max).																							
c)	Bed depth in mm	Activated Carbon - minimum 1200 and Support Gravel - minimum 300.																						
d)	Percentage freeboard	75 % minimum.																						
(xvii)	Details of Regeneration of Filter Media																							
a)	Backwash	Backwash by reversible flow of filtered water.																						
b)	Backwash Velocity	As per system req.																						
3.6	ALKALI DILLUENT WATER HEATING TANK (HOT WATER TANK)																							
(i)	Number	One (1)																						



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(ii)	Type/Capacity	Vertical Cylindrical with dished end with Electric heater / 120% of water required for single regeneration of a condensate polisher mixed bed.
(iii)	Temperature of alkali to be heated	To obtain temp. from 15 deg C to 50 deg C at alkali mixing feed out let within 5 hours.
(iv)	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. .(Min.8 kg/cm2(g).)
(v)	Material of construction	
	Shell	Shell-SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
	Dished Ends	Shell-SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
(vi)	Burn out protection	To be provided by the bidder
(vii)	Inside protection	Inside lined with Natural Rubber [8.0 mm thick in (8) layers] Suitable for temperature 70 ⁰ C.
(viii)	Design code	ASME sec VIII div 1 (Latest edition)
(ix)	Accessories	Manhole, vent, drain, sample connection, level transmitter, operating platform, ladders, lifting lugs (4 Nos minimum) etc.
3.7	D.M. WATER PUMPS FOR REGENERATION AND RESIN TRANSFER	
(xi)	Number	Two (2x100%)
(xii)	Type	Horizontal, centrifugal
(xiii)	Operation	Intermittent
(xiv)	Capacity & head	As required
(xv)	Suction condition	Flooded
(xvi)	Material of construction	
	• casing, impeller	SS 316
	• Shaft	SS 410
	• shaft sleeve material	SS 410
(xvii)	Packing seal	Mechanical type
(xviii)	Pump Speed	Maximum 1500 rpm
(xix)	Accessories required for each	Common base plate, coupling guards, drain plug, vent valve, suction hoses, isolation valves, Y-type strainers etc.
(xx)	Pressure dampener	One number per pump
3.8	AIR-BLOWERS FOR RESIN MIXING (REGENERATION AREA)	
(i)	Number	Two (2x100%) with acoustic enclosure.
(ii)	Type	Rotary, Twin Lobe, oil free, positive displacement
(iii)	Duty	Intermittent
(iv)	Capacity and head	As required
(v)	Pressure gauge	One per blower
(vi)	Capacity and head/Noise Level	As required/80 dB (A) Max. at one meter
(vii)	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
4.0	NEUTRALISING SYSTEM	
4.1	NEUTRALIZATION PIT	
(i)	Number	One (1) no. Pit with two (2) compartments for 1x800 MW Unit
(ii)	Type	Necessary air grid arrangement of polypropylene construction (In bidder's scope) shall be provided in each compartment for effective neutralization of the waste effluent.
(iii)	Material of	RCC .Inside lined with PVC sheet (3 mm thick).



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	Construction		
(iv)	No. of compartments	Two compartments	
(v)	Capacity of each compartment	Adequate to hold the quantity of waste effluent generated due to single regeneration of Condensate Polisher Mixed Bed plus 20% overall margin.	
(vi)	Gates	Two Nos (in bidder's scope). MOC of the gates will be Carbon Steel rubber lined.	
4.2	NEUTRALIZATION PIT DISPOSAL PUMPS		
(i)	Number	Two nos (1 working + 1 Standby)	
(ii)	Type	Vertical Centrifugal	
(iii)	Capacity & head	Capacity= 100 M3/Hr min. (To be increased by the Bidder if necessary to transfer the waste of single regeneration of the resins of a Condensate Polisher Mixed Bed within four (4) hours) Head=As per system req..(Refer also cl. no.E.6/Section C1)	
(iv)	Material of construction		
	casing, impeller	SS 316	
	Shaft	SS 410	
(v)	Pressure dampener	One number per pump	
4.3)	CHEMICAL TANKS FOR N PIT	ALKALI MEASURING TANK	ACID MEASURING TANK
(i)	Number required	One (1)	One (1)
(ii)	Type	-----Vertical Cylindrical with dished end, over ground-----	
(iii)	Useful capacity	Suitable to meet the requirement for neutralization of excess acid/alkali present in the regeneration waste effluent due to single regeneration of a condensate polisher mixed bed + 20% margin	Suitable to meet the requirement for neutralization of excess acid/alkali present in the regeneration waste effluent due to single regeneration of a condensate polisher mixed bed + 20% margin
(iv)	Type of fluid to be handled	40-48% Sodium Hydroxide	30-33% Hydrochloric Acid.
(v)	Vent, Overflow, drain connection	Required	
(vi)	Stirrer	Slow speed stirrer driven by motor drive and reduction gear. Speed of stirrer = 200 rpm max Material of Construction of each stirrer and agitator = Stainless Steel – 316.	NA
(vii)	Dissolving Basket per tank	----- (50-60 mesh B.S.)----- -----Material of Construction of each Dissolving Basket = Stainless Steel 316.	NA
(viii)	Accessories	Fume absorbers, carbon dioxide absorber, manhole, vent, drain, sample connection, level transmitter, operating platform, ladders, lifting lugs etc.	
(ix)	Material of construction	Shell-SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70. Dish end – SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.	
(x)	Internal painting / lining	Inside lined with Natural rubber (4.5 mm thick in three layers)	
5.0	PIPING		
(i)	Resin Transfer piping	ASTM A 312 Gr. TP 304 sch 10S Minimum Pipe Size: 80 NB Velocity: 2-3 m/s	
(ii)	DM water line	ASTM A 312 Gr. TP 304 sch 40S for Piping less than and equal to 50 mm NB & ASTM A 312 Gr. TP 304 sch 10S for piping equal to greater than 65 mm NB	
(iii)	Acid piping (All concentration)	Carbon Steel (inside rubber lined)	



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(iv)	Alkali piping (All concentration)	CPVC Sch 80
(v)	Condensate inlet and outlet piping to CPU, CPU drain, CPU bypass, Rinse Recirculation piping	CS as per ASTM A 106 GR. C
(vi)	Rinse water to hot well	CS as per ASTM A 106 GR. B
(vii)	Instrument air /service air line	ASTM A 312 Gr. TP 304 sch 40S for Piping less than and equal to 50 mm NB & ASTM A 312 Gr. TP 304 sch 10S for piping equal to greater than 65 mm NB
(viii)	Piping for air blower	Hot dip MS galvanized (heavy grade).
(ix)	Effluent disposal piping	CSRL
(x)	Sampling Pipe	Stainless Steel to ASTM Schedule-10.
(xi)	Service water	ERW Carbon Steel Pipe to ASTM 53 Gr. B / IS-1239, Part-I heavy grade for pipe size up to 150mm NB and IS-3589 for 200mm NB & above
6.0	VALVES	
(i)	Butterfly valves at inlet of condensate polisher vessel	Body- A 216 WC B Disc-CF8M
(ii)	Butterfly valves at outlet of condensate polisher vessel	Body- CF8M Disc-CF8M
(iii)	Ball valves	Body- CF8M Ball-CF8M
(iv)	Diaphragm valve	Body, Bonnet-Cast Iron Compressor-SS.
7.0	Safety Equipments	Two (2) sets of safety equipment comprising PVC protection suits with hoods, rubber boots, face visors and thick PVC gauntlets shall also be provided. One number personnel water drench shower/safety shower and eye bath in regeneration area shall be provided by the bidder.



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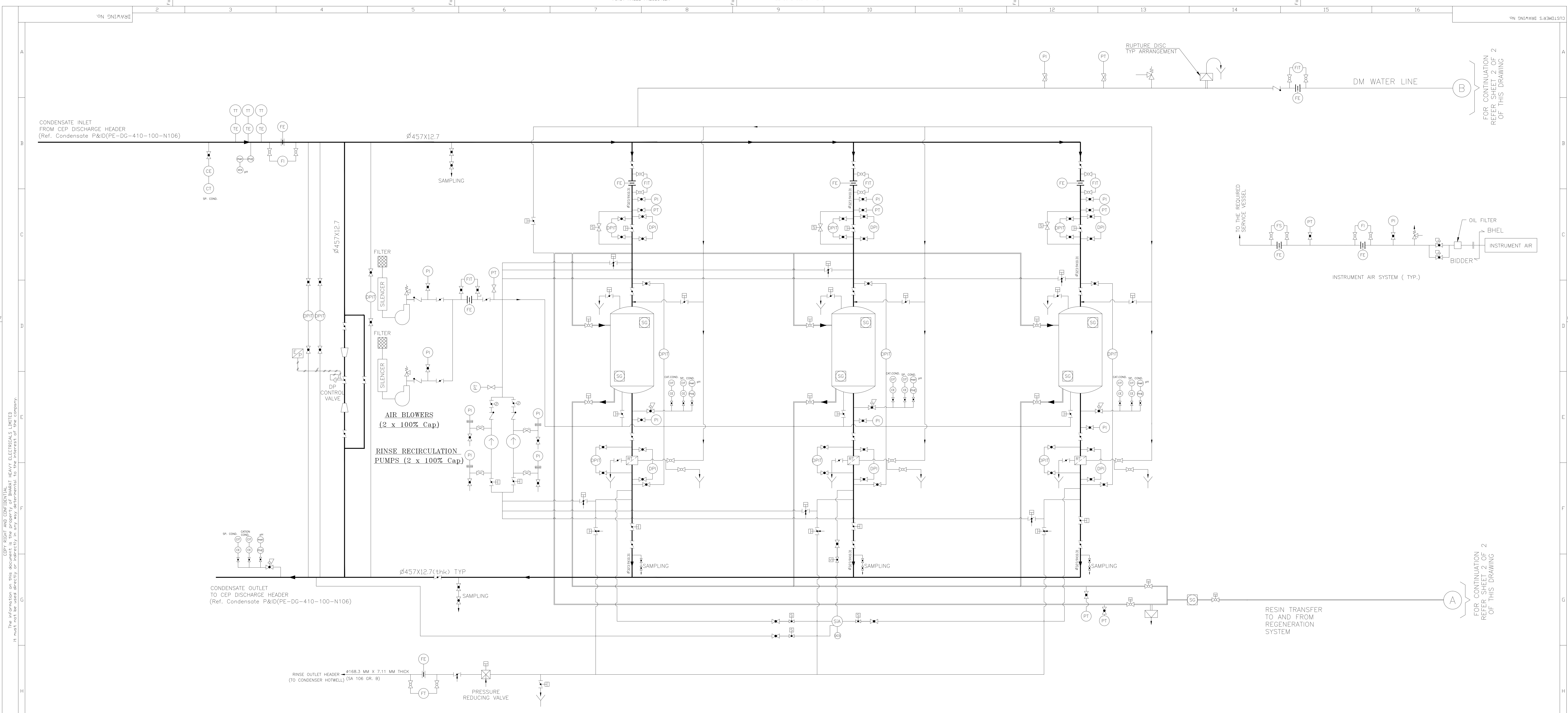
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DRAWINGS

- P&ID FOR CONDENSATE POLISHING UNIT(SHEET 1 OF 2 & SHEET 2 OF 2)
(PE-DG-410-155A-A001)
- SPACE AVAILABLE FOR CPU SERVICE VESSEL AREA
(PE-DG-410-155A-A002)
- SPACE AVAILABLE FOR CPU REGENERATION AREA
(PE-DG-410-155A-A003)
- PLOT PLAN
(PE-DG-410-100-M001)



FOR CONTINUATION REFER SHEET 2 OF 2 OF THIS DRAWING

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NOTES :

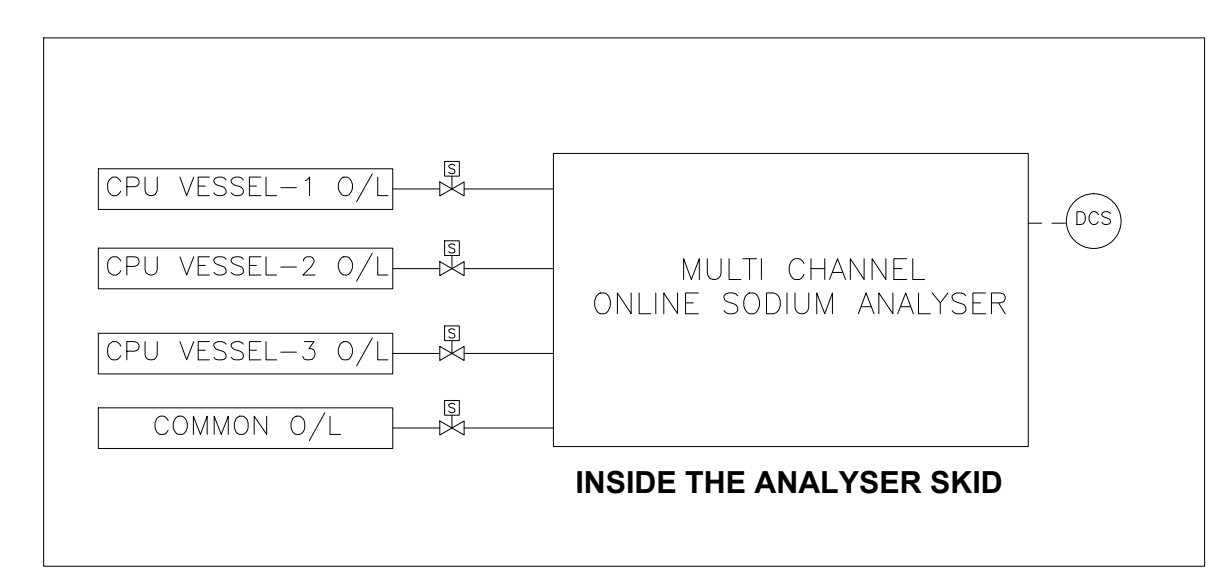
1. THE P&ID DIAGRAM IS INDICATIVE AND ONLY MINIMUM REQUIREMENT OF VALVES, INSTRUMENTATION ETC. HAS BEEN SHOWN. BIDDER SHALL FURNISH SCHEME, COMPLETE IN ALL RESPECTS INCLUDING ALL INSTRUMENTS, VALVES ETC. FOR SMOOTH, SAFE, EFFICIENT, TROUBLE FREE OPERATION OF PLANT FOR BHEL/CUSTOMER/CONSULTANT APPROVAL DURING DETAILED ENGINEERING.
2. SERVICE VESSELS SHALL BE OF SPHERICAL DESIGN.
3. 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/S-VALVE MANIFOLD FOR DPTS. BALL VALVE FOR FLOW INDICATORS/ANALYTICAL INSTRUMENT SHALL BE PROVIDED.
4. WHEREVER, PROVIDING 2 VALVE MANIFOLD IS NOT FEASIBLE, TWO NUMBERS OF GLOBE VALVES SHALL BE PROVIDED TO MEET THE FUNCTION OF 2-VALVE MANIFOLD.
5. PR. INSTRUMENTS USED IN ACID, ALKALI, DM LINE, REG WASTE, RESIN LINES, REGENERATION VESSEL AND MIXED RESIN STORAGE VESSELS, SHALL BE PROVIDED WITH DIAPHRAGM SEAL.
6. FLOW TOTALISATION SHALL BE DONE IN SOFTWARE.
7. DP CONTROL VALVE BETWEEN INLET/OUTLET OF CPU SHALL BE MODULATING TYPE DULY PROVIDED WITH PNEUMATIC ACTUATOR, MICRO-PROCESSOR BASED POSITIONER, POS. XMTR, AIR LOCK DEVICE AND SOLENOID VALVE ETC.
8. ALL SOLENOID OPERATED VALVES SHALL BE PROVIDED WITH SOLENOID VALVE, AIR LOCK RELAY ETC. AS REQUIRED BY PROCESS.
9. BLIND FLANGES, COUNTER FLANGES & ISOLATION VALVES SHALL BE PROVIDED BY THE BIDDER AT THE TERMINAL POINTS WHEREVER APPLICABLE.
10. ALL THE ANALYSERS SHALL BE PANEL MOUNTED.
11. ALL THE ISOLATION VALVES OF ALL THE INSTRUMENTS SHALL BE OF SS316 CONFORM TO ANSI 300# CLASS.
12. REFER SHEET 2 OF 2 OF THIS DRAWING FOR ADDITIONAL NOTES.
13. FOR DESIGN PRESSURE BETWEEN 40 BAR TO 60 BAR, DESIGN TEMPERATURE LESS THAN 425 DEG C, 2 NOS. ROUTE VALVES OF 15 NB SIZE OF 800 CLASS FOR INST. (PRESSURE, FLOW, LEVEL MEASUREMENT), HAVE TO BE PROVIDED BY THE BIDDER.
14. ALL THE CONTROL LOOPS SHALL BE INDICATED IN VENDOR DOCUMENT.
15. ALL THE INDIVIDUAL "Y" TYPE STRAINERS SHALL BE PROVIDED WITH DPS.
16. ALL SOLENOID VALVE SHALL BE PROVIDED BY BIDDER WITH LOCAL LED STATUS DISPLAY AND LIMIT SWITCHES SHALL BE PROVIDED BY BIDDER FOR CRITICAL APPLICATIONS TO FACILITATE REMOTE INDICATION ON OWS.
17. LOCATION OF SODIUM & SILICA ANALYZER SHALL BE INSIDE THE CONTROL ROOM. ALL REQUIRED TUBING AND RACK ALONG WITH DRAIN DISPOSAL PIPES SHALL BE IN BIDDER'S SCOPE.
18. TWO NOS. SLICCE GATES INDICATED IN N-PIT SHALL BE IN BIDDER'S SCOPE.
19. LIMIT SWITCHES SHALL BE PROVIDED BY THE BIDDER FOR ALL THE PUMPS FOR AUTO OPERATION.
20. FOR DETAIL A AND ALL ANALYZERS, ALL REQUIRED ACCESSORIES & VALVES SUCH AS ISOLATION VALVES, PRESSURE REDUCING VALVES, BACK PRESSURE REDUCING VALVES ETC SHALL BE PROVIDED FOR IMPLEMENTING SAMPLE MEASUREMENT AS PER BIDDER'S STANDARD PRACTICE.
21. Ø DENOTES OD (OUTER DIAMETER).
22. INSTRUMENTS, ANALYZERS ETC. USED IN SYSTEM SHOULD SUSTAIN OPERATING & DESIGN PARAMETERS OF SYSTEM. IN CASE OPERATING & DESIGN PARAMETERS OF INSTRUMENTS, ANALYZERS ARE LESS THAN SYSTEM'S PARAMETER, NECESSARY ARRANGMENT/ACCESSORIES SHALL BE PROVIDED BY BIDDER FOR SAFE OPERATION.
23. ∩ INDICATES TERMINAL POINTS BETWEEN BHEL & BIDDER.
24. ALL THE TRANSMITTERS (PRESSURE, LEVEL, TEMPERATURE, DIFFERENTIAL PRESSURE, FLOW ETC.) USED FOR INTERLOCK & PROTECTION, SHALL BE REDUNDANT.

CONDENSATE POLISHING FOR STATION

LEGEND

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

- CS CONTROL SYSTEM
- LS LEVEL SWITCH
- TT TEMPERATURE TRANSMITTER
- PI PRESSURE INDICATOR
- PT PRESSURE TRANSMITTER
- TI TEMPERATURE INDICATOR
- FI FLOW INDICATOR
- CE CONDUCTIVITY ELEMENT
- FT FLOW TOTALISER
- DPI DIFF. PRESSURE INDICATOR
- DPS DIFF. PRESSURE SWITCH
- FE FLOW TRANSMITTER
- FT FLOW ELEMENT
- CT CONDUCTIVITY TRANSMITTER
- DPIT DIFF. PRESSURE INDICATING TRANSMITTER
- FS FLOW SWITCH
- CIT CONDUCTIVITY INDICATING TRANSMITTER
- DT DENSITY TRANSMITTER
- TE TEMPERATURE ELEMENT
- LI LEVEL INDICATOR
- PHE pH ELECTRODE
- PHAT pH ANALYSER TRANSMITTER
- SIA SILICA ANALYZER (MULTI CHANNEL)
- ORIFICE (Pressure Breakdown)
- LT LEVEL TRANSMITTER
- SC SAMPLE COOLER
- FCV FLOW CONTROL VALVE



TYPICAL FOR UNIT 1 & 2

JOB NO.	391
STATUS	CONTRACT
DISTRIBUTION	

PROJECT: 1X800 MW TSGENCO KOTHAGUEDEM TPS STAGE-VII, PALONCHA

OWNER: TELANGANA STATE POWER GENERATION CORPORATION LTD.

OWNER'S CONSULTANT: DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI

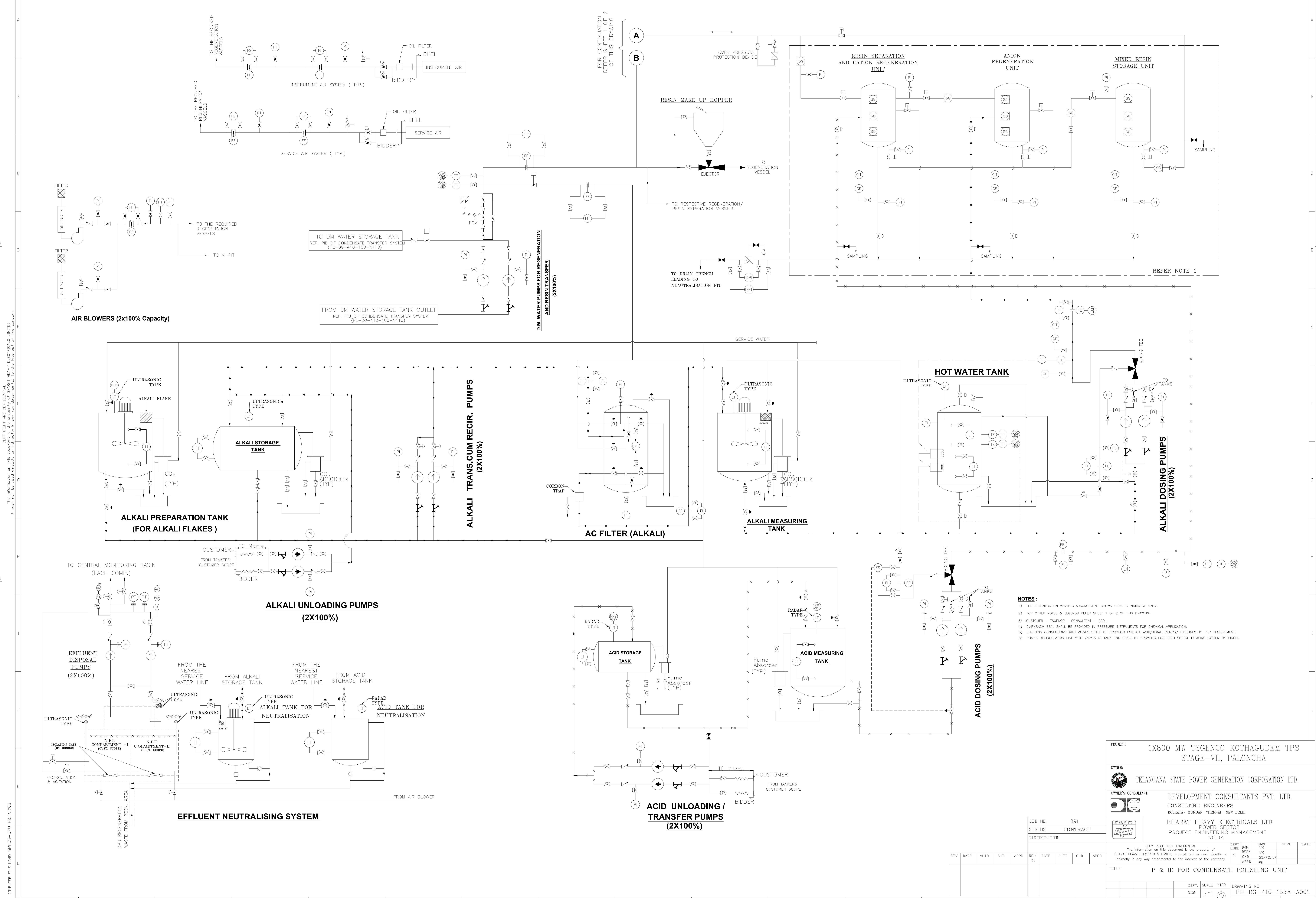
CLIENT: BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA

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DEPT.	SCALE	NAME	DATE
DESIGN	1:100	SK	
CHK		CS/ES/JP	
APPD		PK	

TITLE	P & ID FOR CONDENSATE POLISHING UNIT			
DEPT.	SCALE	DRAWING NO.	REV.	
DESIGN	1:100	PE-DG-410-155A-A001	02	02
CHK				
APPD				

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FOR CONTINUATION
REFER SHEET 1 OF 2
OF THIS DRAWING

REFER NOTE 1

- NOTES :**
- 1) THE REGENERATION VESSELS ARRANGEMENT SHOWN HERE IS INDICATIVE ONLY.
 - 2) FOR OTHER NOTES & LEGENDS REFER SHEET 1 OF 2 OF THIS DRAWING.
 - 3) CUSTOMER - TSGENCO CONSULTANT - DCP.
 - 4) DIAPHRAGM SEAL SHALL BE PROVIDED IN PRESSURE INSTRUMENTS FOR CHEMICAL APPLICATION.
 - 5) FLUSHING CONNECTIONS WITH VALVES SHALL BE PROVIDED FOR ALL ACID/ALKALI PUMPS/ PIPELINES AS PER REQUIREMENT.
 - 6) PUMPS RECIRCULATION LINE WITH VALVES AT TANK END SHALL BE PROVIDED FOR EACH SET OF PUMPING SYSTEM BY BIDDER.

PROJECT: 1X800 MW TSGENCO KOTHAGUEDEM TPS
STAGE-VII, PALONCHA

OWNER: TELANGANA STATE POWER GENERATION CORPORATION LTD.

OWNER'S CONSULTANT: DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA - MUMBAI - CHENNAI - NEW DELHI

CLIENT: BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA

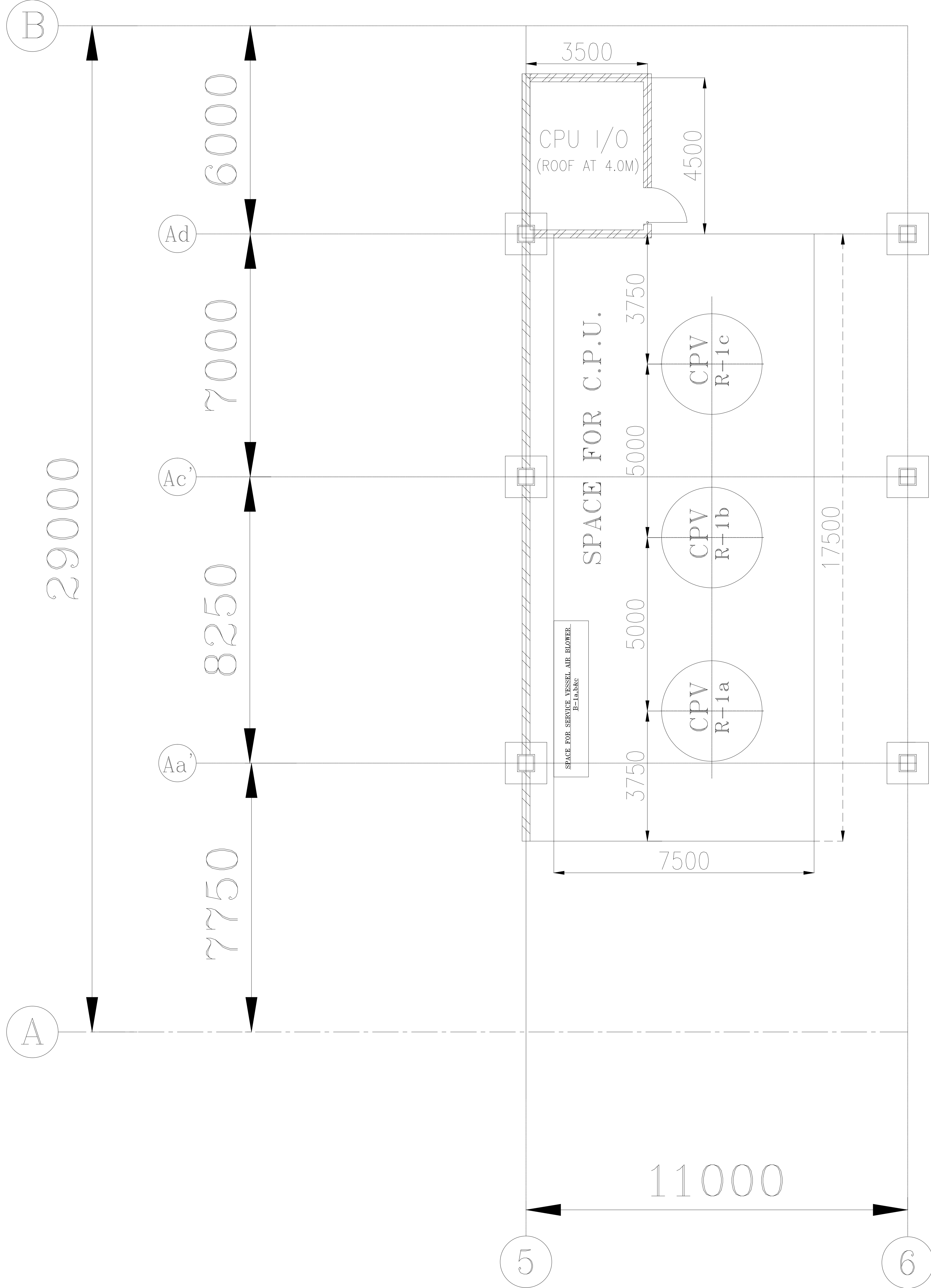
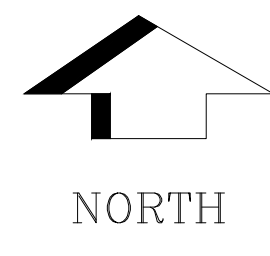
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DISTRIBUTION:

DEPT. CODE: DECN
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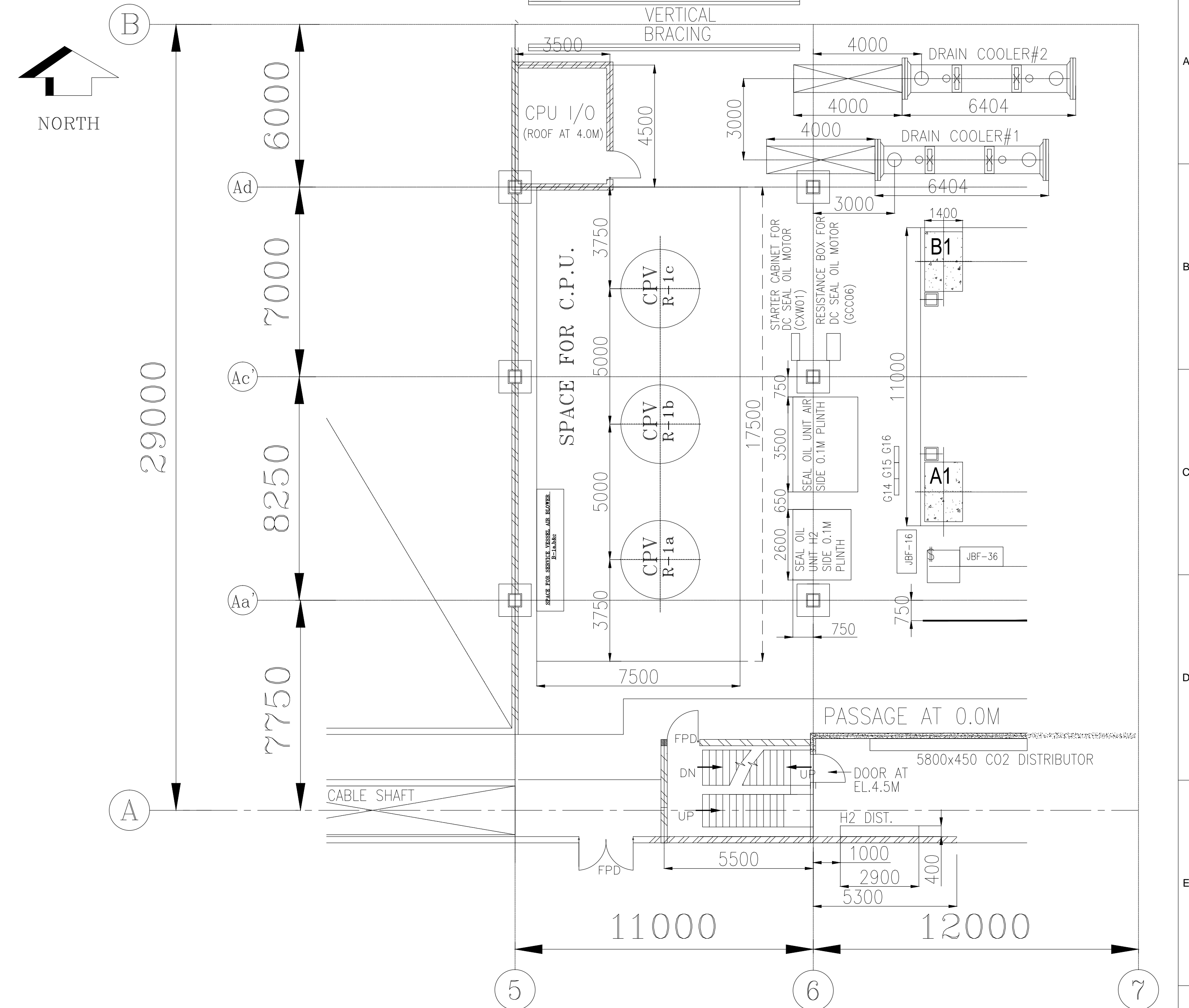
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DEPT. SCALE: 1:100
DRAWING NO.: PE-DG-410-155A-A001
SHEET: 02 OF 02
REV.: 00

COMPUTER FILE NAME: SPECS-CPU P&ID.DWG



CPU SERVICE VESSEL AREA (TG BUILDING)



KEY PLAN

LEGEND:

- BRICK WALL
- CONDENSATE POLISHER VESSEL
- ALL DIMENSIONS ARE IN "mm".

PROJECT: 1X800 MW TSGENCO KOTHAGUDEM TPS STAGE-VII, PALONCHA

OWNER: TELANGANA STATE POWER GENERATION CORPORATION LTD.

OWNER'S CONSULTANT: DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI

STATUS: CONTRACT

DISTRIBUTION

BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA

JOB NO.	391
STATUS	CONTRACT
DISTRIBUTION	

REV.	DATE	ALTD.	CHD.	APPD.	REV.	DATE	ALTD.	CHD.	APPD.	DEPT. CODE	DRN. YK.	NAME	SIGN.	DATE
										M	CHD	QSF/UP		
											APPD	PK		

TITLE: SPACE AVAILABLE FOR CPU SERVICE VESSEL AREA

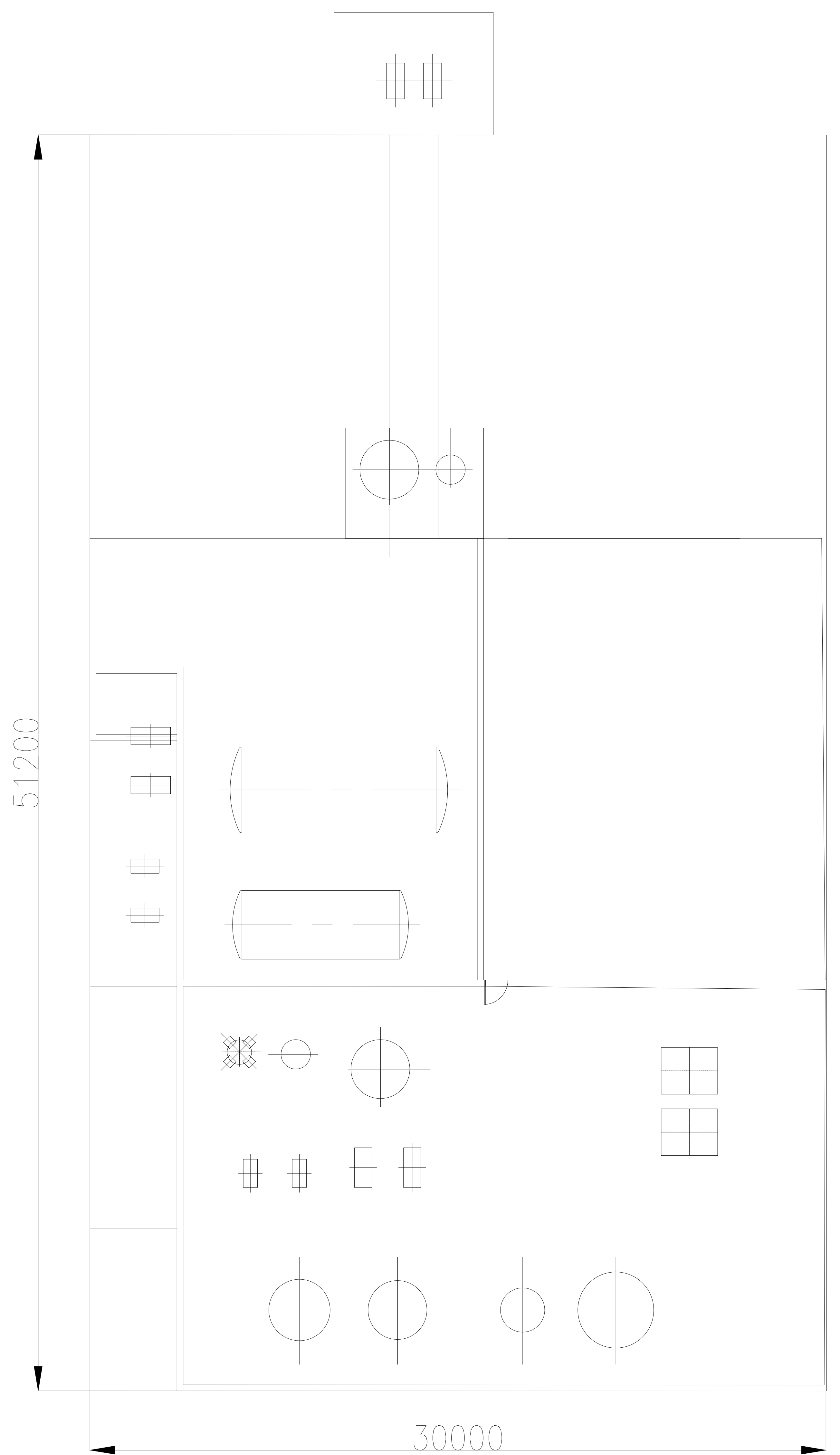
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DRAWING NO. PE-DG-410-155A-A002

SHEET 01 OF 01 REV. 00

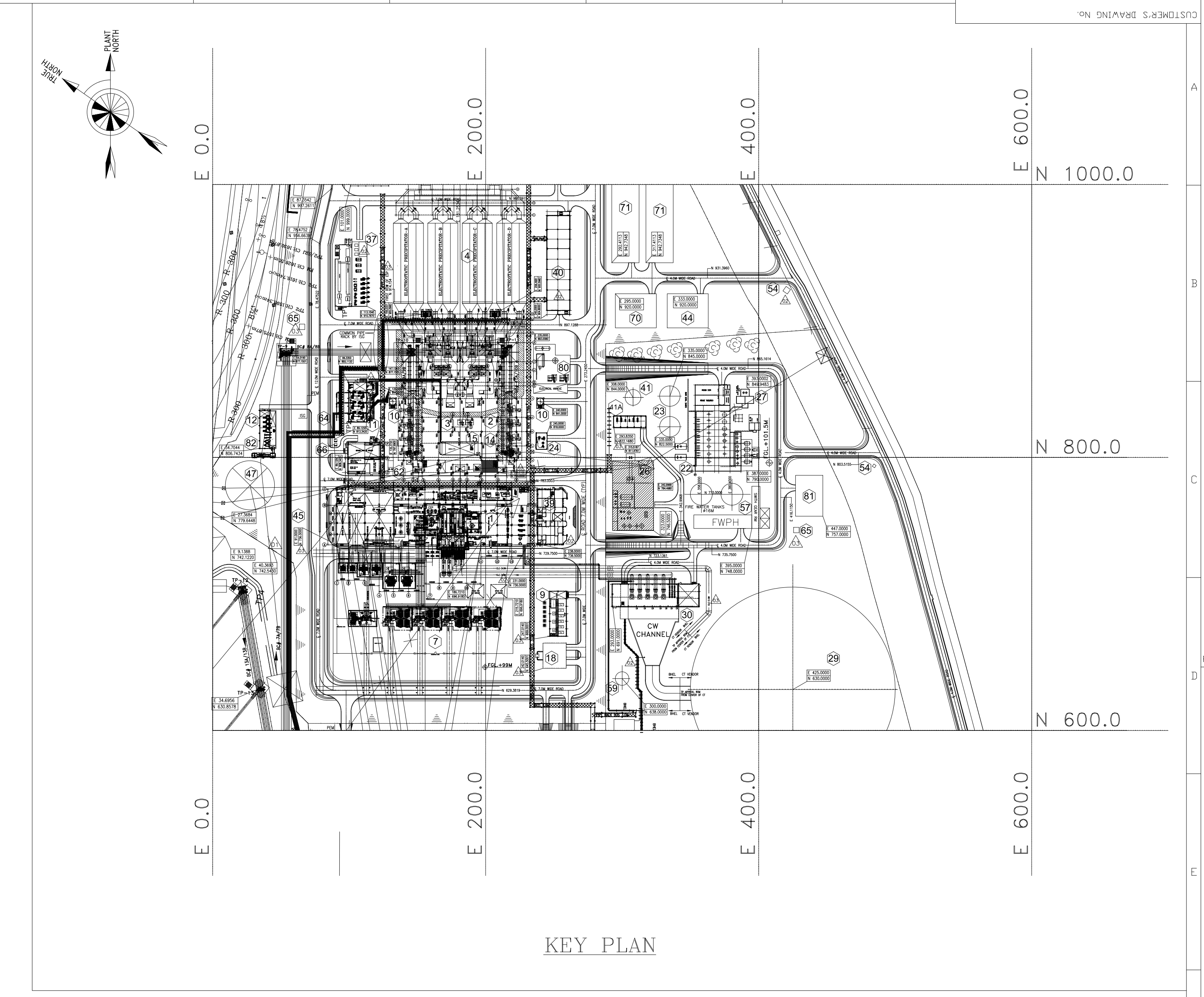
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COMPUTER FILE NAME: SERVICE VESSEL AREA.DWG






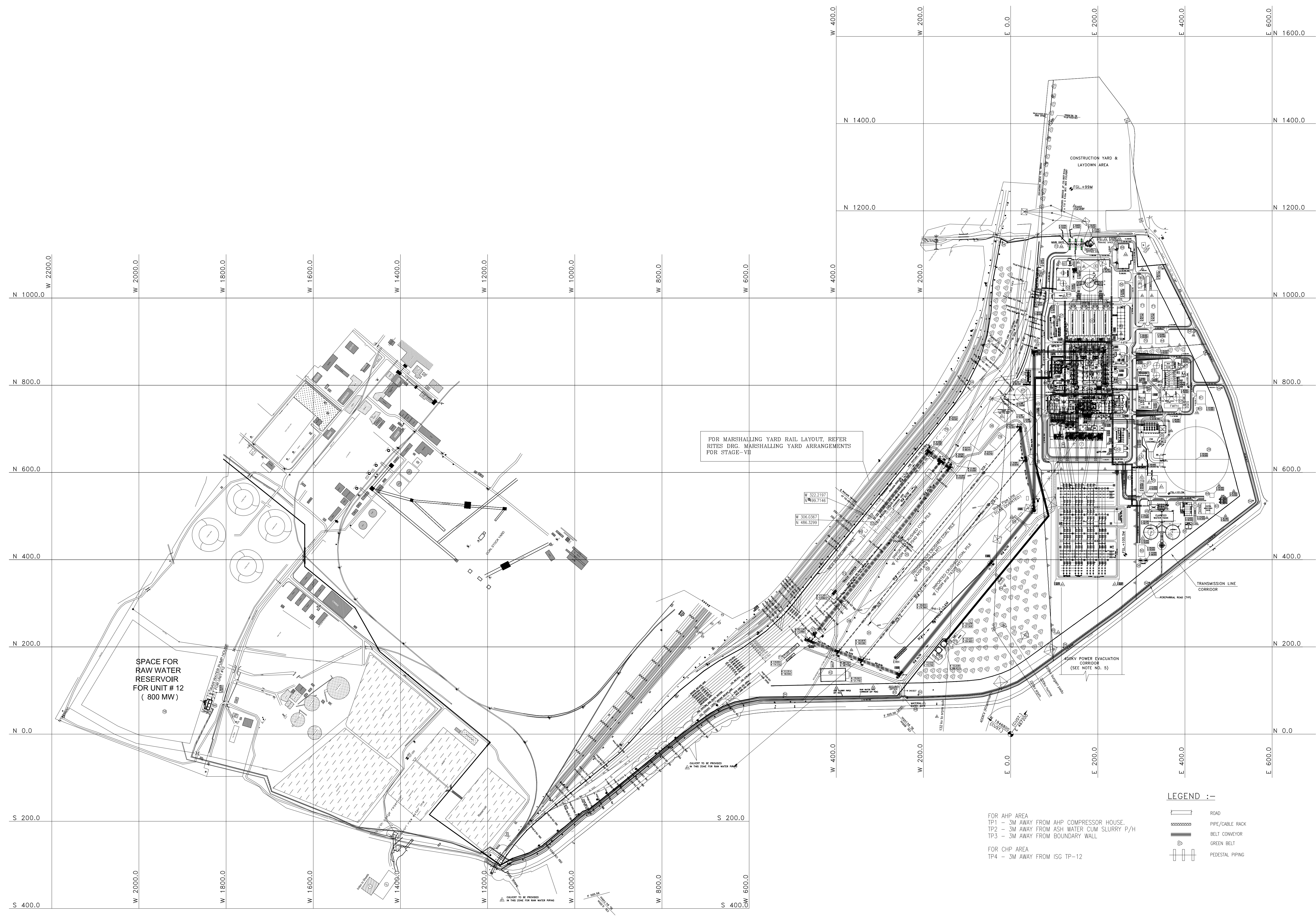
CPU REGENERATION AREA

ALL DIMENSIONS ARE IN "mm".



KEY PLAN

PROJECT:		1X800 MW TSGENCO KOTHAGUDEM TPS STAGE-VII, PALONCHA	
OWNER:		 TELANGANA STATE POWER GENERATION CORPORATION LTD.	
OWNER'S CONSULTANT:		 DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA · MUMBAI · CHENNAI · NEW DELHI	
JOB NO.		391	
STATUS:		CONTRACT	
DISTRIBUTION:		 BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA	
REV.		DEPT. CODE: DECN / SJK NAME: GS/ES/JP SIGN: PK DATE:	
TITLE:		SPACE AVAILABLE FOR CPU REGENERATION AREA	
DEPT. SIGN:		SCALE: 1:100 DRAWING NO.: PE-DG-410-155A-A003 SHEET: 06 OF 01 REV.: 00	



IDENTIFICATION NUMBER	DESCRIPTION
1	POWER HOUSE BUILDING INCLUDING ELECTRICAL BAY
2	COAL MILL
3	STEAM GENERATOR
4	ESP
5	CHIMNEY
6	SPACE FOR FGD PLANT
7	TRANSFORMER BAY
8	400 KV SWITCHYARD
9	COMPRESSOR HOUSE
10	MILL REACTORS LOADING HOPPERS
11	ASH WATER CUM SLURRY PUMP HOUSE
12	ASH WATER PUMP HOUSE
13	FLY ASH SILOS
14	BA OVER FLOW SLUMP
15	BOTTOM ASH HOPPER
16	RAW WATER STORAGE RESERVOIR
17	CLARIFIERS
18	DC SET
19	WATER STREAM FILTRATION AREA
20	CM TREATMENT & CHEMINATION AREA
21	FOAM PUMP HOUSE
22	DM PLANT
23	DM WATER STORAGE TANK
24	BOOSTER PUMP HOUSE
25	CHEMICAL HOUSE
26	CRU REGENERATION AREA
27	NEUTRALISING PIT
28	WATCH HOUSE CONTROL ROOM
29	COOLING TOWER
30	COOLING WATER PUMP HOUSE
31	TRACK HOPPER
32	MASON TOWER
33	CRUSHER HOUSE
34	STACKER CUM RECLAMER (2 Nos.)
35	CRUSHER CUM PALE
36	CHP CONTROL/ SWITCHGEAR ROOM
37	AHP COMPRESSOR HOUSE CUM AHP CONTROL / AHP CONTROL/ SWITCHGEAR ROOM
38	THICKENER
39	SERVICE BUILDING
40	ESP CONTROL ROOMS
41	CONDENSATE STORAGE TANK
41A	MAKE-UP PUMP HOUSE
42	COAL PALE SETTING BASIN
43	S&D UTILITY BUILDING
44	TRAINING & SIMULATOR ROOM
45	PERISCOPIC RACK (SS)
46	RAW WATER PUMP HOUSE
47	CLASSIFIED ASH HANDLING SYSTEM
48	MATERIAL ENTRY GATE
49	CLASSIFIED WATER STORAGE TANK & PUMP HOUSE
50	SEWERAGE BUILDING
51	SURGE PIT
52	HFO & LDO STORAGE TANK SPIKE AREA
53A	HFO & LDO CIRCULATING PUMP HOUSE
53B	HFO & LDO FORWARDING PUMP HOUSE
54	WATCH TOWER
55	BULLDOZER SHED
56	FIRE STATION
57	FIRE WATER STORAGE TANK & PUMP HOUSE
58	WASH BRIDGE (SS)
59	SERVICE WATER OVER HEAD TANK (10.0M DIA)
60	WASH BRIDGE FOR INDOOR STORAGE (SPM)
61	PERISCOPIC RACK (SPM)
62	PHE CL. WATER SEPARATOR PIT
63	C.W.B. WASTE TREATMENT SYSTEM
64	BOILER WASH WATER SUMP
65	AMBIENT AIR QUALITY MONITORING STATION
66	T.O. WASH WATER SUMP
67	NOT USED
68	TREATED WATER PIT (SS SCOPE)
69	ADMINISTRATIVE BUILDING
70	CANTEEN
71	INDOOR STORE
72	MAIN GATE
73	NOT USED
74	NOT USED
75	AHP S&D UTILITY MISC ROOM
76	CHP MISC
77	DS PUMP HOUSE-1
78	DS PUMP HOUSE-2
79	BT CONTROL ROOM-1&2
80	AUXILIARY BOILER
81	CHEMICAL LAB
82	CHEMICAL HOUSE (SS)
83	SECURITY OFFICE FOR MATERIAL ENTRY GATE
84	GRG COLUMNER SHED

- NOTES:-**
1. ALL DIMENSIONS AND CO-ORDINATES ARE IN METERS UNLESS NOTED OTHERWISE.
 2. THE FINISHED FLOOR LEVEL (F.F.L) OF POWER HOUSE BUILDING GROUND FLOOR IS (L.L. 0.0M WHICH CORRESPONDS TO 0.5M (RL. 99.5M) ABOVE F.F.L.
 3. THE EXISTING BUILDINGS SHOWN IN DOTTED LINE BY THE POWER PLANT AREA, ETC. AND AS REQUIRED FOR THE CONSTRUCTION OF THE FACILITIES FOR UNIT #12 ARE TO BE DEMOLISHED.
 4. THE PIPE RACK SHOWN IS INDICATIVE ONLY.
 5. ABOVE GROUND LINES ARE TO BE ADOPTED FULLY CLEARING THE RE-REQUIRED ZONE LINES SPANNING ALONG THE PLANT BOUNDARY.
 6. RE-ROUTING OF EXISTING ABOVE LINE NEAR PROPOSED SWITCHYARD AND CHP AREA TO BE SUITABLY INCORPORATED IN THIS DRAWING BY TSCENCO.
 7. COST ORDER HAVE BEEN CONSIDERED TO PLANT CREDS. REDUCED POINT HAS BEEN INDICATED.
 8. DUE TO HEAVY MARSHALLING YARD RAIL TRACKS ARE COMING OVER RAW WATER PIPES, HENCE, CLEARANCE TO BE PROVIDED AS INDICATED IN THE PLOT PLAN AND NECESSARY APPROVAL FROM RITTS/ OTHER AGENCIES TO BE OBTAINED BY TSCENCO.
 9. MARSHALLING YARD RAIL TRACKS ARE CONSIDERED AT FIG. 104.0M.

REFERENCE DWG. :-

1. PLOT PLAN (CUSTOMER) 13A06-DWG-M-002 REVA

- LEGEND :-**
- ROAD
 - PIPE/CABLE RACK
 - BELT CONVEYOR
 - GREEN BELT
 - PEDESTAL PIPING

- FOR AHP AREA**
- TP1 - 3M AWAY FROM AHP COMPRESSOR HOUSE.
 - TP2 - 3M AWAY FROM ASH WATER CUM SLURRY P/H
 - TP3 - 3M AWAY FROM BOUNDARY WALL.
- FOR CHP AREA**
- TP4 - 3M AWAY FROM ISG TP-12



TITLE:

TECHNICAL SPECIFICATION FOR
CONDENSATE POLISHING UNIT
1X800 MW TSGENCO KOTHAGUEDEM TPS
STAGE -VII, PALONCHA

SPEC NO: PE-TS-410-155A-A001

VOLUME: II-B

SECTION: C2

REV NO: 00

DATE:


SECTION – C2
SPECIFIC TECHNICAL REQUIREMENT- ELECTRICAL



TITLE: ELECTRICAL EQUIPMENT SPECIFICATION FOR CONDENSATE POLISHING UNIT (CPU) KOTHAGUDEM TPS (1 X 800MW)	SPECIFICATION NO.
	VOLUME NO. : II-B
	SECTION: C2
	REV NO. : 00 DATE: 19/03/2015
	SHEET: 1 OF 1

CONTENTS

SECTION	TITLE	NO OF SHEETS
C	SPECIFIC TECHNICAL REQUIREMENTS	2
C	ELECTRICAL SCOPE BETWEEN BHEL & VENDOR	3
C	TECHNICAL SPECIFICATION FOR MOTORS/ACUATORS	21
D	MOTOR DATASHEET-C	7
D	QUALITY PLAN	2+9
D	APPROVED SUBVENDOR LIST (MOTOR) (ANN-I)	1
D	ELECTRICAL LOAD DATA FORMAT (ANN-II)	1
D	CABLE SCHEDULE FORMAT INCLUDING NOTES (ANN-III)	3

	TITLE:	SPECIFICATION NO.
	ELECTRICAL EQUIPMENT SPECIFICATION FOR CONDENSATE POLISHING UNIT (CPU)	VOLUME NO. : II-B
	KOTHAGUDEM TPS (1 X 800MW)	SECTION: <u>C2</u>
		REV NO. : 00 DATE: 19/03/2015
		SHEET: 1 OF 1

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:

The equipment and services to be provided by bidder under this specification shall be as detailed here below but shall not be limited to the following:


- a) Services and Equipment as per “Electrical Scope between BHEL and Vendor”.
- b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work 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.
- c) Supply of mandatory spares as specified in the specifications of mechanical equipments.
- d) Electrical load requirement for Condensate Polishing Unit (CPU)
- e) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
- f) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer / BHEL approval without any commercial and delivery implications to BHEL.
- g) Various drawings including GA drg, data sheet as per required format, quality plans, calculations, test reports, test certificates, operation and maintenance manuals, characteristic curves, wiring diagrams/schemes etc. shall be furnished as specified at contract stage. All documents shall be subject to customer / BHEL approval without any commercial implications to BHEL.
- h) The sub-vendor list for various electrical items is subject to BHEL/Customer approval without any commercial implications.
- i) Motors shall meet minimum requirement of Electric motor specification.
- j) Purchaser will furnish data sheets to the vendor after award of contract. Vendor shall furnish filled in data sheets meeting the specification requirements.
- k) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.
- l) Cable BOQ worked out based on routing of cable listing provided by the vendor for “both end equipment in vendor’s scope” shall be binding to the vendor with +10 % margin to take care of slight variation in routing length & wastages.

2.0 EQUIPMENT & SERVICES TO BE PROVIDED BY PURCHASER FOR ELECTRICAL & TERMINAL POINTS:

Refer “Electrical Scope between BHEL and Vendor”.

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

- 3.1 Bidder shall confirm total compliance to the electrical specification without any deviation from the technical / quality assurance requirements stipulated. In line with this, the bidder as technical offer shall furnish two signed and stamped copies of the following:

	TITLE: ELECTRICAL EQUIPMENT SPECIFICATION FOR CONDENSATE POLISHING UNIT (CPU) KOTHAGUDEM TPS (1 X 800MW)	SPECIFICATION NO.
		VOLUME NO. : II-B
		SECTION: C2
		REV NO. : 00 DATE: 19/03/2015
		SHEET: 1 OF 1

- a) A copy of this sheet "Electrical Equipment Specification for Condensate Polishing Unit (CPU) and sheet "Electrical Scope between BHEL and Vendor" with bidder's signature and company stamp.
- b) Electrical load requirement.

3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer.

4.0 LIST OF ENCLOSURES

- 4.1 Electrical scope between BHEL & vendor
- 4.2 Technical specification – Specification for Electric Motors/Actuators
- 4.3 Datasheets & quality plan for motors.
- 4.4 Load Data Format. (Annexure –II)
- 4.5 BHEL Cable listing format (Annexure –III)

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGE : CONDENSATE POLISHING UNIT (CPU)

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

PROJECT: 1 x 800 MW KOTHAGUDEM TPS

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	BHEL	BHEL	1. 415 V AC (3 Phase, 3 Wire) supply to motors, 415 V AC (3 Phase, 4 Wire) /240 V AC supply to other equipment etc. shall be provided by BHEL based on load data provided by vendor at contract stage for the equipment supplied by vendor as part of contract. 2. Any other voltage level (AC/DC) required will be derived by the vendor. Located near the motor.
2	Local Push Button Station (for motors)	BHEL	BHEL	
3	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	BHEL BHEL BHEL	BHEL Vendor BHEL	1. For 3.b) & c): Sizes of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL) in the form of cable listing. Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Termination at BHEL equipment terminals by BHEL. 3. Termination at Vendor equipment terminals by Vendor.
4	Junction box for control & instrumentation cable	Vendor	Vendor	Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 10-12 mtrs) and trunk cable.
5	Any special type of cable like compensating, co-axial, prefab, MICC, optical fibre etc.	Vendor	Vendor	Refer C&I portion of specification for scope of fibre Optical cables if used between PLC/ microprocessor & DCS.
6	Cable trays, accessories & cable trays supporting system 100/ 50 mm cable trays/ Conduits/ Galvanised steel cable troughs for local cabling	BHEL Vendor	BHEL Vendor	Local cabling from nearby main route cable tray (BHEL scope) to equipment terminal (vendor's scope) shall be through 100/ 50 mm. cable trays/ conduits/ Galvanised steel cable troughs, as per approved layout drawing during contract stage.
7	Cable glands ,lugs and bimetallic strip for equipment supplied by Vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty finned copper lugs for power and control cables.
8	Conduit and conduit accessories for cabling between equipment supplied by vendor	Vendor	Vendor	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537.

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGE : CONDENSATE POLISHING UNIT (CPU)

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

PROJECT: 1 x 800 MW KOTHAGUDEM TPS

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
9	Lighting	BHEL	BHEL	
10	Equipment grounding (including electronic earthing) & lightning protection	BHEL	BHEL	Refer note no. 4 for electronic earthing
11	Below grade grounding	BHEL	BHEL	
12	LT Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to customer/ BHEL approval at contract stage.
13	Mandatory spares	Vendor	-	Vendor to quote as per specification.
14	Recommended O & M spares	Vendor	-	As specified elsewhere in specification
15	Any other equipment/ material/ service required for completeness of system based on system offered by the vendor (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	
16	a) Input cable schedules (Control & Screened Control Cables) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable and electronic earthing cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
17	Electrical Equipment & cable tray layout drawings	Vendor	-	For ensuring cabling requirements are met, vendor shall furnish Electrical equipment layout & cable tray layout drawings (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipment requiring cabling, and shall incorporate cable trays routing details marked on the drawing as per PEM interface comments. Cabling arrangement of the same (wherever overhead cable trays, trenches, cable ducts, conduits etc.) shall be decided during contract stage. Electrical equipment layout & cable tray layout drawing shall be subjected to BHEL/ customer approval without any commercial implications to BHEL.
18	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGE : CONDENSATE POLISHING UNIT (CPU)

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

PROJECT: 1 x 800 MW KOTHAGUDEM TPS

NOTES:

1. Make of all electrical equipment/ items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.
3. In case the requirement of Junction Box arises on account of Power Cable size mis-match due to vendor engineering at later stage, vendor shall supply the Junction Box for suitable termination.
4. Vendor shall indicate location of Electronic Earth pit in their Civil assignment drawing.

**Telangana State Power Generation Corporation Ltd
1x800 MW Kothagudem TPS**

**EPC Bid Document
e-PCT/TS/K/02/2014-15**

**TECHNICAL SPECIFICATION
FOR
A.C. & D.C. MOTORS**

DEVELOPMENT CONSULTANTS
(e-PCT/TS/K/02/2014-15/V-A/SEC-II)

CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE
2.00.00	CODES & STANDARDS
3.00.00	SERVICE CONDITIONS
4.00.00	TYPE AND RATING
5.00.00	PERFORMANCE
6.00.00	SPECIFIC REQUIREMENTS
7.00.00	ACCESSORIES
8.00.00	TESTS
9.00.00	DRAWINGS, DATA & MANUALS
ATTACHMENT	
ANNEXURE-A	DESIGN DATA

**TECHNICAL SPECIFICATION
FOR
A.C. & D.C. MOTORS**

- 1.00.00 **SCOPE**
- 1.01.00 This section covers the general requirements of the drive motors for power station auxiliary equipment.
- 1.02.00 Motors shall be furnished in accordance with both this general specification and the accompanying driven equipment specification.
- 1.03.00 In case of any discrepancy, the driven equipment specification shall govern.
- 2.00.00 **CODES & STANDARDS**
- 2.01.00 All motors shall conform to the latest applicable IS, IEC and CBIP Standards/ Publications except when otherwise stated herein or in the driven equipment specification.
- 2.02.00 Major standards, which shall be followed, are listed below other applicable Indian Standards for any component part even if not covered in the listed standards shall also be followed:
- i) IS-325
- ii) IS-12615
- iii) IEC-60034
- 3.00.00 **SERVICE CONDITIONS**
- 3.01.00 The motors will be installed in hot, humid and tropical atmosphere highly polluted at places with coal dust and/or fly ash.
- 3.02.00 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the annexure to this specification.
- 3.03.00 For motor installed outdoor and exposed to direct sunrays, the effect of solar heat shall be considered in the determination of the design ambient temperature.
- 4.00.00 **TYPE AND RATING**
- 4.01.00 **A.C. Motors**
- 4.01.01 Motors shall be general purpose, constant speed, squirrel cage, three/single phase, induction type.

- 4.01.02 All motors shall be rated for continuous duty. They shall also be suitable for long period of inactivity.
- 4.01.03 LT motor & HT motor name-plate rating at 50°C shall have at least 15% margin and 10% margin respectively over the input power requirement of the driven equipment at rated duty point unless stated otherwise in driven equipment specification.
- 4.01.04 The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating, pull up, break down and full load torques are available for the intended service.
- 4.01.05 Motors efficiency class shall be IE1, IE2 as per latest version of IEC-60034.
- 4.02.00 **D.C. Motors**
- 4.02.01 D.C. motor provided for emergency service shall be shunt/compound wound type.
- 4.02.02 Motor shall be sized for operation with fixed resistance starter for maximum reliability.
- Starter panel complete with all accessories shall be included in the scope of supply.
- 5.00.00 **PERFORMANCE**
- 5.01.00 **Running Requirements**
- 5.01.01 Motor shall run continuously at rated output over the entire range of voltage and frequency variations as given in the annexure.
- 5.01.02 The motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals.
- 5.01.03 The motor shall be designed to withstand momentary overload of 60% of full load torque for 15 second without any damage.
- 5.02.00 **Starting Requirements**
- Motor shall be designed for direct online starting at full voltage. Breakaway starting current as percentage of full load current for various motor rating shall not exceed the given below-
- | | | |
|---------------------|---|---|
| Motors up to 1500kW | - | 600% subject to IS tolerance of plus 20%. |
| Motors above 1500kW | - | 450% not subject to any positive tolerance. |
- 5.02.01 The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage.

- 5.02.02 Motor shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminals except mill motor. Mill motor shall start with rated load and accelerate to full speed at 85% of the rated voltage at the motor terminals.
- 5.02.03 a) Two hot starts in succession with motor initially at normal running temperature.
b) Pump motor subject to reverse rotation shall be designed to withstand the stresses encountered when starting with shaft rotating at 125% rated speed in reverse direction.
- 5.02.04 The motors shall be designed to withstand 120% of rated speed for 2 minutes without any mechanical damage.
- 5.03.00 **Stress During Bus Transfer**
- 5.03.01 The motor may be subjected to sudden application of 150% rated voltage during bus transfer, due to the phase difference between the incoming voltage and motor residual voltage.
- 5.03.02 The motor shall be designed to withstand any torsional and/or high current stresses, which may result, without experiencing any deterioration in the normal life and performance characteristics.
- 5.04.00 **Locked Rotor Withstand Time**
- 5.04.01 The locked rotor withstand time under hot condition at 110% rated voltage shall be more than motor starting time by at least 3 seconds for motors up to 20 seconds starting time and by 5 seconds for motor with more than 20 seconds starting time.
- 5.04.02 Starting time mentioned above is at minimum permissible voltage of 80% rated voltage.
- 5.04.03 Hot thermal withstand curve shall have a margin of at least 10% over the full load current of the motor to permit relay setting utilising motor rated capacity.
- 6.00.00 **SPECIFIC REQUIREMENTS**
- 6.01.00 **Enclosure**
- 6.01.01 All motor enclosures for outdoor, semi-outdoor & indoor application shall conform to the degree of protection IP-55 unless otherwise specified. Motor for outdoor or semi-outdoor service shall be of weather-proof construction with canopy.
- 6.01.02 For hazardous area approved type of increased safety enclosure shall be furnished.
- 6.02.00 **Cooling**
- 6.02.01 The motor shall be self ventilated type, either totally enclosed fan cooled IC 411(TEFC), totally enclosed tube ventilated IC 511(TETV) or closed air circuit air- cooled IC 611(CACA).

- 6.02.02 For large capacity motors not available with above type of cooling may be accepted with IC 81W or IC 91W, closed air circuit water cooled (CACW) subject to the approval of the owner.
- 6.03.00 **Winding and Insulation**
- 6.03.01 All insulated winding shall be of copper.
- 6.03.02 All motors shall have class F insulation but limited to class B temperature rise.
- 6.03.03 Windings shall be impregnated to make them non-hygroscopic and oil resistant.
- 6.04.00 **Tropical Protection**
- 6.04.01 All motors shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.
- 6.04.02 All fittings and hardwares shall be corrosion resistant.
- 6.05.00 **Bearings**
- 6.05.01 Motor shall be provided with antifriction bearings, unless sleeve bearings are required by the motor application. Bearings shall be rated for minimum service life of 40,000Hrs.
- 6.05.02 Vertical shaft motors shall be provided with thrust and guide bearings. Thrust bearing of tilting pad type is preferred.
- 6.05.03 Bearings shall be provided with seals to prevent leakage of lubricant or entrance of foreign matters like dirt, water etc. into the bearing area.
- 6.05.04 Sleeve bearings shall be split type, ring oiled, with permanently aligned, close running shaft sleeves.
- 6.05.05 Grease lubricated bearings shall be pre-lubricated and shall have provisions for in-service positive lubrication with drains to guard against over lubrication. LT motors 15kW and above shall be provided with external greasing arrangement.
- 6.05.06 Oiled bearing shall have an integral self cooled oil reservoir with oil ring inspection ports, oil sight glass with oil level marked for standstill and running conditions and oil fill and drain plugs.
- 6.05.07 Forced lubricated or water cooled bearing shall not be used without prior approval of Owner.
- 6.05.08 Lubricant shall not deteriorate under all service conditions. The lubricant shall be limited to normally available types with IOC equivalent.
- 6.05.09 Bearings shall be insulated as required to prevent shaft current and resultant bearing damage.
- 6.06.00 **Noise & Vibration**

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- 6.06.01 All HT motors shall be provided with vibration pads for mounting of vibration detectors. Vibration monitoring devices shall be provided on DE and NDE side in x&y direction with remote DCS monitoring, alarm and tripping.
- 6.06.02 The maximum double amplitude vibrations for HT motors upto 1500 rpm shall be 25 microns and 15 microns upto 3000 rpm. For 415V motors, maximum double amplitude vibrations upto 1500 rpm shall be 40 microns and 15 microns upto 3000 rpm.
- 6.06.03 The noise level shall not exceed 85db (A) at 1.5 meters from the motor.
- 6.07.00 **Motor Terminal Box**
- 6.07.01 Motor terminal box shall be detachable type and located in accordance with Indian Standards clearing the motor base- plate/ foundation
- 6.07.02 Terminal box shall be capable of being turned 360 Deg. in steps of 180 Deg. for HT motors and 90 Deg. for LT motors unless otherwise approved.
- 6.07.03 The terminal box shall be split type with removable cover with access to connections and shall have the same degree of protection as motor.
- 6.07.04 The terminal box shall have sufficient space inside for termination/connection of XLPE insulated armoured aluminium cables.
- 6.07.05 Terminals shall be stud or lead wire type, substantially constructed and thoroughly insulated from the frame.
- 6.07.06 The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor.
- 6.07.07 The terminal box shall be capable of withstanding maximum system fault current for a duration of 0.25 sec.
- 6.07.08 For 11000V and 3300V motor, the terminal box shall be phase-segregated type. The neutral leads shall be brought out in a separate terminal box (not necessarily phase segregated type) with shorting links for star connection.
- 6.07.09 Motor terminal box shall be furnished with suitable cable lugs and double compression brass glands to match with cable used.
- 6.07.10 The gland plate for single core cable shall be non-magnetic type.
- 6.07.11 Minimum clearances to be provided between phase to phase and phase to earth shall be as under-

Voltage Rating of Motor	Minimum Ph-Ph & Ph-Earth clearance
0.415 kV	: 25 mm
3.3 kV	: 65 mm
11.0 kV	: 140 mm

Note: In case it is not possible to maintain these clearances, the live parts shall be totally insulated from earth and other Phases. Adequate clearances shall be provided for cable connections.

6.08.00 **Grounding**

6.08.01 The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GI bolts and washer.

6.08.02 The grounding connection shall be suitable for accommodation of ground conductors as follows:

Rating		Conductor Size	
Above	Up to		
-----	5.5 kW	:	8 SWG GI Wires.
5.5 kW	22 kW	:	25mm X 4mm GS Flat.
23 kW	55 kW	:	40mm X 6mm GS Flat.
56kW	174kW	:	50mm X 8mm GS Flat.
175kW	ABOVE	:	75mm X 10mm GS Flat.

6.08.03 The cable terminal box shall have a separate grounding pad.

6.09.00 **Minimum Cable Size for LT & HT Motors shall as be as follows-**

a) For 415V, 3-Ph, LT Motors-

Rating		Cable Size	
Above	Up to		
-----	5.5 kW	:	1R X 3C X 6 Sq.mm
5.5 kW	11 kW	:	1R X 3C X 10 Sq.mm
11 kW	22 kW	:	1R X 3C X 35 Sq.mm
22 kW	37.5 kW	:	1R X 3C X 70 Sq.mm.
37.5kW	55 kW	:	1R X 3C X 150 Sq.mm
55 kW	75 kW	:	1R X 3C X 300 Sq.mm
75 kW	110kW	:	2R X 3C X 150 Sq.mm
110 kW	175kW	:	2R X 3C X 300 Sq.mm

b) For 3.3kV & 11kV, 3-Ph, HT Motors-

Rating		Cable Size	
Above	Up to		

175 kW	1000 kW	:	1R X 3C X 240 Sq.mm
1000 kW	2000 kW	:	2R X 3C X 240 Sq.mm
2000 kW	4500 kW	:	2R X 3C X 300 Sq.mm
4501 kW	10,000 kW	:	9R X 1C X 1000 Sq.mm.

Note: During detail engineering if higher cable size is required same shall be provided.

6.10.00 **Rating Plate**

In addition to the minimum information required by IS, the following information shall be shown on motor rating plate :

- Temperature rise in Deg.C under rated condition and method of measurement.
- Degree of protection.
- Bearing identification no. and recommended lubricant.
- Location of insulated bearings.

7.00.00 **ACCESSORIES**

7.01.00 **General**

Accessories shall be furnished, as listed below, or if otherwise required by driven equipment specification or application.

7.02.00 **Space Heater**

7.02.01 Motor of rating 30 kW and above shall be provided with space heaters, suitably located for easy removal or replacement.

7.02.02 The space heater shall be rated 240 V, 1 Phase, 50Hz and sized to maintain the motor internal temperature above dew point when the motor is idle.

7.02.03 Minimum Cable Size for space heater shall be as listed-

- For LT motors: 2.5 sq.mm, 2-Core copper cable complying with IS-1554(Part-1).
- For HT motors: 6 sq.mm, 2 Core aluminium cable complying with IS-1554(Part-1).

7.03.00 **Temperature Detectors**

7.03.01 All 11000V and 3300V motors shall be provided with twelve (12) nos. simplex type winding temperature detectors, four (4) nos. per phase.

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- 7.03.02 11000V and 3300V motor bearing shall be provided with duplex type temperature detectors.
- 7.03.03 The temperature detector mentioned above shall be resistance type, 3 wire, platinum wound, 100 Ohms at 0°C.
- 7.03.04 Leads of all simplex type motor winding RTDS and motor bearing RTDS shall be wired up to respective switchgear metering & protection compartment. From which one set of RTDS will be connected to numerical protection relay and another set shall be kept free for DDCMIS connectivity.
- 7.03.05 0.5 sq.mm annealed tinned copper conductor complying with IS-1554(Part-1). shall be used for RTD/BTD wiring.
- 7.04.00 **Indicator/Switch**
- 7.04.01 Dial type local indicator with alarm contacts shall be provided for the following:
- a) 11000 V and 3300V motor bearing temperature.
 - b) Hot and cold air temperature of the closed air circuit for CACA and CACW motor.
- 7.04.02 Flow switches shall be provided for monitoring cooling water flow of CACW motor and oil flow of forced lubrication bearing, if used. CACW motor shall be provided with water leakage detector with remote alarm and tripping.
- 7.04.03 Alarm switch contact rating shall be minimum 2.0 A at 220V D.C. and 10A at 240V A.C.
- 7.05.00 **Current Transformer for Differential Protection**
- 7.05.01 Motor 1000 kW and above shall be provided with three differential current transformers mounted over the neutral leads within the enclosure.
- 7.05.02 The arrangement shall be such as to permit easy access for C.T. testing and replacement. Current transformer characteristics shall match Owner's requirements to be intimated later.
- 7.06.00 **Accessory Terminal Box**
- 7.06.01 All accessory equipment such as space heater, temperature detector, current transformers etc., shall be wired to and terminated in terminal boxes, separate from and independent of motor (power) terminal box.
- 7.06.02 Accessory terminal box shall be complete with double compression brass glands and pressure type terminals to suit owner's cable connections.
- 7.07.00 **Drain Plug**
- Motor shall have drain plugs so located that they will drain the water, resulting from the condensation or other causes from all pockets of the motor casing.

7.08.00 **Lifting Provisions**

Motor weighing 25 Kg. or more shall be provided with eyebolt or other adequate provision of lifting.

7.09.00 **Dowel Pins**

The motor shall be designed to permit easy access for drilling holes through motor feet or mounting flange for installation of dowel pins after assembling the motor and driven equipment.

7.10.00 **Painting**

PL. REFER PAINTING SCHEDULE OF MECHANICAL SPECIFICATION

8.00.00 **TESTS**

Routine and Type Tests are to be conducted in presence of customer's representative as per IS:325 and in addition, any special test called for in the driven equipment specification shall be performed and required copies of test certificates are to be furnished for approval. In addition, following tests shall have to be carried out on the motors in presence of OWNER's representative on 3.3kV/11kV motors.

- a. Impulse test by 1.2 / 50 micro sec. On sample coil of Stator winding insulation as type test as per IEC-60034, part -15 test voltages as under :

Voltage rating of motor	Impulse Test Voltage
3.3 kV	18 kV peak
11 kV	49 kV peak

- b. Tan delta, charging current and dielectric loss measurements on each phase of motor stator winding as routine test.
- c. Polarization Index Test as per IS: 7816 as routine test
- d. Test for suitability of IPW– 55(Weather proof) as per IS 4691 as type test. Type test certificate for first numeral shall be acceptable in lieu to test, provided the test motor is identical to motor being supplied. Second numeral test shall be carried out on one motor of each type and rating.
- e. Fault Withstand Test for main terminal box as type test. Type test certificate shall be acceptable, if the test is conducted on exactly identical terminal box.
- f. Test for noise level as routine test.
- g. Test for vibration as routine test.

- h. Tan delta measurement on coils.
- i. Surge withstand test for inter turn insulation.
- j. Test to diagnose rotor bar failure during manufacture.
- k. Over speed test as routine test.
- l. Temperature rise test.

Temperature rise under normal condition above ambient temperature shall be limited to-

Specified Design Ambient temperature	Thermometer Method	Resistance Method
50 deg.C	60 deg.C	70 deg.C
45 deg.C	65 deg.C	75 deg.C
40 deg.C	70 deg.C	80 deg.C

Tests indicated at (h), (i), (j) shall be carried out during manufacture of the coils and shall be furnished for verification.

9.00.00 **DRAWINGS, DATA & MANUALS**

9.01.00 Drawings, Data & Manuals shall be submitted in triplicate with the bid and in quantities and procedures as specified in General Conditions of Contract and/or elsewhere in the specification for approval and subsequent distribution after the issue of 'Letter of Intent'.

9.02.00 **To be Submitted with the bid**

- a) List of the motors
- b) Individual motor data sheet as per format of the proposal data sheets.
- c) Scheme & write-up on forced lubrication system, if any
- d) Type test report

9.03.00 **To be submitted for Owner / Purchaser's Approval and Distribution**

All relevant drawings and data pertaining to the equipment like GTP, GA drawing, foundation plan, QAP, etc. shall be submitted by the Bidder for approval of Owner/Owner's consultant. ~~Also refer clause no. 1.19.02(u) of Section-I of Volume - V-A: Technical Specifications for Electrical Equipment & Accessories.~~

ANNEXURE-A**DESIGN DATA**

1.0 AUXILIARY POWER SUPPLY

Supply	Description	Consumer
H.V. Supply	11000 V, 3Ø, 3W, 50 Hz, Non-effectively earthed Fault level 44 kA symm. for 1 sec.	Motors 1500 kW & above
M.V. Supply	3300 V, 3Ø, 3W, 50 Hz, Non-effectively earthed Fault level 40 kA symm. for 1 sec.	Motors 175 kW and Up to less than 1500 kW.
L.V. Supply (i)	415V, 3Ø, 3W, 50 Hz effectively earthed Fault level 50 kA symm. for 1 sec.	Motors above 0.2kW and below 175kW.
	240V, 1Ø, 2W, 50 Hz effectively earthed	Lighting, Space heat- ing , A.C supply for Contr- ol & protective devices.
D.C. Supply	220V, 2W, unearthed Fault level 25* kA. for 1 sec.	D.C. alarm, control & protective devices

* Indicative only, the actual value will be decided by the Bidder, after substantiating the same by calculation.

Note-

- 415V or 3.3 kV may be adopted by the bidder for the drives in the range of 160-210 kW.
- 3.3 kV AC supply for CHP conveyor motors of rating above 160 kW is to be used.
- The voltage rating of the drives indicated above is for basic guideline. Minor variations can be accepted on case to case basis based on techno-economic considerations of the various sub-systems.
- Voltage rating for special purpose motors viz, VFD and screw compressors, shall be as per manufacturer's standard. All the motors ratings on Stacker/ reclaimer shall be 415V ac supply only.

2.0 RANGE OF VARIATION**A.C. Supply :**

Voltage	:	± 10%
Frequency	:	+3% to -5%
Combined Volt + frequency	:	10% (absolute sum)

During starting of large motor, the voltage may drop to 80% of the rated voltage for a period of 60 seconds. All electrical equipment while running shall successfully ride over such period without affecting system performance.

D.C. Supply :

Voltage	:	187 to 242 Volt
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**TECHNICAL SPECIFICATION
FOR
ELECTRIC MOTOR ACTUATORS**

DEVELOPMENT CONSULTANTS
(e-PCT/TS/K/02/2014-15/IV-A/SEC-III)

CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE
2.00.00	STANDARDS
3.00.00	SERVICE CONDITIONS
4.00.00	RATING
5.00.00	PERFORMANCE
6.00.00	SPECIFIC REQUIREMENT
7.00.00	ACCESSORIES
8.00.00	TEST
9.00.00	DRAWINGS, DATA & MANUALS
ATTACHMENT	
ANNEXURE-A	DESIGN DATA

**TECHNICAL SPECIFICATION
FOR
ELECTRIC MOTOR ACTUATORS**

- 1.00.00 **SCOPE**
- 1.01.00 This Section covers the general requirements of Electric Motor Actuators for valves/dampers.
- 1.02.00 All electric motor actuators shall be furnished in accordance with this general specification and the accompanying driven equipment specification. All the electrical actuators shall be INTEGRAL type only.
- 2.00.00 **STANDARDS**
- 2.01.00 All electrical equipment shall conform to the latest applicable IS, ANSI and NEMA Standards, except when stated otherwise herein or in driven equipment specification.
- 2.02.00 Major standards, which shall be followed, are listed below. Other applicable Indian Standards for any component part even if not covered in the listed standards shall also be followed
- i) IS-9334
- ii) IS-325
- 3.00.00 **SERVICE CONDITIONS**
- 3.01.00 The actuator shall be suitable for operation in hot, humid and tropical atmosphere, highly polluted at places with coal dust and/or fly ash.
- 3.02.00 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the general specification.
- 3.03.00 For actuator motor installed outdoor and exposed to direct sun rays, the effect of solar heat shall be considered in the determination of the design ambient temperature.
- 4.00.00 **RATING**
- 4.01.00 For isolating service, the actuator shall be rated for three successive open-close operation of the valve/damper or 15 minutes, whichever is longer.
- 4.02.00 For regulating service, the actuator shall be suitably time-rated for the duty cycle involved with necessary number of starts per hour, but in no case less than 150 starts per hour.

- 5.00.00 **PERFORMANCE**
- The actuator shall meet the following performance requirements:
- 5.01.00 Open and close the valve completely and make leak-tight valve closure without jamming.
- 5.02.00 Attain full speed operation before valve load is encountered and imparts an unseating blow to start the valve in motion (hammer blow effect).
- 5.03.00 Operate the valve stem at standard stem speed and shall function against design differential pressure across the valve seat.
- 5.04.00 The motor reduction gearing shall be sufficient to lock the shaft when the motor is de-energised and prevent drift from torque switch spring pressure.
- 5.05.00 The entire mechanism shall withstand shock resulting from closing with improper setting of limit switches or from lodging of foreign matter under the valve seat.
- 6.00.00 **SPECIFIC REQUIREMENT**
- 6.01.00 **Construction**
- 6.01.01 The actuator shall essentially comprise the drive motor, torque/ limit switches, gear train, clutch, hand wheel, position indicator/ transmitter, in-built thermostat for over load protection, space heater and internal wiring.
- 6.01.02 The actuator enclosure shall be totally enclosed, dust tight, weather-proof suitable for outdoor use without necessity of any canopy. Degree of protection of enclosure for motor actuator shall be IP-65.
- 6.01.03 All electrical equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth.
- 6.01.04 The actuator shall be designed for mounting in any position without any lubricant leakage or operating difficulty.
- 6.02.00 **Motor**
- 6.02.01 The drive motor shall be three phase, squirrel cage, induction machine with minimum class B insulation and IPW-55 enclosure, designed for high torque and reversing service. Canopy shall be provided for outdoor service.
- 6.02.02 The motor shall be designed for full voltage direct on-line start, with starting current limited to 6 times full-load current.
- 6.02.03 The motor shall be capable of starting at 85 percent of rated voltage and running at 80 percent of rated voltage at rated torque and 85 percent rated voltage at 33 percent excess rated torque for a period of 5 minutes each.
- 6.02.04 Motor leads shall be terminated in the limit switch compartment.
- 6.02.05 Motor actuators for valves/dampers shall be with integral starter with 3phase/3wire, 415V AC and operable from remote.

- 6.02.06 Earthing terminals shall be provided on either side of the motor.
- 6.03.00 **Limit Switches**
- Each actuator shall be provided with following limit switches: -
- 6.03.01 2 torque limit switches, one for each direction of travel, self-locking, adjustable torque type.
- 6.03.02 4 end-of-travel limit switches, two for each direction of travel.
- 6.03.03 2 position limit switches, one for each direction of travel, each adjustable at any position from fully open to fully closed positions of the valve/damper.
- 6.03.04 Each limit switch shall have 2 NO + 2 NC potential free contacts. Contact rating shall be 5A at 240V A.C. or 0.5A at 220V D.C.
- 6.04.00 **Hand Wheel**
- Each actuator shall be provided with a hand wheel for emergency manual operation. The hand wheel shall declutch automatically when the motor is energized.
- 6.05.00 **Position Indicator/Transmitter**
- The actuator shall have:
- 6.05.01 One (1) built-in local position indicator for 0-100% travel.
- 6.05.02 One (1) position transmitter, 4-20 mA current signal as position feedback, for remote indicator.
- 6.06.00 **Space Heater**
- A space heater shall be included in the limit switch compartment suitable for 240V, 1 phase, 50 Hz supply.
- 6.07.00 **Wiring**
- All electrical devices shall be wired up to and terminated in a terminal box. All wiring shall be done with 1100V grade fire resistance PVC insulated stranded copper conductor of not less than 2.5 Sq.mm cross section. All wiring shall be identified at both ends with ferrules. All the electrical actuators shall have uniform wiring.
- 6.08.00 **Terminal Box**
- The terminal box shall be weather proof, with removable front cover and cable glands for cable connection. The terminal shall be suitable for connection of 2.5 Sq.mm copper conductor.
- 7.00.00 **ACCESSORIES**

As required for the driven equipment, the actuator shall be furnished with starting equipment mounted on the actuator. This shall include:

- 7.01.00 One (1) triple pole MCCB
- 7.02.00 One (1) reversing starter with mechanically interlocked contactors, 3 thermal overload relays, 2 NO + 2 NC auxiliary contacts for each contactor.
- 7.03.00 One (1) remote-local selector switch.
- 7.04.00 CLOSE-STOP-OPEN oil tight push buttons with indication lights.
- 7.05.00 415/240 V control transformer with primary & secondary fuses.

8.00.00 TEST

The actuator and all components thereof shall be subject to tests as per relevant Standards. In addition, if any special test is called for in equipment specification, the same shall be performed.

9.00.00 DRAWINGS, DATA & MANUALS

- 9.01.00 Drawings, Data & Manuals shall be submitted in triplicate with the bid and in quantities and procedures as specified in General Conditions of Contract and/or elsewhere in the specification for approval and subsequent distribution after the issue of 'Letter of Intent'.

9.02.00 To be submitted with Bid

Data sheet for each type of actuator shall be furnished along with internal wiring diagram, suggested control schematic and torque limit switch contact development and manufacturer's catalogues. Drawings, Data & Manuals shall be submitted in triplicate with the bid and in quantities and procedures as specified in General Conditions of Contract and/or elsewhere in the specification for approval and subsequent distribution after the issue of 'Letter of Intent'.

9.03.00 To be submitted for Owner / Purchaser's Approval and Distribution

All relevant drawings and data pertaining to the equipment like GTP, GA drawing, foundation plan, BOM, control & schematics, QAP, etc. shall be submitted by the Bidder for approval of Owner/Owner's consultant. ~~Also refer clause no. 1.19.02(u) of Section I of Volume V-A: Technical Specifications for Electrical Equipment & Accessories.~~

ANNEXURE-A**DESIGN DATA**

1.0 AUXILIARY POWER SUPPLY

Supply	Description	Consumer
L.V. Supply (i)	415V, 3Ø, 3W, 50 Hz Effectively earthed Fault level 50 kA symm. for 1 sec.	Motors above 0.2kW upto less than 175kW.
	240V, 1Ø, 2W, 50 Hz effectively earthed	Lighting, Space heat- ing , A.C supply for Contr- & protective devices.
D.C. Supply	220V, 2W, unearthed Fault level 25* kA. for 1 sec.	D.C. alarm, control & protective devices

* Indicative only, the actual value will be decided by the Bidder, after substantiating the same by calculation.

2.0 RANGE OF VARIATION


A.C. Supply :

Voltage	:	± 10%
Frequency	:	+3% to -5%.
Combined Volt + frequency	:	10% (absolute sum)

During starting of large motor, the voltage may drop to 80% of the rated voltage for a period of 60 seconds. All electrical equipment while running shall successfully ride over such period without affecting system performance.

D.C. Supply :

Voltage	:	187 to 242
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	TITLE	SPECIFICATION NO.
	MOTOR DATA SHEET - C	VOLUME II B
		SECTION D
		REV NO. 00 DATE 08/09/2010
		SHEET 1 OF 7


LT MOTORS**A. GENERAL**

1. Manufacturer & Country of origin.
(Shall be as per approved QA make)
2. Equipment driven by motor
3. Motor type
4. Quantity

B. DESIGN AND PERFORMANCE DATA


1. Frame size
2. Type of duty
3. Type of enclosure /Method of cooling/Degree of protection
4. Applicable standard to which motor generally conforms
5. Efficiency class as per IS 12615
6. (a) Whether motor is flame proof Yes/No
(b) If yes, the gas group to which it conforms as per IS:2148
7. Type of mounting
8. Direction of rotation as viewed from DE END__
9. Standard continuous rating at 40 deg.C. ambient temp. as per Indian Standard (KW)
10. Derated rating for specified normal condition i.e. 50 deg. C ambient temperature (KW)
11. Maximum continuous load demand of driven equipment in KW
12. Rated Voltage (volts)
13. Permissible variation of :

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

	TITLE	SPECIFICATION NO.
	MOTOR DATA SHEET - C	VOLUME II B
		SECTION D
		REV NO. 00 DATE 08/09/2010
		SHEET 2 OF 7

- a. Voltage (Volts)
 - b. Frequency (Hz)
 - c. Combined voltage and frequency
14. Rated speed at rated voltage and frequency(RPM)
15. At rated Voltage and frequency:
- a. Full load current
 - b. No load current
16. Power Factor at
- a. 100% load
 - b. NO load
 - c. Starting.
17. Efficiency at rated voltage and frequency,
- a. 100% load
 - b. 75% load
 - c. 50% load
18. Starting current (amps) at
- a. 100 % voltage
 - b. 85% voltage
 - c. 80% voltage
19. Minimum permissible starting Voltage (Volts)
20. Starting time with minimum permissible voltage
- a. Without driven equipment coupled
 - b. With driven equipment coupled

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			


	TITLE	SPECIFICATION NO.
	MOTOR DATA SHEET - C	VOLUME II B
		SECTION D
		REV NO. 00 DATE 08/09/2010
		SHEET 3 OF 7

21. Safe stall time with 100% and 110% of rated voltage
- a. From hot condition
 - b. From cold condition
22. Torques :
- a. Starting torque at min. permissible voltage(kg-mtr.)
 - b. Pull up torque at rated voltage.
 - c. Pull out torque
 - d. Min accelerating torque (kg.m) available
 - e. Rated torque (kg.m)
23. Stator winding resistance per phase (ohms at 20 Deg.C.)
24. GD^2 value of motors
25. No of permissible successive starts when motor is in hot condition
26. Locked Rotor KVA Input
27. Locked Rotor KVA/KW
28. Vibration limit :Velocity (mm/s)
29. Noise level limit (dBA)

C. CONSTRUCTIONAL FEATURES


1. Stator winding insulation
 - a. Class & Type
 - b. Winding Insulation Process
 - c. Tropicalised (Yes/No)

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

	TITLE	SPECIFICATION NO.
	MOTOR DATA SHEET - C	VOLUME II B
		SECTION D
		REV NO. 00 DATE 08/09/2010
		SHEET 4 OF 7

- d. Temperature rise over specified maximum ambient temperature of 50 deg C
 - e. Method of temperature measurement
 - f. Stator winding connection
2. Main Terminal Box
- a. Type
 - b. Location (viewed from NDE side)
 - c. Entry of cables(bottom/side)
 - d. Recommended cable size (To be matched with cable size envisaged by owner)
 - e. Fault level (MVA), Fault level duration (sec)
 - f. Cable glands & lugs details (shall be suitable for power cable)
3. Type of DE/NDE Bearing
4. Motor Paint shade
5. Weight of
- a. Motor stator (KG)
 - b. Motor Rotor (KG)
 - c. Total weight (KG)
- D. List of accessories.**
- 1. Space Heaters (Applicable for 30 KW & above motor) (Nos./Power in watts/supply voltage)
 - 2. Terminal Box for Space Heater (Yes/No)
 - 3. Speed switch (Yes/No)
No of contacts and contact ratings of speed switch

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

	TITLE	SPECIFICATION NO.
	MOTOR DATA SHEET - C	VOLUME II B
		SECTION D
		REV NO. 00 DATE 08/09/2010
		SHEET 5 OF 7

4. Insulation of bearing (Yes/No)

5. Noise reducer(Yes/No)

6. Grounding pads

i) No and size on motor body

ii) Nos on terminal Box

7. Vibration pads

i) Nos and size

ii) Location

8. Any other fitments

E. List of curves.

1. Torque speed characteristic of the motor

2. Thermal withstand characteristic

3. Starting. current Vs. Time

4. Starting. current Vs speed

5. P.F. and Effi. Vs Load

F. Additional Data to be filled for each rating of DC Motor

1. Rated armature voltage (Volt)

2. Rated field excitation (Amp)

3. Permissible % variation in voltage


4. Minimum Permissible Starting voltage (volt)

5. At rated voltage

i) Full load Armature current.(Amp)


ii) Full load Field current (Amp)

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

	TITLE	SPECIFICATION NO.
	MOTOR DATA SHEET - C	VOLUME II B
		SECTION D
		REV NO. 00 DATE 08/09/2010
		SHEET 6 OF 7

- iii) No load Armature current (Amp)
6. Full load Field current (Amp)
7. No load Aramature current (Amp)
8. Minimum permissible field current(Amp) to avoid overspeeding at
- i) Maximum permissible voltage
- ii) Rated voltage
- iii) Minimum Permissible Voltage
9. Resistance (indicative Values) in ohm
- i) Armature winding (Arm + IP + Series) at 25 deg.C
- ii) Field Winding at 25 deg. C
10. Inductance (indicative values)
- i) Armature winding
- ii) Field winding
11. Value of trimmer resistance (ohm) to be connected in series with the shunt field to obtain rated speed at
- i) 220 V DC
- ii) 250 V DC
- iii) 187 V DC
12. Value of the external resistance (ohm) required to be connected in series with armature during starting only
13. Technical data sheet for external resistance box
14. GA drawing of motor
15. Starting time calculation

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

	TITLE MOTOR DATA SHEET - C	SPECIFICATION NO.	
		VOLUME	II B
		SECTION D	
		REV NO. 00	DATE 08/09/2010
		SHEET 7	OF 7


- 16. Starter resistance design calculation
- 17. Electrical connection diagram of motor

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			


THIS IS A PART OF TECHNICAL SPECIFICATION NO.-PE-TS-410-155A-A001

SL. NO.	COMPONENT/OPERATION	QUALITY PLAN CHARACTERISTICS CHECK	CUSTOMER :				PROJECT				SPECIFICATION :					
			BIDDER/ VENDOR SYSTEM		TITLE		1X800MW KOTHAGUDEM		NUMBER :		SPECIFICATION TITLE		SECTION		VOLUME III	
			CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	P	W	V	AGENCY	REMARKS			
1	2	3	4	5	6	7	8	9	10	11						
1.0	ASSEMBLY	1.WORKMANSHIP 2.DIMENSIONS 3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE 1.SHADE	MA	VISUAL	100%	MANUF'S SPEC	MANUF'S SPEC	-DO-	2	-						
2.0	PAINTING		MA	-DO-	-DO-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	-DO-	2	-						
3.0	TESTS	1.ROUTINE, TYPE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC. 2.OVERALL DIMENSIONS & ORIENTATION	MA	-DO-	100%	IS-325/ BHEL SPEC/ DATA SHEET	SAME AS COL.7	TEST REPORT	2	1*				* NOTE -1 & NOTE-3		
			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													


THIS IS A PART OF TECHNICAL SPECIFICATION NO.-PE-TS-410-155A-A001

		QUALITY PLAN		CUSTOMER :		PROJECT TITLE		SPECIFICATION :		
		BIDDER/ VENDOR SYSTEM		1X800MW KOTHAGUDEM		QUALITY PLAN		NUMBER :		
SHEET 2 OF 2		NUMBER PED-506-00-Q-006, REV-01		ITEM AC.ELECT. MOTORS BELOW 55KW (LV)		FORMAT OF RECORD		TITLE :		
SL. NO.	COMPONENT/OPERATION CHARACTERISTICS CHECK	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	SECTION				
						P	W	V		
1	2	3	4	5	6	7	8	9	10	11
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1
<p style="text-align: center;">NOTES:</p> <p>1. ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE, TYPE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON</p> <p>2. WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.</p> <p>3. FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY.</p> <p style="text-align: center;"><u>Legends for Inspection agency</u></p> <p>1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER)</p> <p>P. PERFORM W. WITNESS V. VERIFY</p>										
BHEL		PARTICULARS		BIDDER/VENDOR						
		NAME								
		SIGNATURE								
		DATE								
										BIDDER'S/VENDORS COMPANY SEAL

THIS IS A PART OF TECHNICAL SPECIFICATION NO.-PE-TS-410-155A-A001

		QUALITY PLAN		CUSTOMER :			PROJECT			SPECIFICATION :		
				BIDDER/ VENDOR SYSTEM			TITLE			NUMBER :		
SL. NO.	COMPONENT/OPERATION	SHEET 1 OF 9	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION		
										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	MANFRS DRG./SPEC	MANFRS 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	MANFRS DRG./SPEC BOOK	RELEVANT IS/SPEC.	SUPPLIERS TC & LOG	3	-	2
			1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK	3	-	2
1.3	CASTING		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	MANFRS DRG./SPEC	RELEVANT IS/	SUPPLIER'S TC	3	-	2
			3.DIMENSIONS	MA	MEASUREMENT	100%	MANUFRS DRG.	MANUFRS DRG.	LOG BOOK	3	-	2
1.4	PAINT & VARNISH		1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	MANFRS DRG./SPEC	MANFRS 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-410-155A-A001

		QUALITY PLAN		CUSTOMER :		PROJECT TITLE		SPECIFICATION NUMBER :		
				BIDDER/ VENDOR SYSTEM		1X800MMV KOTHAGUDEM		NUMBER :		
SHEET 3 OF 9		CHARACTERISTIC CHECK		EXTENT OF CHECK		ACCEPTANCE NORM		VOLUME III REMARKS		
SL. NO.	COMPONENT/OPERATION	CAT.	TYPE/METHOD OF CHECK	5	6	7	8	9	10	11
1	2	3	4	5	6	7	8	9	10	11
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	MA	VISUAL	100%			NO VISUAL DEFECTS	INSPT. REPORT	3	2
	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)	MA	VISUAL	100%			NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK	3	-
	2. DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE		MANUF'S DRG. . .	MANUF'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	MA	VISUAL	100%			FREE FROM VISUAL DEFECTS	LOG BOOK	3*	2*
	1. SURFACE FINISH	MA	ELECT. & MECH. TEST	SAMPLES		RELEVANT IS/ BS OR OTHER STANDARDS	RELEVANT IS/ BS OR OTHER STANDARDS	SUPPLIER'S TC & VENDOR'S INSPN. REPORTS	3	2
	2. ELECT. PROP. & MECH. PROP	MA								
* 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								
				BIDDERS/VENDORS COMPANY SEAL						

THIS IS A PART OF TECHNICAL SPECIFICATION NO.-PE-TS-410-155A-A001

SL. NO.	COMPONENT/OPERATION	QUALITY PLAN		CUSTOMER :	PROJECT TITLE	SPECIFICATION :					
		SHEET 4 OF 9	CHARACTERISTIC CHECK			BIDDER/ VENDOR SYSTEM	NUMBER :	TITLE	REMARKS		
1	2	3	4	5	6	7	8	9	10	11	
									P	W	V
1.10	BEARINGS	3.DIMENSIONS 1.MAKE & TYPE 2.DIMENSIONS 3.SURFACE FINISH	MA MA MA MA	MEASUREMENT VISUAL MEASUREMENT VISUAL	-DO- 100% SAMPLE 100%	MANFR'S DRG./ APPROVED DATASHEET BHEL DATA SHEET	-DO- MANFR'S DRG./ APPROVED DATASHEET BHEL DATA SHEET BEARING MANUJ'S CATALOGUES FREE FROM VISUAL DEFECTS	Log Book -DO- -DO- -DO-	3 3 3 3	- - - -	2 2 2 2
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND. 2.DIMENSIONS 3.TEMP.WITH- STAND CAPACITY	MA MA MA	VISUAL MEASUREMENT ELECT.TEST	100% SAMPLE -DO-	MANUJ'S DRG MANUJ'S SPEC./BHEL SPEC.	-DO- MANUJ'S DRG MANUJ'S SPEC./ BHEL SPEC.	-DO- -DO- -DO-	3 3 3	- - -	- - 2
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET 2.SURFACE COND. 3.DIMENSIONS	MA MA MA	VISUAL VISUAL MEASUREMENT	100% 100% SAMPLE	MANUJ'S DRG/SPECS MANUJ'S DRG	MANUJ'S DRG/SPECS. FREE FROM VISUAL DEFECTS MANUJ'S DRG	-DO- -DO- -DO- -DO-	3 3 3 3	- - - -	- - - -
BHEL											
PARTICULARS										BIDDER/VENDOR	
NAME											
SIGNATURE											
DATE											
										BIDDERS/VENDORS COMPANY SEAL	

THIS IS A PART OF TECHNICAL SPECIFICATION NO.-PE-TS-410-155A-A001

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

THIS IS A PART OF TECHNICAL SPECIFICATION NO.-PE-TS-410-155A-A001

SL. NO.	COMPONENT/OPERATION	SHEET 6 OF 9	QUALITY PLAN		CUSTOMER :	PROJECT TITLE	1X800MW KOTHAGUDEM		SPECIFICATION : NUMBER :		
			CHARACTERISTIC CHECK	EXTENT OF CHECK			TYPE/METHOD OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION AGENCY
1	2	3	4	5	6	7	8	9	10	11	
2.4	SHEET STACKING	1.COMPLETENESS 2.COMPRESSION & TIGHTENING 3.CORE LOSS & HOTSPOT	MA	MEASUREMENT	SAMPLE	MANUFR'S SPEC.	MANUFR'S SPEC.	Log Book	2	-	
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	MANUFR'S SPEC./BHEL SPEC.	MANUFR'S SPEC./BHEL SPEC.	Log Book	2	1*	
		2.CLEANLINESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	
		3.IR-HV-IR	CR	ELECT. TEST	-DO-	-DO-	-DO-	-DO-	Log Book	2	-
		4.RESISTANCE	CR	-DO-	-DO-	-DO-	-DO-	-DO-	Log Book	2	-
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-DO-	-DO-	-DO-	Log Book	2	-
		6.SURGE WITH STAND AND TAN DELTA TEST	CR	-DO-	-DO-	-DO-	-DO-	-DO-	Log Book	2	-
2.6	IMPREGNATION	1.VISCOSITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	
		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	-	
(FOR MOTORS OF 2MW AND ABOVE) * ON 10% RANDOM SAMPLE											
FOR MV MOTOR											
THREE DIPS TO BE GIVEN											
BHEL			PARTICULARS		BIDDER/VENDOR						
			NAME								
			SIGNATURE								
			DATE								
BIDDERS/VENDORS COMPANY SEAL											

THIS IS A PART OF TECHNICAL SPECIFICATION NO.-PE-TS-410-155A-A001

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

THIS IS A PART OF TECHNICAL SPECIFICATION NO.-PE-TS-410-155A-A001

SL. NO.	COMPONENT/OPERATION	SHEET 8 OF 9	QUALITY PLAN		CUSTOMER :	PROJECT TITLE	1X800MMV KOTHAGUDEM		SPECIFICATION : NUMBER :		
			CHARACTERISTIC CHECK	TYPE/METHOD OF CHECK			EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION AGENCY
1	2	3	4	5	6	7	8	9	10	11	
3.0	TESTS	1. TYPE TESTS INCLUDING SPECIAL TESTS AS PER BHEL SPEC. 2. ROUTINE TESTS INCLUDING SPECIAL TEST AS PER BHEL SPEC. 3. VIBRATION & NOISE LEVEL 4. OVERALL DIMENSIONS AND ORIENTATION 5. DEGREE OF PROTECTION 6. MEASUREMENT OF RESISTANCE OF RTD & BTD 7. MEASUREMENT OF RESISTANCE IR OF SPACE HEATER 8. NAMEPLATE DETAILS 9. EXPLOSION FLAME PROOF NESS (IF SPECIFIED) 10. PAINT SHADE, THICKNESS & FINISH	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
			MA	-DO-	100%	-DO-	-DO-	-DO-	2	1\$ 1	\$ NOTE - 2
			MA	-DO-	100%	IS-12075 & IS-12065	IS-12075 & IS-12065	-DO-	2	1\$ 1	\$ NOTE - 2
			MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPC. REPORT	2	1 -	
			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
			MA	-DO-	100%	-DO-	-DO-	-DO-	2	1\$ 1	\$ NOTE - 2
			MA	-DO-	100%	-DO-	-DO-	-DO-	2	1\$ 1	\$ NOTE - 2
			MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPC. REPORT	2	1\$ 1	\$ NOTE - 2
			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
			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											
BIDDER/VENDOR											
PARTICULARS											
NAME											
SIGNATURE											
DATE											
BIDDERS/VENDORS COMPANY SEAL											

ANNEXURE-I

SUB-VENDOR LIST

The list of approved make of the LT Motors are as mentioned below:

S.No.	LIST OF LT MOTORS
1.	BHARAT BIJLEE LTD.
2.	CROMPTON GREAVES
3.	ASEA BROWN BOVERI
4.	KIRLOSKAR ELECTRIC CO LTD.
5.	NGEF
6.	SIEMENS
7.	MARATHON
8.	GE-POWER
9.	RAJINDRA ELECT INDUSTRIES
10.	LAXMI HYDRAULICS PVT. LTD

However, the final list of makes for the LT Motors is subjected to BHEL/Customer approval, during contract stage, without any commercial implications.

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

1. For the purpose of clarity, it may please be noted that the information given in regard to the cables to be routed through WinPath as per the system elaborated below is called "Cable List", while the term "Cable Schedule" applies to the cable list with routing information added after routing has been carried out.
2. The cable list shall be entered as an MS Excel file in the format as per enclosed template EXT_CAB_SCH_FORMAT.XLS. No blank lines, special characters, header, footer, lines, etc. shall be introduced in the file. No changes shall be made in the title line (first line) of the template.
3. The field properties shall be as under:
 - a. UNITCABLENO: A/N, up to sixteen (16) characters; each cable shall have its own unique, unduplicated cable number. In case this rule is violated, the cable cannot be taken up for routing.
 - b. FROM: A/N, up to sixty (60) characters; the "From" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - c. TO: A/N, up to sixty (60) characters; the "To" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - d. PURPOSE: A/N, up to sixty (60) characters; the purpose (i.e. power cable/ indication/ measurement, etc.) to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - e. REMARKS: A/N, up to forty (40) characters; Any information pertinent to routing to be specified here (e.g., cable number of the cable redundant to the cable number being entered). Information in excess of 40 characters will be truncated after 40 characters.
 - f. CABLESIZE: A/N, 7 characters exactly as per the codes indicated below shall be specified here. The program cannot route cables described in any other way/ format.
 - g. PATHCABLENO: Field reserved for utilization by the program. User shall not enter any information here.
4. One list shall be prepared for each system/ equipment (i.e., separate and unique cable lists shall be prepared for each system).
5. The cables shall be described as per the scheme listed below:

A	NN	A	NNN
Cable	No. of cores	Cable code	Cable size
Voltage	(e.g. 01,03,3H, 07)	(See C below)	(e.g. 035,185,2.5, 0.5)
Code (see B below)			

(A) SYSTEM VOLTAGE CODES:

(ac) A = 11KV, B = 6.6KV, C = 3.3KV, D = 415V, E = 240V, F = 110V

(dc) G = 220V, H = 110V, J = 48V, K = +24V, L = -24V

(B) CABLE VOLTAGE CODES:

A = 11KV (Power cables)

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

B = 6.6KV (Power cables)
 C = 3.3KV (Power cables)
 D = 1.1KV (LV & DC system power & control cables)
 E = 0.6KV (0.5 sq. mm. Control cables)

(C) CABLE CODES

PVC Copper

A = Armoured FRLS
 C = unarmoured FRLS
 B = Armoured Non-FRLS
 D = Unarmoured Non-FRLS

PVC Aluminium

E = Armoured FRLS
 G = unarmoured FRLS
 F = Armoured Non-FRLS
 H = Unarmoured Non-FRLS

XLPE Copper

J = Armoured FRLS
 L = unarmoured FRLS
 K = Armoured Non-FRLS
 M = Unarmoured Non-FRLS

XLPE Aluminium

N = Armoured FRLS
 Q = unarmoured FRLS
 P = Armoured Non-FRLS
 R = Unarmoured Non-FRLS

S = FIRE SURVIVAL CABLES
 T = TOUGH RUBBER SHEATH
 U = OVERALL SCREENED
 V = PAIRED OVERALL SCREENED
 W = PAIRED INDIVIDUAL SCREENED
 Y = COMPENSATING CABLES
 I = PRE-FABRICATED CABLES
 Z = JELLY FILLED CABLES



TITLE:

TECHNICAL SPECIFICATION FOR
CONDENSATE POLISHING UNIT
1X800 MW TSGENCO KOTHAGUEDEM TPS
STAGE -VII, PALONCHA

SPEC NO: PE-TS-410-155A-A001

VOLUME: II-B

SECTION: C3

REV NO: 00

DATE:

SECTION – C3
SPECIFIC TECHNICAL REQUIREMENT- C&I

FORM NO. PEM-6686-0



1X800 MW KOTHAGUDEM TPS
CONTROL & INSTRUMENTATION
Technical specification for
CONDENSATE POLISHING UNIT

SPEC NO.: **PE-TS-410-145-I**

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SECTION 'D'

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1X800 MW KOTHAGUDEM TPS
CONTROL & INSTRUMENTATION
Technical specification for
CONDENSATE POLISHING UNIT

SPEC NO.: PE-TS-410-145-I

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2. DRIVE CONTROL PHILOSOPHY
3. ACTUATOR SPECIFICATION
4. ACTUATOR DATA SHEET
5. INSTUMENT DATASHEET
6. INSTUMENT QUALITY PLAN
7. LCP AND JUNCTION BOX SPECIFICATION
8. LCP QUALITY PLAN
9. CABLE BOQ
10. ERECTION HARDWARE
11. KKS PHILOSOPHY



Technical specification for
CONTROL & INSTRUMENTATION

1X800 MW KOTHAGUEDEM

SPEC NO.: **PE-TS-410-145-I**

VOLUME


SECTION


REV. NO. 00


DATE : 10.03.2015


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SPECIFIC TECHNICAL REQUIREMENT

	<p align="center">Telangana State Power Generation Corporation Ltd. 1x800 MW Kothagudem TPS</p>	<p align="right">SECTION: C</p>
<p align="center">SPECIFIC TECHNICAL REQUIREMENTS (C&I) CONDENSATE POLISHING UNIT</p>		
<p>Specific Technical Requirements (C&I):</p> <ol style="list-style-type: none"> 1.0 Condensate Polishing Unit (CPU) shall be operated from DCS (BHEL's scope). 2.0 All instruments shall be terminated on JB/LCP in field and both instrument and JB/LCP are in bidder scope. 3.0 Bidder to perform tests of C&I items/instruments/systems as per Quality plans/type test attached in the specification. However, if any test not specified in the quality plan but specified in specification Tests for I&C equipment included elsewhere in specification will have to perform by Bidder without any cost implication. 4.0 Bidder to furnish electrical load/UPS load data during detailed engineering 5.0 230 V AC UPS Power supply shall be provided by BHEL at a single point, further distribution to various instruments/equipment of the system shall be in bidder scope. Bidder to include necessary power distribution board in his scope. Any power supply other than the above, if required by any instrument/equipment has to be derived by the bidder from the above supply & all necessary hardware for the same shall be in bidder scope. Bidder to submit the power requirement along with the bid. 6.0 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 in 2 days advance. All the expenses like boarding, lodging and travel, Air fare etc. shall be in bidder's scope. 7.0 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. 8.0 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. 9.0 Interface of MCC, HT SWGR, field instruments, Actuators etc. with DDCMIS based control system shall be as per Drive Control Philosophy enclosed in specification. 10.0 Local control panel if any required for operation shall be in bidder scope. 		

	<p align="center">Telangana State Power Generation Corporation Ltd. 1x800 MW Kothagudem TPS</p>	<p align="center">SECTION: C</p>
	<p align="center">SPECIFIC TECHNICAL REQUIREMENTS (C&I) CONDENSATE POLISHING UNIT</p>	
	<p>11.0 The solenoid operated valves/Dampers/Gate shall have a limit switch for open/close feedback. Solenoid Valve shall be rated for 24V Dc only.</p> <p>12.0 Diaphragm seal shall be provided with Instruments having contact with corrosive media.</p> <p>13.0 Double root valve shall be provided for all pressure tapings where the pressure exceeds 40kg/cm2.</p> <p>14.0 Use of process actuated shall be avoided unless unavoidable.</p> <p>15.0 Sodium Analyser and Silica Analyser, if applicable, shall be Multi Channel Type.</p> <p>16.0 Bidder to include all the instruments (PG, PS, PT, LS, RTD, Analysers etc.) required for the package along with necessary fittings, accessories and valve manifold etc.</p> <p>17.0 The solenoid operated valves/ damper/gates shall have limit switches for open/ close feedback. Solenoid valve shall be rated for 24 V DC only.</p> <p>18.0 The junction boxes/LIEs for termination of instruments /solenoid valve limit switches etc are in bidder's scope.</p> <p>19.0 BHEL shall provide 230 VAC UPS supply feeder at a single point. Further distribution to various instruments shall be in Bidder's scope. Bidder to include necessary power distribution board in his scope. Any power supply other than the above, if required by any instrument/device, has to be derived by the Bidder and all necessary hardware/software for the same shall be in bidder's scope. Bidder to furnish UPS power requirement along with the bid.</p> <p>20.0 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. In case of any conflict or repetition of clauses in the specification, the more stringent requirements among them are to be complied with.</p> <p>21.0 Mandatory spare to be supplied by bidder as per mandatory spares list.</p> <p>22.0 The design, manufacture, inspection, testing, site calibration and installation of all C&I equipment and systems covered under this specification shall conform to the latest editions of applicable codes and standards eg. ANSI, ASME, IEEE, ISO, IEC, IGCI, AWS, NFPA, AISC, IGS, SAMA, UBC, UL, NESC, NEMA, ISA, DIN, VDE, IS etc.</p>	

	<p align="center">Telangana State Power Generation Corporation Ltd. 1x800 MW Kothagudem TPS</p>	<p align="right">SECTION: C</p>
	<p align="center">SPECIFIC TECHNICAL REQUIREMENTS (C&I) CONDENSATE POLISHING UNIT</p>	
	<p>23.0 The scope of cable shall be referred in Electrical scope split sheet in Electrical portion of the specification.</p> <p>24.0 Instrument installation drawings are to be provided by bidder. All instrument fitting and erection hardware as per instrument installation diagram shall be in bidder's scope.</p> <p>25.0 Every panel-mounted instrument, requiring power supply, shall be provided with a pair of easily replaceable glass cartridge fuses of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus.</p> <p>26.0 Provision for separate Terminal block/wiring diagram for power and control blocks of control panel to be ensured.</p> <p>27.0 The make of all the items shall be from approved sub-vendor list.</p> <p>28.0 Bidder shall provide Cable Schedule in BHEL excel format provided in Electrical portion of the specification. Also, cable interconnections details for complete system shall be in Bidders' scope.</p> <p>29.0 Editable & pdf copy of Drawings/Documents and data to be furnished after award of the contract:</p> <ul style="list-style-type: none"> • Control & operational write-up for the system • Recommended control scheme/ logic diagram • Process manuscript for implementation in DCS • List of Drives (Solenoid valves etc) • I/O list (DCS) • GA & wiring diagram of local panel. • Power requirement. • Local control panel and field instruments quality plan. • Local control panel & instruments data sheet. • JB grouping document. • Cable schedule and cable interconnection drawing. • Instrument schedule • Alarm Schedule • SOE schedule • Instrument hook-up diagram. • Mandatory spare BOQ • UPS load list • Any other document decided during detailed engineering. <p>Note:-</p>	

	<p align="center">Telangana State Power Generation Corporation Ltd. 1x800 MW Kothagudem TPS</p>	<p align="center">SECTION: C</p>
	<p align="center">SPECIFIC TECHNICAL REQUIREMENTS (C&I) CONDENSATE POLISHING UNIT</p>	
<ol style="list-style-type: none"> 1. All equipment items shall be of latest design with proven on track record. 2. The above given scope is indicative & minimum. Any item/ equipment not indicated above however required for the completeness of the system is to be supplied by bidder without any technical, commercial and delivery implication to BHEL. 3. Documents of C&I System shall be submitted to end user/owner for approval during detail engineering. Changes, if any, shall be accommodated by the bidder without any price/time implication. 4. Uniformity of make and type of instruments and control components shall be followed throughout for rationalization of spares' inventory, except for certain proprietary items where this requirement cannot be met. 		



Technical specification for
CONTROL & INSTRUMENTATION

1X800 MW KOTHAGUEDEM

SPEC NO.: **PE-TS-410-145-I**

VOLUME

SECTION

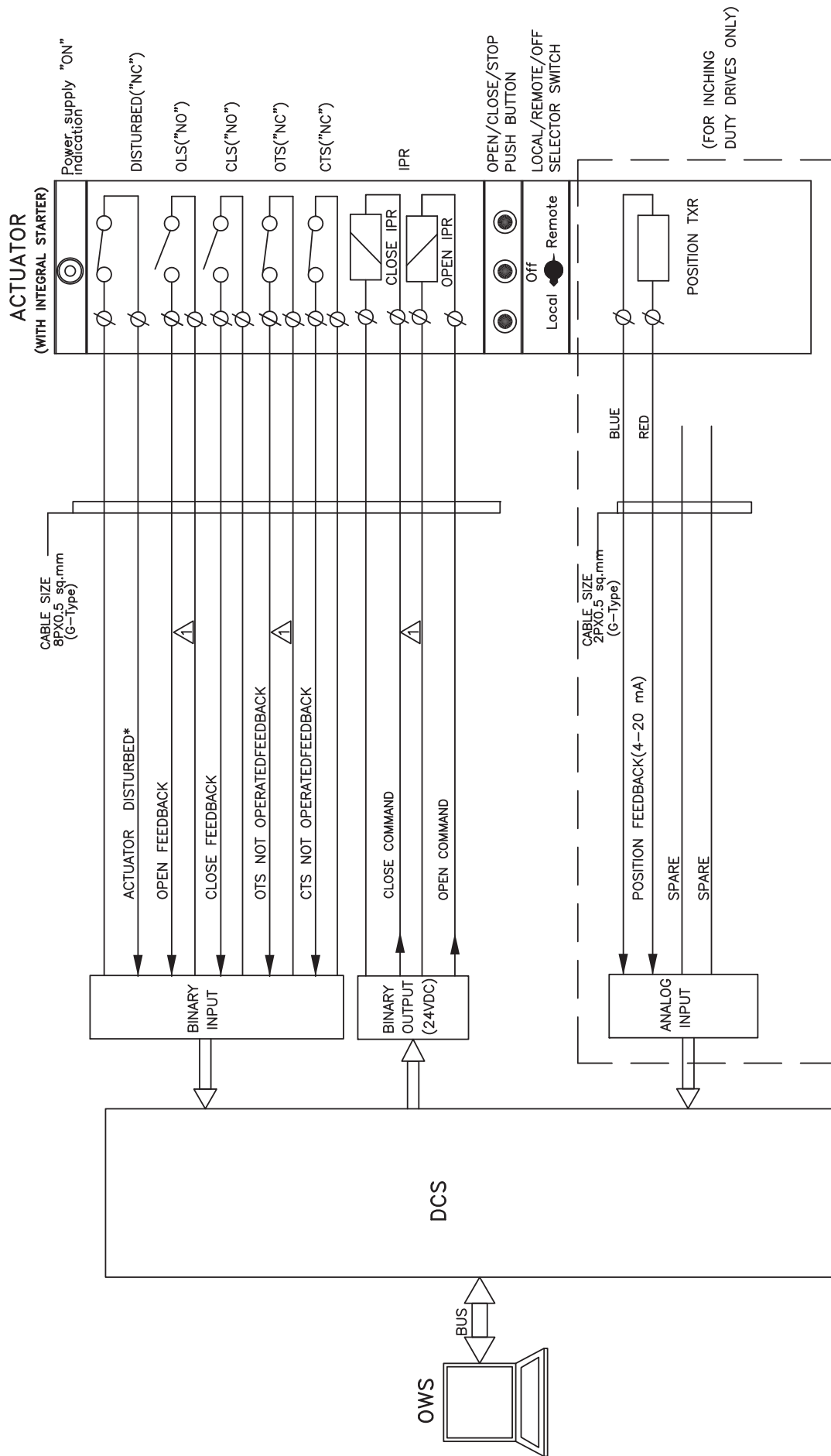
REV. NO. 00

DATE : 10.03.2015

SHEET OF

Drive Control Philosophy

DCS INTERFACE FOR BIDIRECTIONAL DRIVE (WITH INTEGRAL STARTER)



NOTE:

- * DISTURBED= Loss of Power supply (1 Phase/3 Phase)/
- Loss of control supply/ Motor thermostat trip/
- Thermal over load/Torque open/ Release cutoff mode/
- Local/Off/Remote Sel. switch
- Stop PB optd.



PROJECT:

1X800 KOTHAGUDEM TPS
STAGE-VII, UNIT-12

TITLE:

DDCMIS INTERFACE FOR
BIDIRECTIONAL DRIVE

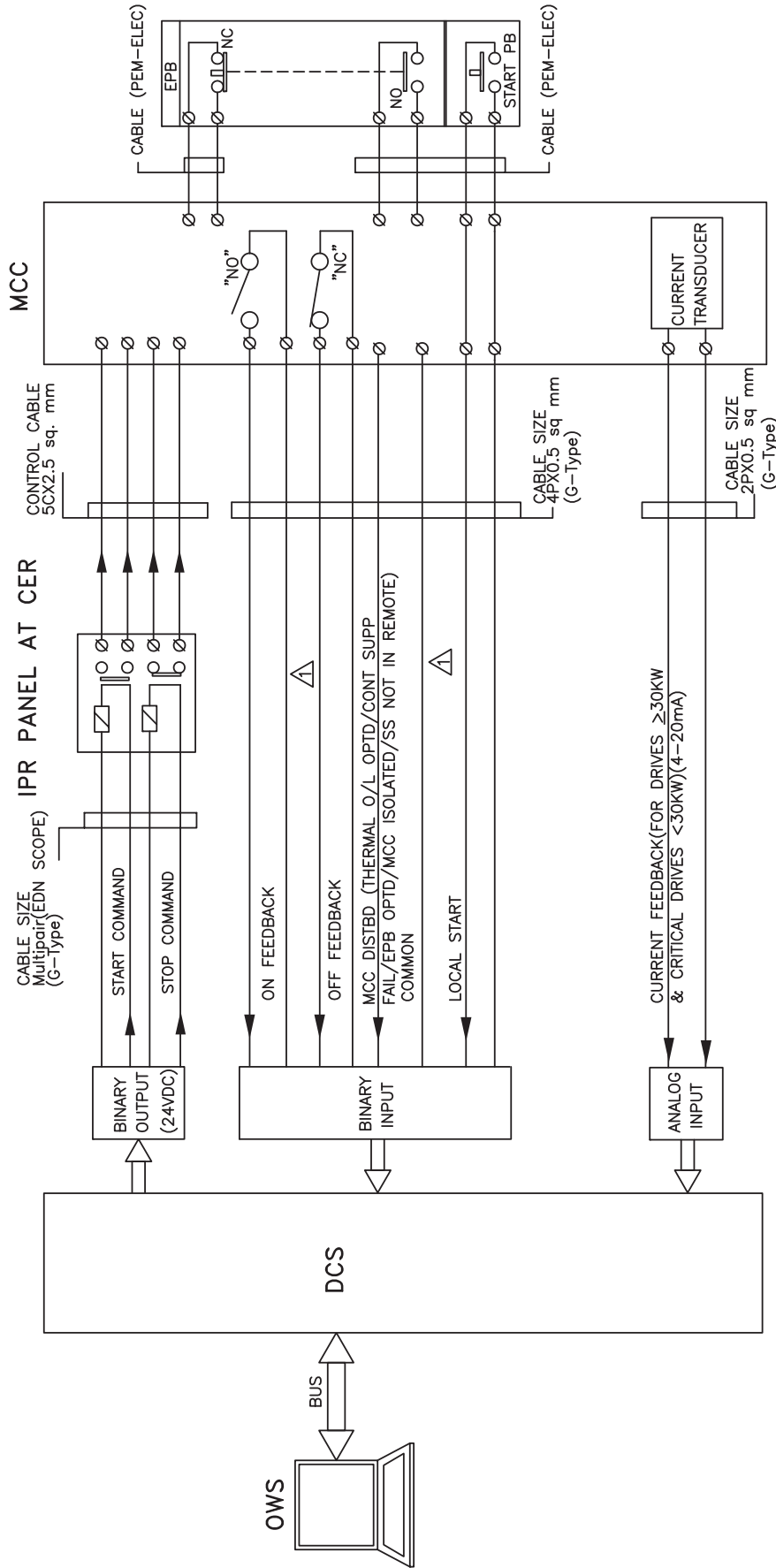
DRG.NO. PE-DM-410-145-1002

DATE 09.03.2015

REV.NO. 01

SHT 7 OF 11

DCS INTERFACE FOR UNIDIRECTIONAL LT DRIVE

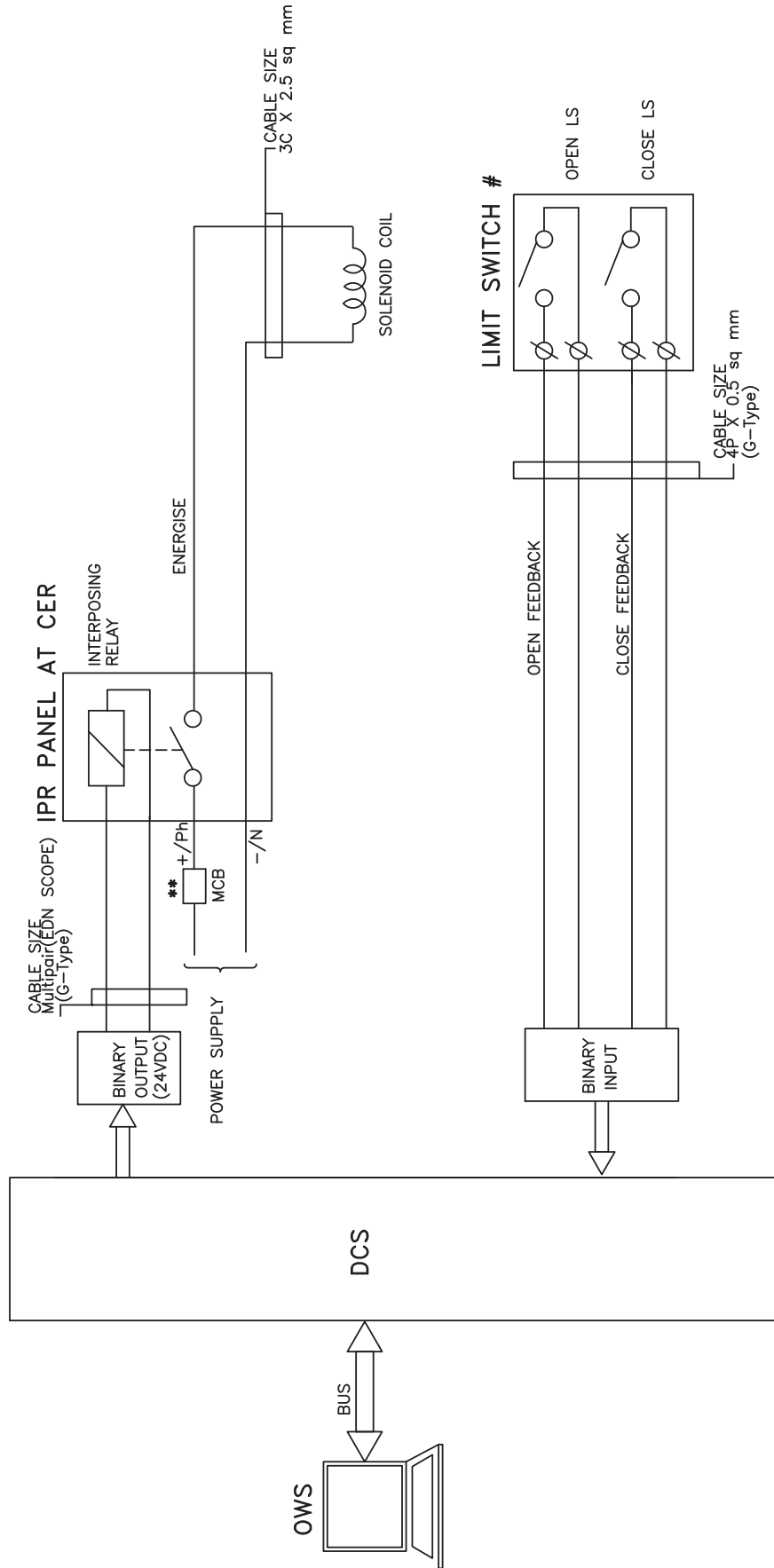


PROJECT:	1X800 KOTHAGUDEM TPS	DRG.NO.	PE-DM-410-145-1002
	STAGE-VII, UNIT-12	DATE	09.03.2015
TITLE:	DDCMS INTERFACE FOR UNIDIRECTIONAL LT DRIVE	REV.NO.	01
		SHT	8 OF 11




* FOR LTUD DRIVES ALL LUBE OIL PUMPS, SCANNER AIR FANS, SEAL AIR FANS, 4-20mA CURRENT TRANSDUCER SHALL BE CONSIDERED.

DCS INTERFACE FOR SOLENOID DRIVE (24V DC / 240V AC UPS)

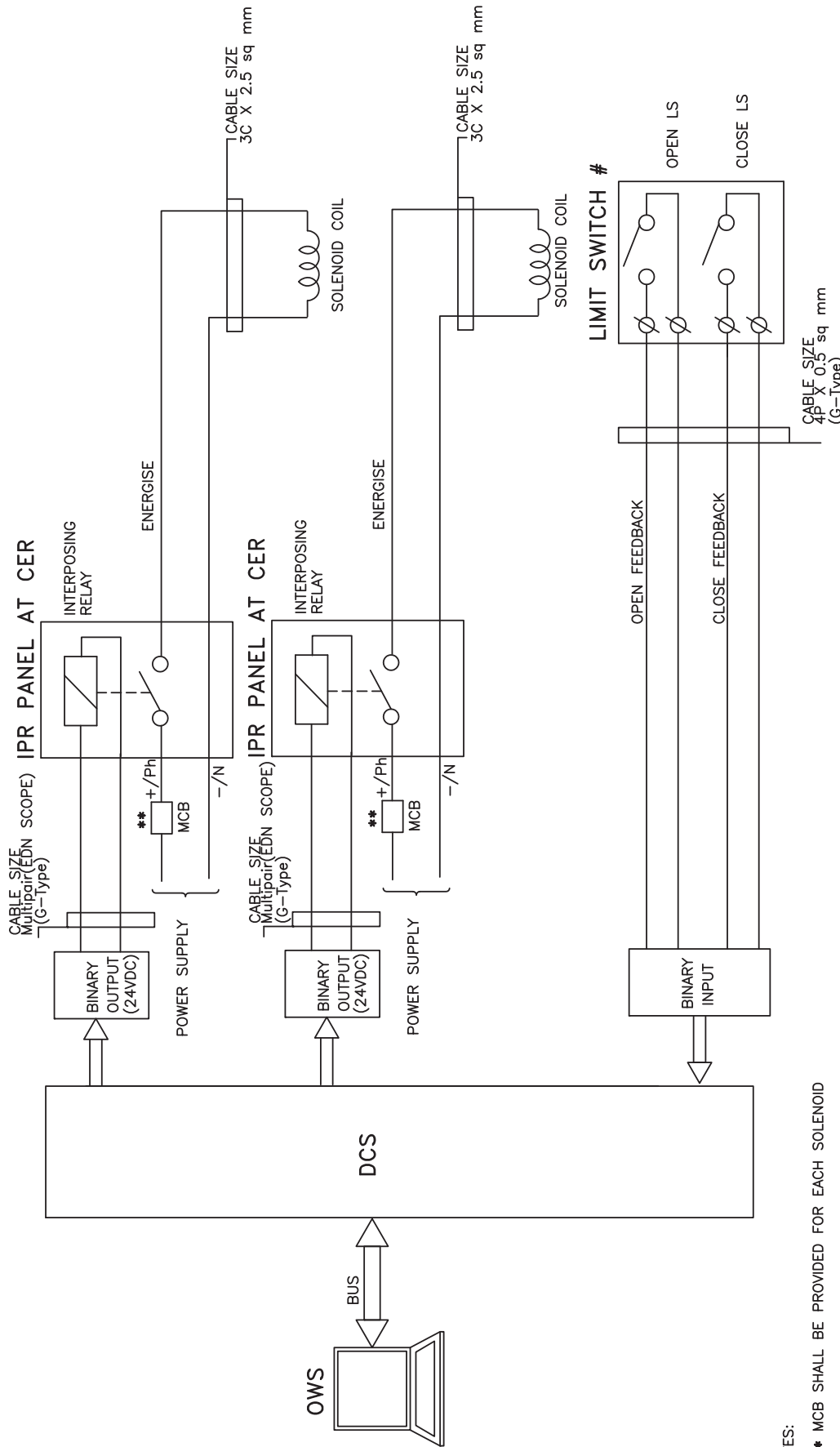


NOTES:

- ** MCB SHALL BE PROVIDED FOR EACH SOLENOID VALVE.
- # FOR ON/OFF TYPE, SOLENOID ACTUATED CONTROL


	PROJECT: 1X800 KOTHAGUDEM TPS STAGE-VII, UNIT-12	DRG.NO.: PE-DM-410-145-1002
	TITLE: DDCMIS INTERFACE FOR SOLENOID DRIVE (SINGLE COIL)	DATE: 09.03.2015
	REV.NO.: 01	SHT 9 OF 11

DCS INTERFACE FOR SOLENOID DRIVE (24V DC / 240V AC UPS)

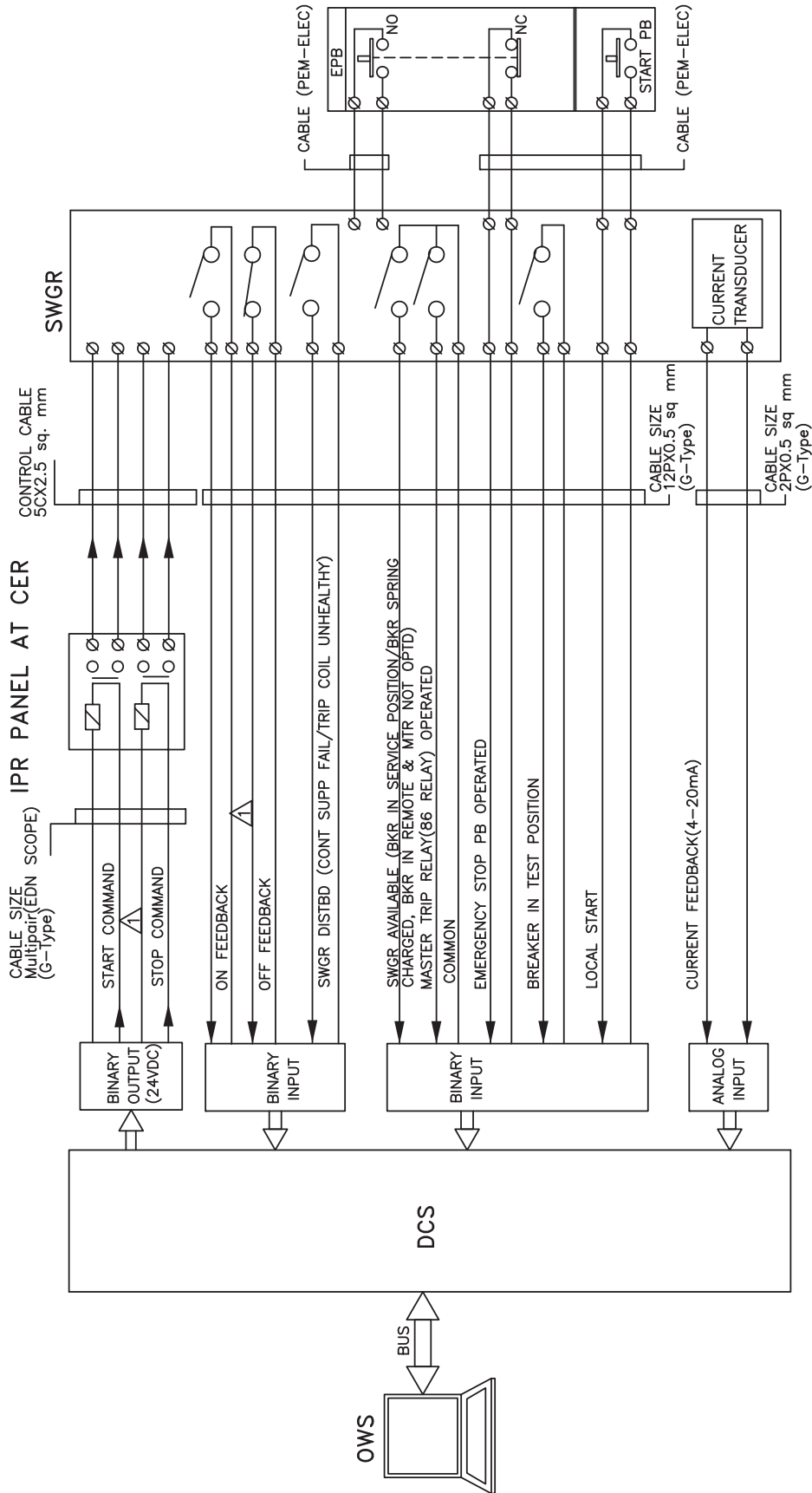



NOTES:

- ** MCB SHALL BE PROVIDED FOR EACH SOLENOID
- # FOR ON/OFF TYPE, SOLENOID ACTUATED CONTROL VALVE.

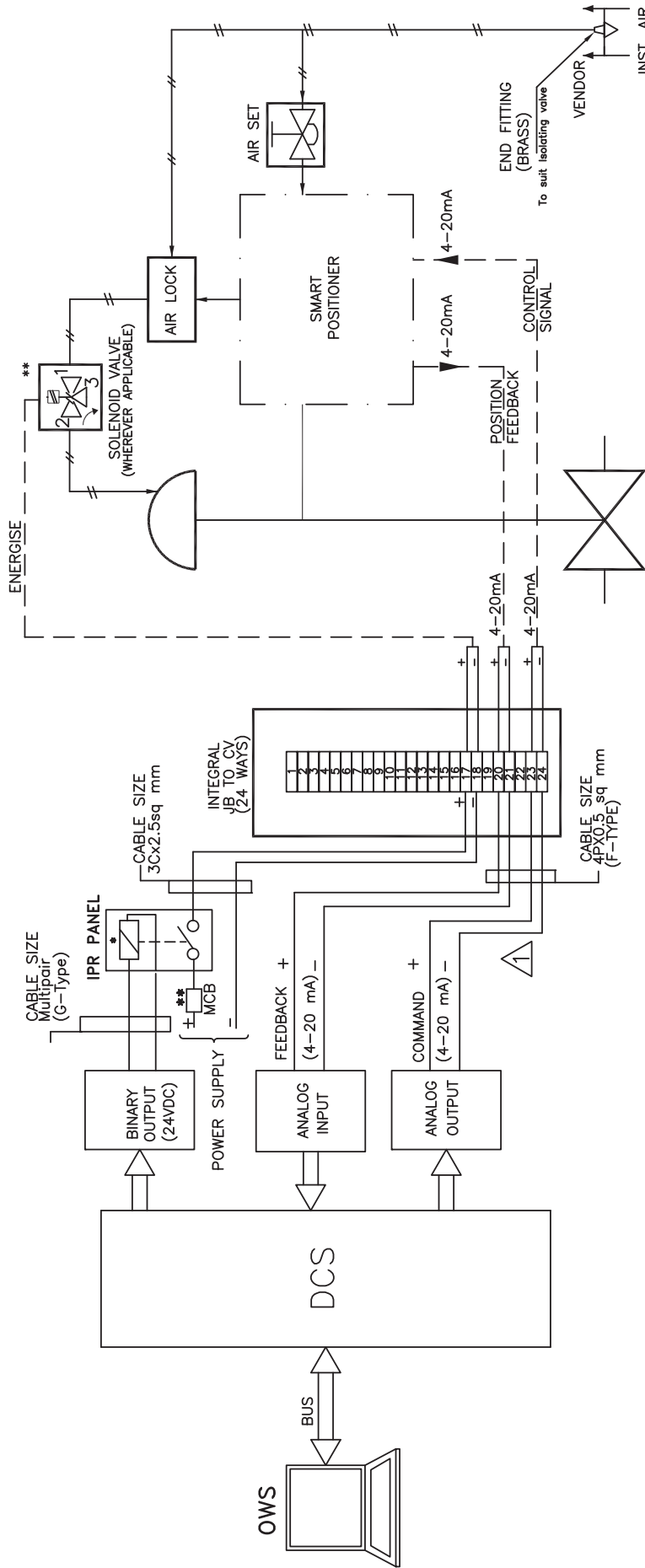
	PROJECT:	1X800 KOTHAGUDEM TPS STAGE-VII, UNIT-12	DRG.NO:	PE-DM-410-145-1002
	TITLE:	DDCMS INTERFACE FOR SOLENOID DRIVE (DOUBLE COIL)	DATE:	09.03.2015
			REV.NO:	01
			SHT	9a OF 11

DCS INTERFACE FOR HT/LT UNIDIRECTIONAL DRIVES(BREAKER OPERATED)




	PROJECT:	1X800 KOTHAGUDEM TPS	DRG.NO:	PE-DM-410-145-1002
	TITLE:	STAGE-VII, UNIT-12	DATE:	09.03.2015
		DDCMS INTERFACE FOR	REV.NO:	01
		UNIDIRECTIONAL HT DRIVE	SHT	10 OF 11

DCS INTERFACE FOR ANALOG DRIVE (WITH SMART POSITIONER)



NOTES:

- ** APPLICABLE TO VALVES WHERE PROTECTION OPEN/CLOSE ACTION FOR CONTROL DEMAND OVERRIDING IS REQUIRED.

	PROJECT:	1X800 KOTHAGUDEM TPS STAGE-VII, UNIT-12	DRG.NO:	PE-DM-410-145-1002
	TITLE:	TYPICAL HOOK-UP DIAGRAM ANALOG DRIVE (WITH SMART POSITIONER)	DATE:	09.03.2015
			REV.NO:	01
			SHT	11 OF 11



Technical specification for
CONTROL & INSTRUMENTATION

1X800 MW KOTHAGUEDEM

SPEC NO.: **PE-TS-410-145-I**

VOLUME

SECTION

REV. NO. 00

DATE : 10.03.2015

SHEET OF

ACTUATOR SPECIFICATION

VOLUME: V-A

SECTION-III

**TECHNICAL SPECIFICATION
FOR
ELECTRIC MOTOR ACTUATORS**

- 1.00.00 **SCOPE**
- 1.01.00 This Section covers the general requirements of Electric Motor Actuators for valves/dampers.
- 1.02.00 All electric motor actuators shall be furnished in accordance with this general specification and the accompanying driven equipment specification. All the electrical actuators shall be INTEGRAL type only.
- 2.00.00 **STANDARDS**
- 2.01.00 All electrical equipment shall conform to the latest applicable IS, ANSI and NEMA Standards, except when stated otherwise herein or in driven equipment specification.
- 2.02.00 Major standards, which shall be followed, are listed below. Other applicable Indian Standards for any component part even if not covered in the listed standards shall also be followed
- i) IS -9334
- ii) IS-325
- 3.00.00 **SERVICE CONDITIONS**
- 3.01.00 The actuator shall be suitable for operation in hot, humid and tropical atmosphere, highly polluted at places with coal dust and/or fly ash.
- 3.02.00 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the general specification.
- 3.03.00 For actuator motor installed outdoor and exposed to direct sun rays, the effect of solar heat shall be considered in the determination of the design ambient temperature.
- 4.00.00 **RATING**
- 4.01.00 For isolating service, the actuator shall be rated for three successive open-close operation of the valve/damper or 15 minutes, whichever is longer.
- 4.02.00 For regulating service, the actuator shall be suitably time-rated for the duty cycle involved with necessary number of starts per hour, but in no case less than 150 starts per hour.

- 5.00.00 **PERFORMANCE**
- The actuator shall meet the following performance requirements:
- 5.01.00 Open and close the valve completely and make leak-tight valve closure without jamming.
- 5.02.00 Attain full speed operation before valve load is encountered and imparts an unseating blow to start the valve in motion (hammer blow effect).
- 5.03.00 Operate the valve stem at standard stem speed and shall function against design differential pressure across the valve seat.
- 5.04.00 The motor reduction gearing shall be sufficient to lock the shaft when the motor is de-energised and prevent drift from torque switch spring pressure.
- 5.05.00 The entire mechanism shall withstand shock resulting from closing with improper setting of limit switches or from lodging of foreign matter under the valve seat.
- 6.00.00 **SPECIFIC REQUIREMENT**
- 6.01.00 **Construction**
- 6.01.01 The actuator shall essentially comprise the drive motor, torque/ limit switches, gear train, clutch, hand wheel, position indicator/ transmitter, in-built thermostat for over load protection, space heater and internal wiring.
- 6.01.02 The actuator enclosure shall be totally enclosed, dust tight, weather-proof suitable for outdoor use without necessity of any canopy. Degree of protection of enclosure for motor actuator shall be IP-65.
- 6.01.03 All electrical equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth.
- 6.01.04 The actuator shall be designed for mounting in any position without any lubricant leakage or operating difficulty.
- 6.02.00 **Motor**
- 6.02.01 The drive motor shall be three phase, squirrel cage, induction machine with minimum class B insulation and IPW-55 enclosure, designed for high torque and reversing service. Canopy shall be provided for outdoor service.
- 6.02.02 The motor shall be designed for full voltage direct on-line start, with starting current limited to 6 times full-load current.
- 6.02.03 The motor shall be capable of starting at 85 percent of rated voltage and running at 80 percent of rated voltage at rated torque and 85 percent rated voltage at 33 percent excess rated torque for a period of 5 minutes each.
- 6.02.04 Motor leads shall be terminated in the limit switch compartment.
- 6.02.05 Motor actuators for valves/dampers shall be with integral starter with 3phase/3wire, 415V AC and operable from remote.

- 6.02.06 Earthing terminals shall be provided on either side of the motor.
- 6.03.00 **Limit Switches**
- Each actuator shall be provided with following limit switches: -
- 6.03.01 2 torque limit switches, one for each direction of travel, self-locking, adjustable torque type.
- 6.03.02 4 end-of-travel limit switches, two for each direction of travel.
- 6.03.03 2 position limit switches, one for each direction of travel, each adjustable at any position from fully open to fully closed positions of the valve/damper.
- 6.03.04 Each limit switch shall have 2 NO + 2 NC potential free contacts. Contact rating shall be 5A at 240V A.C. or 0.5A at 220V D.C.
- 6.04.00 **Hand Wheel**
- Each actuator shall be provided with a hand wheel for emergency manual operation. The hand wheel shall deenergize automatically when the motor is energized.
- 6.05.00 **Position Indicator/Transmitter**
- The actuator shall have:
- 6.05.01 One (1) built-in local position indicator for 0-100% travel.
- 6.05.02 One (1) position transmitter, 4-20 mA current signal as position feedback, for remote indicator.
- 6.06.00 **Space Heater**
- A space heater shall be included in the limit switch compartment suitable for 240V, 1 phase, 50 Hz supply.
- 6.07.00 **Wiring**
- All electrical devices shall be wired up to and terminated in a terminal box. All wiring shall be done with 1100 V grade fire resistance PVC insulated stranded copper conductor of not less than 2.5 Sq.mm cross section. All wiring shall be identified at both ends with ferrules. All the electrical actuators shall have uniform wiring.
- 6.08.00 **Terminal Box**
- The terminal box shall be weather proof, with removable front cover and cable glands for cable connection. The terminal shall be suitable for connection of 2.5 Sq.mm copper conductor.
- 7.00.00 **ACCESSORIES**

As required for the driven equipment, the actuator shall be furnished with starting equipment mounted on the actuator. This shall include:

- 7.01.00 One (1) triple pole MCCB
- 7.02.00 One (1) reversing starter with mechanically interlocked contactors, 3 thermal overload relays, 2 NO + 2 NC auxiliary contacts for each contactor.
- 7.03.00 One (1) remote-local selector switch.
- 7.04.00 CLOSE-STOP-OPEN oil tight push buttons with indication lights.
- 7.05.00 415/240 V control transformer with primary & secondary fuses.
- 8.00.00 **TEST**
- The actuator and all components thereof shall be subject to tests as per relevant Standards. In addition, if any special test is called for in equipment specification, the same shall be performed.
- 9.00.00 **DRAWINGS, DATA & MANUALS**
- 9.01.00 Drawings, Data & Manuals shall be submitted in triplicate with the bid and in quantities and procedures as specified in General Conditions of Contract and/or elsewhere in the specification for approval and subsequent distribution after the issue of 'Letter of Intent'.
- 9.02.00 **To be submitted with Bid**
- Data sheet for each type of actuator shall be furnished along with internal wiring diagram, suggested control schematic and torque limit switch contact development and manufacturer's catalogues. Drawings, Data & Manuals shall be submitted in triplicate with the bid and in quantities and procedures as specified in General Conditions of Contract and/or elsewhere in the specification for approval and subsequent distribution after the issue of 'Letter of Intent'.
- 9.03.00 **To be submitted for Owner / Purchaser's Approval and Distribution**
- All relevant drawings and data pertaining to the equipment like GTP, GA drawing, foundation plan, BOM, control & schematics, QAP, etc. shall be submitted by the Bidder for approval of Owner/Owner's consultant. Also refer clause no. 1.19.02(u) of Section-I of Volume – V-A : Technical Specifications for Electrical Equipment & Accessories.

ANNEXURE-A
DESIGN DATA
1.0 AUXILIARY POWER SUPPLY

S	upply	Description	Consumer
	L.V. Supply (i)	415V, 3Ø, 3W, 50 Hz Effectively earthed Fault level 50 kA symm. for 1 sec.	u Motors above 0.2kW pto less than 175kW.
	(ii)	240V AC/415V AC 240V, 1Ø, 2W, 50 Hz effectively earthed	Motors upto 0.2kW. o Lighting, Space heat- ing , A.C supply for Contr- l & protective devices.
	D.C. Supply	220V, 2W, unearthed Fault level 25* kA. for 1 sec.	& D.C. alarm, control protective devices

* Indicative only, the actual value will be decided by the Bidder, after substantiating the same by calculation.

2.0 RANGE OF VARIATION

A.C. Supply :

V	voltage	:	± 10%
	Frequency	:	+3% to -5%.
	Combined Volt + frequency	:	10% (absolute sum)

During starting of large motor, the voltage may drop to 80% of the rated voltage for a period of 60 seconds. All electrical equipment while running shall successfully ride over such period without affecting system performance.

D.C. Supply :

Voltage	:	187 to 242
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Technical specification for
CONTROL & INSTRUMENTATION

1X800 MW KOTHAGUDEM

SPEC NO.: **PE-TS-410-145-I**

VOLUME


SECTION


REV. NO. 00

DATE : 10.03.2015

SHEET OF

Actuator Data Sheet

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR		SPECIFICATION NO.:			
			VOLUME			
			SECTION			
			REV. NO.	00	DATE:	06.01.2015
			SHEET	1	OF	3
Data Sheet A & B						
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)			
GENERAL*	* PROJECT	1 X 800 MW KOTHAGUDAM TPS				
	OFFER REFERENCE					
	* TAG NO. SERVICE					
	* DUTY	<input type="checkbox"/> ON / OFF	<input type="checkbox"/> INCHING			
	* LINE SIZE (inlet/outlet): MATERIAL					
	* VALVE TYPE	<input type="checkbox"/> GLOBE <input type="checkbox"/> GATE <input type="checkbox"/> REG. GLOBE <input type="checkbox"/> 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, DUST TIGHT, WEATHER PROOF, SUITABLE FOR OUTDOOR USE WITHOUT CANOPY, IP:65				
	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 90% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER. FOR REGULATING SERVICE - 150 STARTS/HR MINIMUM				
HANDWHEEL	* REQUIRED	<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO				
	* ORIENTATION	<input type="checkbox"/> TOP MOUNTED <input type="checkbox"/> 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	<input checked="" type="checkbox"/> ENCLOSED <input checked="" type="checkbox"/> DRG. NO. 3-V-MISC-24227 R00 (INDICATIVE)				
	COLOUR SHADE	<input checked="" type="checkbox"/> BLUE (RAL 5012), To be decided during detail engg.				
	PAINT TYPE (## Refer Notes)	<input type="checkbox"/> ENAMEL <input checked="" type="checkbox"/> EPOXY <input type="checkbox"/>				
	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, 3 WIRE				
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER <input type="checkbox"/> 230 V <input type="checkbox"/> 110 V				
	@ ENCLOSURE CLASS OF MOTOR	<input type="checkbox"/> IP 65 <input type="checkbox"/> FLAME PROOF				

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR	SPECIFICATION NO.:		
		VOLUME		
		SECTION		
		REV. NO.	00	DATE: 06.01.2015
		SHEET	2	OF 3

Data Sheet A & B

DATA SHEET-A (TO BE FILLED BY PURCHASER)	DATA SHEET-B (TO BE FILLED-UP BY BIDDER)
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	@ INSULATION CLASS	CLASS-F TEMP. RISE LIMITED TO CLASS-B	
	@ WINDING TEMP PROTECTION	<input checked="" type="checkbox"/> THERMOSTAT (3 Nos., 1 IN EACH PHASE) <input type="checkbox"/>	
	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED	
INTEGRAL STARTER	INTEGRAL STARTER	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
	TYPE OF SWITCHING DEVICE	<input checked="" type="checkbox"/> CONTACTORS <input type="checkbox"/> THYRISTORS	
	TYPE	<input checked="" type="checkbox"/> CONVENTIONAL <input type="checkbox"/> SMART (NON-INTRUSIVE)	
	IF SMART	NOT APPLICABLE	
	a) SERIAL LINK INTERFACE	<input type="checkbox"/> INTEGRAL <input type="checkbox"/> FIELD MOUNTED	
	b) SERIAL LINK PROTOCOL	<input type="checkbox"/> FOUNDATION FIELD-BUS <input type="checkbox"/> PROFI-BUS <input type="checkbox"/> DEVICE NET <input type="checkbox"/>	
	c) SERIAL LINK MEDIA	<input type="checkbox"/> TWISTED PAIR Cu-CBL <input type="checkbox"/> CO-AXIAL Cu-CBL <input type="checkbox"/> OFC	
	d) HAND HELD PROGRAMMER	<input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
	e) TYPE OF HAND HELD PROGRAMMER	<input type="checkbox"/> BLUETOOTH <input type="checkbox"/> INFRARED <input type="checkbox"/>	
	f) MASTER STATION	<input type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
	g) MASTER STN INTRFACE WITH DCS	<input type="checkbox"/> MODBUS <input type="checkbox"/> TCP/IP	
	h) DETAILS OF SPECIAL CABLE	<input type="checkbox"/> ENCLOSED <input type="checkbox"/> NOT REQUIRED	
	STEP DOWN CONT. TRANSFORMER	<input checked="" type="checkbox"/> REQUIRED	
	OPEN / CLOSE PB	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
	STOP PB	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
	INDICATING LAMPS	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
LOCAL REMOTE S/S	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED		
STATUS CONTACTS FOR MONITORING	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED		
INTEGRAL STARTER DISTURBED SIGNAL	REQUIRED (O/L RELAY OPERATED, CONT. /POWER SUPPLY FAILED, S/S IN LOCAL, TORQUE SWITCH OPTD. MID WAY)		
INTERPOSING RELAY/OPTO COUPLER (Applicable for integral Starter)	TYPE OF ISOLATING DEVICE	<input checked="" type="checkbox"/> INTERPOSING RELAY <input type="checkbox"/> OPTO COUPLER <input type="checkbox"/> EITHER	
	QUANTITY	<input type="checkbox"/> 2 NOs. <input checked="" type="checkbox"/> 3 NOs.	
	DRIVING VOLTAGE	<input checked="" type="checkbox"/> 20.5 – 24V DC <input type="checkbox"/> _____ V DC	
	DRIVING CURRENT	<input checked="" type="checkbox"/> 125mA MAX <input type="checkbox"/> _____ mA MAX	
	LOAD RESISTANCE	<input checked="" type="checkbox"/> > 192 ohms - <25 k ohms <input type="checkbox"/> > _____ ohms - < _____ ohms	
TORQUE SWITCH (Not Applicable for Smart Actuator) (\$\$ Refer Notes)	MFR & MODEL NO.	BIDDER TO SPECIFY	
	OPEN / CLOSE	<input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 2Nos. / <input checked="" type="checkbox"/> 1 No. <input type="checkbox"/> 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	<input type="checkbox"/> 1 No. 2 Nos. (ADJ.) <input type="checkbox"/> 1 No. <input checked="" type="checkbox"/> 2 Nos. <input checked="" type="checkbox"/> 2Nos.	
	CONTACT TYPE	2 NO + 2 NC	
	RATING (AC / DC)	5A 240V AC AND 0.5A 220V DC	

FORM NO. PEM-5686-0



**SPECIFICATION
FOR
MOTORISED VALVE ACTUATOR**

SPECIFICATION NO.:	
VOLUME	
SECTION	
REV. NO.	00
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SHEET	3 OF 3

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	<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED	
	MFR & MODEL NO.	BIDDER TO SPECIFY	
	TYPE	<input type="checkbox"/> ELECTRONIC (2 WIRE) R/I CONVERTER <input checked="" type="checkbox"/> ELECTRONIC (2 WIRE) CONTACTLESS	
	SUPPLY	<input checked="" type="checkbox"/> 24V DC <input type="checkbox"/>	
	OUTPUT	<input checked="" type="checkbox"/> 4-20mA	
	ACCURACY	± 1% FS	
SPACE HEATER	@SPACE HEATER	REQUIRED	
	@ POWER SUPPLY (NON INTEGRAL)	240V AC, 1 PH., 50 Hz	
	@ POWER SUPPLY (INTEGRAL)	240V AC , 1 PH/415/240 V CTRL TRANSFORMER WITH PRIMARY AND SECONDARY FUSES	
	@ RATING		
TERMINAL BOX	ACTUATOR/MOTOR TERMINAL BOX	REQUIRED	
	ENCL CLASS ACTUATOR/MOTOR T.B.	@ <input type="checkbox"/> IP 68 @ <input type="checkbox"/>	
	@ EARTHING TERMINAL	REQUIRED	
	PLUG & SOCKET(9 PIN) (FOR COMMD, LS/TS FEED BACK, PoT)	<input type="checkbox"/> REQUIRED <input checked="" type="checkbox"/> NOT REQUIRED <input type="checkbox"/> 2 NOS. <input type="checkbox"/>	
CABLE GLANDS	@ POWER CABLE GLAND	SIZE:-----	
	@ SPACE HEATER CABLE GLAND	SIZE:-----	
	OTHER CONTROL CABLE GLANDS-1	INSTRUMENT CABLE SIZE FOR ON/OFF DUTY VALVES SHALL BE 8PXO.5 SQMM - ONE CABLE GLAND OF OD SIZE 20 MM.	
	OTHER CONTROL CABLE GLANDS-2	INSTRUMENT CABLE SIZE FOR INCHING DUTY TYPE VALVES SHALL HAVE TWO NO. CABLES (ONE NO. 8PXO.5 SQMM AND 2ND 2PXO.5 SQMM) - TWO NO. GLANDS OF OD SIZES 20 MM & 15 MM.	
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
 - TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C.
 - CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL, WITH NICKEL COATING 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.
- \$\$ TORQUE SWITCH & LIMIT SWITCH SHALL ACT INDEPENDENT OF EACH OTHER. TANDEM OPERATION IS NOT ACCEPTABLE.**
- ## EPOXY PAINT IS RECOMMENDED FOR COASTAL AREAS.**

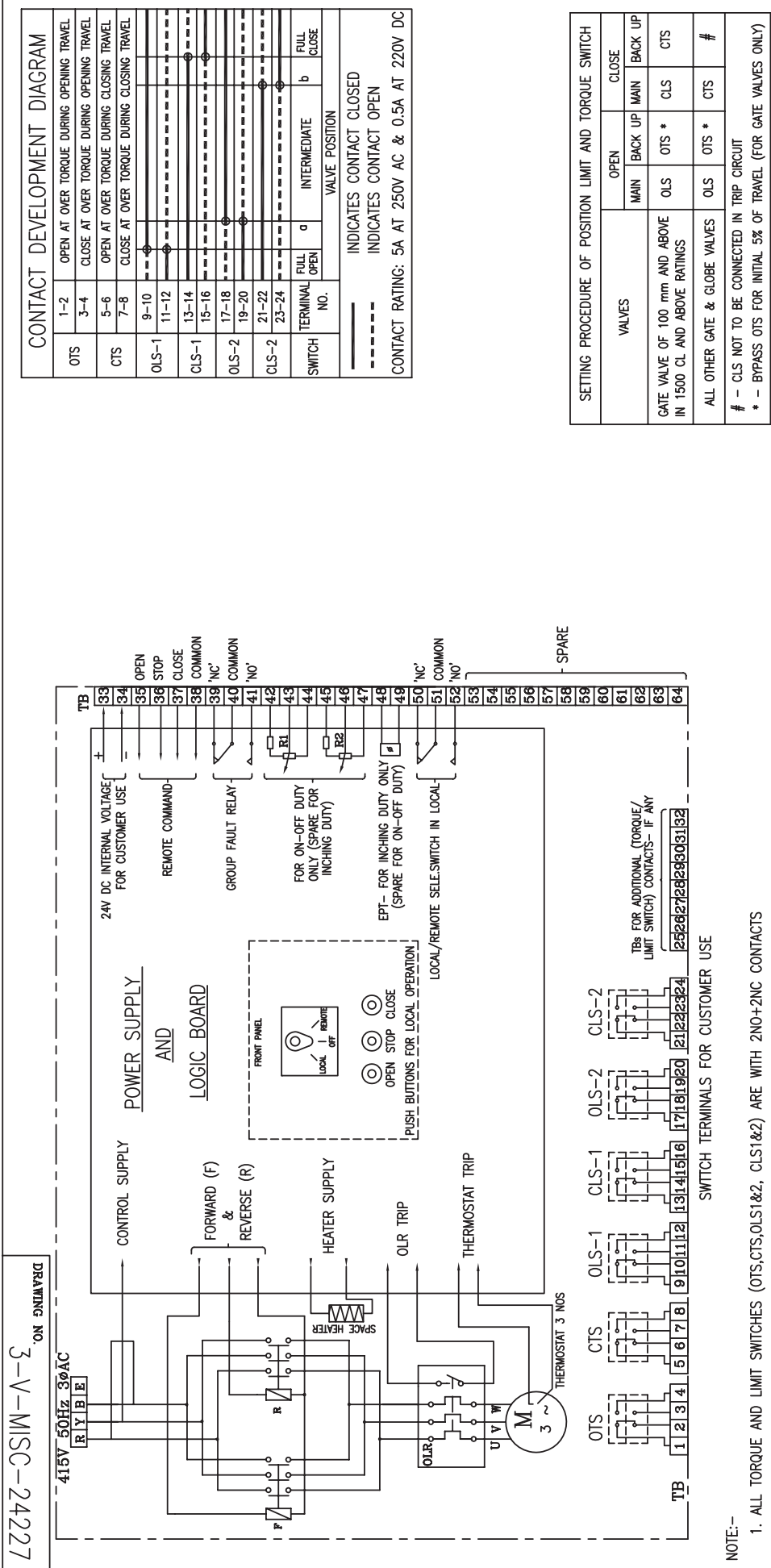
VENDOR COMPANY SEAL

NAME
SIGNATURE
DATE

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

THIS IS A PART OF TECHNICAL SPECIFICATION NO.-PE-TS-410-155A-A001

ALL DIMENSIONS ARE IN MILLIMETRES. FOR TOLERANCES OF UNTOLERANCED DIMENSIONS DURING MANUFACTURE REFER RELEVANT QCP / QP.



TYPE OF PRODUCT ELECTRICAL VALVE ACTUATORS (AC) WITH INTEGRAL STARTERS
(DRAWN FOR INTERMEDIATE POSITION OF VALVES)

OR NAME OF CUSTOMER/PROJECT

BHARAT HEAVY ELECTRICALS LTD.,
UNIT: HIGH PRESSURE BOILER PLANT,
TRUCHIRAPALLI-620014.

DEPT VL 365-121

DRN N.P.ESWAR

CHD D.DINAKARAN

APPD K.ARUNACHALAM

DATE 07.10.04

DATE 07.10.04

DATE 07.10.04

WEIGHT (KG)

SCALE

REV DATE ALTERED

CHD & APPD

TITLE

WIRING DIAGRAM (TERMINAL PLAN)

FOR ACTUATOR WITH INTEGRAL STARTER

DRAWING NO. 3-V-MISC-24227

CARD CODE U 01

REV 0

- NOTE:-
- ALL TORQUE AND LIMIT SWITCHES (OTS,CTS,OLS1&2, CLS1&2) ARE WITH 2NO+2NC CONTACTS '1NO+1NC' IS TERMINATED IN TBS 1-24, REMAINING CONTACTS ARE FOR INTERNAL USE.
 - ANY SPARE CONTACTS WHICH ARE NOT USED INTERNALLY ARE TO BE TERMINATED IN TBS 25-32
 - CTS - TORQUE SWITCHES FOR CW ROTATION (CLOSE)
 - OTS - TORQUE SWITCHES FOR CCW ROTATION (OPEN)
 - OLS-1, OLS-2 - LIMITSWITCHES FOR POSITION OPEN
 - CLS-1, CLS-2 - LIMITSWITCHES FOR POSITION CLOSE
 - EPT - ELECTRONIC POSITION TRANSMITTER (Contactless , FOR INCHING DUTY)
 - R1-R2-POTENTIOMETER 2 x 100 OHMS (FOR ON-OFF DUTY)
 - FOR COMMANDS & EPT EITHER INTERNALLY GENERATED 24 VDC OR EXTERNAL SUPPLY OF 24VDC CAN BE USED
 - M - MOTOR 3φ 415V 50 Hz AC SUPPLY



Technical specification for
CONTROL & INSTRUMENTATION

1X800 MW KOTHAGUDEM

SPEC NO.: **PE-TS-410-145-I**

VOLUME

SECTION

REV. NO. 00

DATE : 10.03.2015

SHEET OF

INSTRUMENTATION DATA SHEET

Telangana State Power Generation Corporation Ltd.
1x800 MW Kothagudem TPS

EPC Bid Document
e-PCT/TS/K/02/2014-15

1.00.00 **SPECIFICATION FOR ELECTRONIC TRANSMITTERS**

1.01.00 PRESSURE TRANSMITTER

1. Working Principle : Smart (HART Compatible)
2. Type : Microprocessor based, 2 – Wire
3. Output Signal : 4-20 mA DC along with superimposed digital signal
4. Measuring Element : Capsule / Diaphragm
5. Element material : SS-316 (Stainless Steel) or better
6. Static Pressure : 150 % of maximum span continuously, without affecting the calibration
7. Turn-down ratio : 100: 1
8. Span and Zero : Continuous, tamper proof, remote as well locally adjustable with zero elevation and suppression by 100% of span
9. Enclosure Class : IP-65 (Explosion proof for NEC Class-1, Division 1 area)
10. Output Indicator : LCD (Integral indicator of 5 digit display)
11. Nameplate : Tag number, service engraved in SS tag plate
12. Body : SS
13. Operating Voltage : 24V DC
14. Load : 600 Ohms (min.) at 24 Volts D.C.
15. Ambient Temperature : 0 - 50 °C
16. Performance: :
 - i. Accuracy ± 0.075% of Span or better

DEVELOPMENT CONSULTANTS
(PCT-K-03-2013-14_V-VI_S VII_SS A.DOC)

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Telangana State Power Generation Corporation Ltd.
1x800 MW Kothagudem TPS

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-
- ii. Repeatability : $\pm 0.05\%$ of Span or better
17. Sealing/Isolation : Extended diaphragm (Silicon oil/ Fluorolub filled) with 5 meters SS armoured capillary for corrosive/viscous/solid bearing or slurry type fluid applications
18. Accessories :
- a. Universal mounting bracket suitable for 2" pipe mounting
 - b. High tensile carbon steel U-bolts
 - c. Siphon for steam and hot water services
 - d. 1/2" NPT 2-valve stainless steel manifold, constructed from SS316 bar stock
 - e. Companion flange with nuts, bolts and gaskets
 - f. 1/2" NPT cable gland
 - g. Handheld calibrator
19. Adjustment/Calibration/ Maintenance : From handheld calibrator/ HART management system

Notes: For primary air/ secondary air/ flue gas applications, DP type transmitters shall be provided for pressure measurement.
 LVDT type is not acceptable.

1.02.00 DIFFERENTIAL PRESSURE TRANSMITTER / FLOW TRANSMITTER

- 1. Working Principle : Smart (HART Compatible)
- 2. Type : Microprocessor based, 2 – Wire
- 3. Output Signal : 4-20 mA DC along with superimposed digital signal
- 4. Measuring Element : Capsule / Diaphragm

DEVELOPMENT CONSULTANTS
 (PCT-K-03-2013-14_V-VI_S VII_SS A.DOC)

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Telangana State Power Generation Corporation Ltd.
1x800 MW Kothagudem TPS

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-
- | | | | |
|-----|---------------------|---|---|
| 5. | Element material | : | SS-316 (Stainless Steel) or better |
| 6. | Static Pressure | : | 150 % of maximum span continuously, without affecting the calibration |
| 7. | Turn-down ratio | : | 100: 1 |
| 8. | Span and Zero | : | Continuous, tamper proof, remote as well locally adjustable with zero elevation and suppression by 100% of span |
| 9. | Enclosure Class | : | IP-65 (Explosion proof for NEC Class-1, Division 1 area) |
| 10. | Output Indicator | : | LCD (Integral indicator of 5 digit display) |
| 11. | Nameplate | : | Tag number, service engraved in SS tag plate |
| 12. | Body | : | SS |
| 13. | Operating Voltage | : | 24V DC |
| 14. | Load | : | 600 Ohms (min.) at 24 Volts D.C. |
| 15. | Ambient Temperature | : | 0 - 50 °C |
| 16. | Performance: | | |
| | i. Accuracy | : | ± 0.075% of Span or better |
| | ii. Repeatability | : | ± 0.05% of Span or better |
| 17. | Sealing/Isolation | : | Extended diaphragm (Silicon oil/ Fluorolub filled) with 5 meters SS armoured capillary for corrosive/viscous/solid bearing or slurry type fluid applications |
| 18. | Accessories | : | <ul style="list-style-type: none"> a. Universal mounting bracket suitable for 2" pipe mounting b. High tensile carbon steel U-bolts |

DEVELOPMENT CONSULTANTS
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- c. Siphon for steam and hot water services
- d. ½” NPT 5-valve stainless steel manifold, constructed from SS316 bar stock
- e. Companion flange with nuts, bolts and gaskets
- f. ½” NPT cable gland
- g. Handheld calibrator

19. Adjustment/Calibration/ Maintenance : From handheld calibrator/ HART management system

1.03.00 Displacer Type Level Transmitters

- 1. Type : Smart (HART Compatible)
- 2. Stages of operation : Continuous
- 3. Material :
- 4. i. Displacer SS-316
- 5. ii. Suspension wire SS-316
- 6. iii. Torque tube housing SS
- 7. iv. Torque tube Inconel
- 8. v. Displacer chamber SS
- 9. vi. Transmitter Housing SS
- 10. Operating Voltage : 24 V DC
- 11. Transmission : Microprocessor based, 2-wire
- 12. Output Signal : 4-20 mA DC along with superimposed digital signal
- 13. Static / overload : Maximum static pressure without

**Telangana State Power Generation Corporation Ltd.
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pressure	:	permanent deformation or loss of accuracy
14. Turn-down ratio	:	10 : 1 or better
15. Zero & Span	:	Continuous, tamper proof, remote as well locally adjustable with zero elevation and suppression by 100% of span
16. Enclosure Class	:	IP-65
17. Output Indicator	:	LCD type (Integral indicator of 5 digit display)
18. Nameplate	:	Tag number and Service engraved in stainless steel tag plate
19. Ambient Temperature	:	0 - 50 °C
20. Load Impedance	:	600 Ohms at 24 Volts (minimum)
21. Process Connection	:	2" Flanged
22. Performance - Accuracy	:	± 0.075 % of span or better
23. Accessories	:	<ul style="list-style-type: none"> a) Counter Flange, nuts, bolts, gaskets etc b) Weights for 5 point calibration of instruments c) Vent and drain plugs d) ½" NPT Glands e) Handheld calibrator
24. Preferred Features	:	<ul style="list-style-type: none"> a) Test plug connection and cutout terminals physically separated from other electronics b) Electronic Damping facility (adjustable)
25. Adjustment/Calibration/ Maintenance	:	From handheld calibrator/ HART management system

DEVELOPMENT CONSULTANTS
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Telangana State Power Generation Corporation Ltd.
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26. Applications : During detail engineering on Owner's approval
- 1.04.00 MASS FLOW METER
- 1.04.01 SENSOR
1. Measuring Principle : Coriolis Mass flow
 2. Primary Element : Flow Tube of 316SS or better
 3. Heating Arrangement : Integral
 4. Temperature Control : For heavy fuel oil application
 5. Process Connection : Flanged of rating as per process requirement
 6. Drain : Self-draining facility
 7. Enclosure : Stainless steel
 8. Accessories : Counter flanges, Mounting nuts, bolts, gaskets etc.
- 1.04.02 TRANSMITTER
1. Measured quantities : Mass Flow rate, Total Mass Flow, Density
 2. Input Signal Processing : Smart (HART compatible)
 3. Display : LCD
 4. Output : 2 nos. isolated output of 4-20mA DC selectable from four measured quantities
 5. Load : < 750 ohms
 6. Power supply : 240V AC, 50 Hz

DEVELOPMENT CONSULTANTS
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-
- | | | | |
|-----|---|---|---|
| 7. | Turn Down | : | 100:1 |
| 8. | Accuracy | : | ± 0.2 % of measured value |
| 9. | Housing | : | IP 65 (Explosion proof) |
| 10. | Nameplate | : | Tag number, service engraved in stainless steel tag plate |
| 11. | Accessories | : | a) Handheld calibrator
b) Mounting U-bolts, nuts, bolts, prefab cable etc
c) $\frac{1}{2}$ "NPT cable gland |
| 12. | Adjustment/Calibration/
/Maintenance | : | From handheld calibrator/ HART management system |
| 13. | Applications | : | Fuel Oil service |

1.05.00 RADAR TYPE LEVEL MEASUREMENT

- | | | | |
|----|---------------------------|---|--|
| 1. | Type | : | Smart (HART Compatible) |
| 2. | Antenna | : | Co axial / guided wave radar /Overspill protection |
| 3. | Principle | : | TDR (Time Domain Reflectometry) |
| 4. | Communication | : | Two wire 4-20mA DC with HART |
| 5. | Environmental temperature | : | 0 – 50 °C |
| 6. | Enclosure | : | IP-65 (Explosion proof for NEC Class-1, Division 1 area) |
| 7. | Calibration | : | a) Self calibration with internal reference
:
b) Zero & Span calibration |
| 8. | Process Connection | : | External cage mounting
Flanged /screwed |
| 9. | Electronic Housing | : | Epoxy painted Die-Cast aluminium |

DEVELOPMENT CONSULTANTS
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		alloy
10. Antenna / Flange assembly	:	316 SS or Hest alloy (as required)
11. Power supply	:	24 V DC
12. Output Indicator	:	LCD
13. Accuracy	:	5 mm or 0.1% of probe length
14. Accessories	:	a) Handheld calibrator
	:	b) Counter Flange, nuts, bolts, gaskets etc
	:	c) ½"NPT cable gland
	:	d) SS Nameplate
15. Adjustment/Calibration/ /Maintenance	:	From handheld calibrator/ HART management system
16. Applications	:	Vessels under vacuum or low pressure applications, solid levels
1.06.00		ULTRASONIC LEVEL TRANSMITTER
1. Type	:	Microprocessor based, 2-wire, Smart (HART Compatible)
2. Operating Principle	:	Detection of reflected ultrasonic pulse
3. Output Signal	:	4-20 mA DC along with superimposed digital signal
4. Operating frequency	:	10 KHz to 50 KHz (typical)
5. Display	:	LCD
6. Temperature Compensation	:	Built in –Programmable
7. Power supply	:	24 V DC
8. Enclosure	:	SS, IP-65 (Explosion proof for NEC Class-1, Division 1 area)

DEVELOPMENT CONSULTANTS
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-
9. Zero & Span : Continuous, tamper proof, remote as well locally adjustable. It shall be possible to calibrate the instrument without any level in the sump/ tank
10. Accuracy & Repeatability : 0.15 % of span or better
11. Resolution : 0.1 % of span
12. Operating temp. : Transmitter- 500 C and Sensor - 800 C
13. MOC Sensor : SS-316/Body- PVC and Face – Polyurethane
14. Mounting : 4" Flanged/ 2" NPT for sensor and Transmitter on panel
15. Accessories : a) Handheld calibrator
b) Weather canopy for protection from direct sunlight and direct rain
c) ½"NPT cable gland
d) All mounting hardware (SS-316), Prefab cable
e) SS Nameplate
16. Diagnosis : On-line
17. Status Indication : Power On, HI, HI-HI, Lo, LO-LO, Fault
18. Output Contacts : 2 SPDT, 230V, 5A
19. Adjustment/Calibration/ Maintenance : From handheld calibrator/ HART management system
20. Applications : Coal Bunker, Water Service etc.

DEVELOPMENT CONSULTANTS
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**Telangana State Power Generation Corporation Ltd.
1x800 MW Kothagudem TPS**

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1.07.00 **ULTRASONIC FLOW TRANSMITTER**

- | | | | | | | | | | | | | | |
|-----|---|---|--|----|---------------------|----|-------------------|----|------------------|----|--------------------------------|----|--------------|
| 1. | Type | : | Ultrasonic – Clamp On | | | | | | | | | | |
| 2. | Accuracy | : | +/- 1 % of reading | | | | | | | | | | |
| 3. | Repeatability | : | +/- 0.3 % of reading | | | | | | | | | | |
| 4. | Rangeability | : | 400 : 1 | | | | | | | | | | |
| 5. | Output Signal | : | 4-20 mA DC with HART | | | | | | | | | | |
| 6. | Measured Parameter | : | Volumetric flow, Totalized flow and flow Velocity | | | | | | | | | | |
| 7. | Display | : | LCD with internal Key Pad (Flow rate & Totalization) | | | | | | | | | | |
| 8. | Power Supply | : | 24 V DC (2 Wire) | | | | | | | | | | |
| 9. | Enclosure | : | SS (IP- 68 – Submersible) | | | | | | | | | | |
| 10. | Mounting | : | SS Chain or Strap | | | | | | | | | | |
| 11. | Accessories | | <table border="0"> <tr> <td style="vertical-align: top;">1.</td> <td style="vertical-align: top;">Handheld calibrator</td> </tr> <tr> <td style="vertical-align: top;">2.</td> <td style="vertical-align: top;">½”NPT cable gland</td> </tr> <tr> <td style="vertical-align: top;">3.</td> <td style="vertical-align: top;">Transducer cable</td> </tr> <tr> <td style="vertical-align: top;">4.</td> <td style="vertical-align: top;">All mounting hardware (SS-316)</td> </tr> <tr> <td style="vertical-align: top;">5.</td> <td style="vertical-align: top;">SS Nameplate</td> </tr> </table> | 1. | Handheld calibrator | 2. | ½”NPT cable gland | 3. | Transducer cable | 4. | All mounting hardware (SS-316) | 5. | SS Nameplate |
| 1. | Handheld calibrator | | | | | | | | | | | | |
| 2. | ½”NPT cable gland | | | | | | | | | | | | |
| 3. | Transducer cable | | | | | | | | | | | | |
| 4. | All mounting hardware (SS-316) | | | | | | | | | | | | |
| 5. | SS Nameplate | | | | | | | | | | | | |
| 12. | Adjustment/Calibration/
/Maintenance | : | From handheld calibrator/ HART management system | | | | | | | | | | |
| 13. | Applications | : | Plant water service | | | | | | | | | | |

Note: Multi-path insertion type (minimum 4 path) Ultrasonic Flow meter shall be provided for Raw water/ Cooling Water flow measurements.

2.00.00 **HART HAND HELD CALIBRATOR**

Hand held calibrators (5 nos. for each type) shall be provided for adjustment/ calibration/maintenance of the HART compatible

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transmitters. The hand held calibrator shall be suitable for all types of transmitters supplied in the package. If one type of hand held type calibrator is not suitable for communicating with all types of transmitters then separate hand held calibrator will be provided.

3.00.00 **PROCESS ACTUATED SWITCHES**

3.01.00 PRESSURE SWITCH

1. Type :
 - i. Piston for high pressure application
 - ii. Bellow / Diaphragm for low pressure application
2. Sensing element : SS-316.
 material All other wetted part SS316
3. Case Material : SS \dagger
4. Setter Scale : Black graduation on white linear scale.
 Graduation 0-100% with red pointer for set points
5. Over range : 150 % of maximum pressure
6. Adjustments :
 - a) Internal Set Point
 - b) Differential adjustment
7. End Connection : 1/2" NPT bottom connected
8. Switch configuration : Two SPDT (240V, 5A AC/220V, 0.5A DC)
9. Switch Type : Snap acting, shock & vibration proof
10. Terminal Block : Suitable for full ring lugs
11. Enclosure Class : IP-65 (Explosion proof for NEC Class-1, Division 1 area)
12. Performance :
 - a) Repeat accuracy \pm 1.0%
 - b) Accuracy of Setting Indication of \pm 1.5%
13. Ambient temperature : 0 – 50 Deg.C

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-
14. Nameplate : Tag number, service engraved in SS tag plate
15. Accessories : a) Silicon oil/ Fluorolub filled Remote diaphragm seal with SS-316 capillary for corrosive/ viscous/ solid bearing or slurry type fluid applications
b) Snubbers for pulsating fluid applications
c) Siphons for steam and hot water services
d) Retention ring and screws for surface mounting
e) 1/2" NPT 2 Valve SS-316 barstock manifold
f) 1/2" NPT cable gland
16. Applications : During Detail Engineering on Owner's approval

3.02.00 DIFFERENTIAL PRESSURE SWITCH

1. Type : i. Piston for high pressure application
ii. Bellow / Diaphragm for low pressure application
2. Sensing element : SS-316.
material All other wetted part SS316
3. Case Material : SS
4. Setter Scale : Black graduation on white linear scale. Graduation 0-100% with red pointer for set points
5. Over range : 150 % of maximum pressure

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- | | | | |
|-----|----------------------|---|---|
| 6. | Adjustments | : | a) Internal Set Point
b) Differential adjustment |
| 7. | End Connection | : | 1/2" NPT bottom/ back connected |
| 8. | Switch configuration | : | Two SPDT (240V, 5A AC/220V, 0.5A DC) |
| 9. | Switch Type | : | Snap acting, shock & vibration proof |
| 10. | Terminal Block | : | Suitable for full ring lugs |
| 11. | Enclosure Class | : | IP-65 (Explosion proof for NEC Class-1, Division 1 area) |
| 12. | Performance | : | a) Repeat accuracy $\pm 1.0\%$
b) Accuracy of Setting Indication of $\pm 1.5\%$ |
| 13. | Ambient temperature | : | 0 – 50 Deg.C |
| 14. | Nameplate | : | Tag number, service engraved in SS tag plate |
| 15. | Accessories | : | a) Silicon oil/ Fluorolub filled Remote diaphragm seal with SS-316 capillary Diaphragm seals for corrosive/ viscous/ solid bearing or slurry type fluid applications
b) Snubbers for pulsating fluid applications
c) Siphons for steam and hot water services
d) Retention ring and screws for surface mounting
e) 1/2" NPT 5 Valve SS-316 barstock manifold
f) 1/2" NPT cable gland |
| 16. | Applications | : | During Detail Engineering on Owner's |

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3.03.00 LEVEL SWITCH

3.03.01 FLOAT OPERATED

1. Float material : SS-316
2. Wetted parts : SS-316
3. Float chamber : Stainless steel/Carbon steel,
construction welded
4. Float chamber : Side mounted
mounting
5. Fluid connection : Side – Side
6. Fluid connection size : 1" ANSI RF Flange (rubber line, if
required)
7. Drain : ½ inch NPT with Plug
8. Pressure rating of
chamber : Minimum 1.5 times of design pressure
9. Repeatability : +/- 1.5 mm or better
10. Switch housing : Stainless Steel
11. Switch housing type : IP- 65
12. Type of switch : Snap acting magnetically operated
hermetically sealed
13. Switch configuration : 2 SPDT (5A, 240 V AC, 0.5A, 220V DC)
14. Accessories : a) Counter flange, nuts
& bolts, suitable
gasket etc.
b) Steel globe type
drain valve
c) ½"NPT cable gland

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d) Stainless steel nameplate with alpha-numeric engraved for service and tag

15. Application : During Detail Engineering on Owner's approval

3.04.00 FLOW SWITCH

1. Type : Paddle /Piston/Disk
2. Wetted part material : Stainless steel or Hastelloy for acidic application
3. End connection :
 - a) Threaded upto 1" line size with integral Tee
 - b) Flanged for line size > 1 ½"
4. Enclosure material : Stainless Steel
5. Enclosure class : IP 65
6. Switch configuration : 2 SPDT (5A, 240 V AC, 0.5A, 220V DC)
7. Repeatability : 2%
8. Cable connection : ½"NPTF
9. Accessories :
 - a) Tee, Counter flange, nuts & bolts, suitable gasket etc
 - b) ½"NPT cable gland
 - c) Stainless steel nameplate with alpha-numeric engraved for service and tag

3.05.00 RF LEVEL SWITCH

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- | | | | |
|-----|---|---|---|
| 1. | Type
Sensing probe | : | RADIO FREQUENCY |
| 2. | Material | : | SS-316 |
| 3. | Mounting | : | Threaded |
| 4. | Application
Temperature
Electronic Controller | : | 250°C (Max.) |
| 5. | Input Supply Voltage | : | 240V AC ±10%, 50 Hz. |
| 6. | Relay Output | : | 2 SPDT (240V AC, 5A) |
| 7. | Ambient Temperature | : | 50 °C |
| 8. | Enclosure Protection | : | IP-66 |
| 9. | Enclosure Housing | : | SS
Normal Level
Power On |
| 10. | Local LED Indication | : | Alarm Level
Probe Healthy |
| 11. | Switching Repeatability | : | ±0.5%
Co-axial cable for probe connection to
controller |
| 12. | Accessories | : | SS Tag plate
½" NPT Cable Glands |
| 13. | Application | : | Solid level |

3.06.00 CONDUCTIVITY TYPE LEVEL SWITCH

- | | | | |
|----|----------------------------|---|-----------------------------|
| 1. | Type | : | Conductivity discrimination |
| 2. | Probe MOC | : | SS-316 |
| 3. | Mounting | : | Flanged on external cage |
| 4. | Application
Temperature | : | 250°C (Max.) |
| 5. | Test Pressure | : | Two times rated pressure |

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|-----|----------------------|---|--|
| 6. | Input Supply Voltage | : | 240V AC \pm 10%, 50 Hz.
Four independent channel with |
| 7. | Input | : | selectable switching threshold for water conductivity |
| 8. | Relay Output | : | 2 SPDT (240V AC, 5A) |
| 9. | Ambient Temperature | : | 50 °C |
| 10. | Enclosure Protection | : | IP-65 (Explosion proof for NEC Class-1, Division-1 area) |
| 11. | Enclosure Housing | : | SS
HI,LO, HIGH-HIGH, LOW-LOW |
| 12. | Local LED Indication | : | Power
Fault |
| 13. | Accessories | : | a) Interconnecting cable from probe to electronics
b) Mounting accessories
c) External cage
d) Washer & Gasket
e) ½" NPT Cable Glands
f) SS Tag Plate |
| 14. | Application | : | During Detail Engineering on Owner's approval |
- 3.07.00 TEMPERATURE SWITCH
- | | | | |
|----|--------------------------|---|--------------------------|
| 1. | Type | : | Bimetallic or gas filled |
| 2. | Sensing Element Material | : | SS-316 |
| 3. | Bulb Material | : | SS-316 |
| 4. | Capillary | : | Stainless Steel armored |

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5. Movement Material : Stainless Steel
6. Case material : Stainless Steel with neoprene gasket and clear glass where applicable cover conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).
- 7.. Scale : Black graduation on white linear scale. Graduation 0-100% with red pointer for set points
8. Over range Protection : 120 %
9. Instrument connection : Bottom
10. Switch configuration : Two SPDT (240V, 5A AC/220V, 0.5A DC)
11. Switch type : Snap acting, shock and vibration-proof
12. Adjustability : Internal Set point adjustable over span range
13. Compensation : a) Capillary compensation with invar wire throughout the capillary length
b) Case compensation
14. Performance
- a) Scale Accuracy : ± 1.0 % of full scale
- b) Repeatability : < 0.5 % of full range
- c) Response time : Less than 40 seconds with thermowell
15. Capillary length : 5 meters (minimum) for local mounting/15 meters for local panel mounting
16. Nameplate : Tag number, service engraved in stainless steel tag plate
17. Accessories : Mounting accessories, 1/2" NPT cable gland
18. Applications : During Detail Engineering on Owner's

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4.00.00 **LOCAL INSTRUMENTS**

4.01.00 PRESSURE GAUGE AND DIFFERENTIAL PRESSURE GAUGE

1. Type : Bourdon/Bellows/Diaphragm
2. Sensing & Socket : SS-316
3. Movement Material : SS-316
4. Case Material : Stainless steel. IP-65 (Explosion proof for NEC Class-1, Division 1 area)
5. Dial Size : Generally 150 mm
6. Scale : Black lettering on white in 270 O arc.
7. Window : Shatterproof glass
8. Range Selection : Normal process pressure: 50~70 % of range
9. Over-range Protection : 125% of maximum range by internal stop. External stop at zero
For Zero adjustment (Micrometer screw external)
10. Adjustment : For Range adjustment (Micrometer screw internal).
11. Element Connection : Argon welding
12. Process Connection : 1/2" NPT (M) Bottom for local, back for panel mounting
13. Performance : Accuracy of ± 1.0 % of span or better
14. Operating ambient : 0 - 50 °C
15. Safety Feature : Blow out disc /diaphragm at the back
16. Accessories :
 - a) Snubbers for pulsating fluid application.discharge
 - b) Stainless steel Diaphragm seals

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for corrosive/ viscous/ solid bearing or slurry type fluid applications

c) 3-Way SS316 Gauge cock for pressure gauges

5-valve SS316 manifold from

d) barstock for differential pressure gauge

e) Siphons for steam and hot water services

17. Nameplate : Tag number, service engraved in stainless steel tag plate

4.02.00 LEVEL INDICATOR (FLOAT & BOARD TYPE)

1. Type : Float and Board

2. Float Material : SS-316

3. Float Cable : SS-316

4. Indicator Assembly : Epoxy painted Aluminium

5. Guide wire spring assembly : SS-316 (2 Nos.)

6. Guide Wire Anchor : SS-316

Anodized Aluminium with engraved marking (Minimum graduation 10mm),

7. Scale Board :

mounting brackets and suitable hardware required as per tank height

8. Elbow Assembly : Anodized Aluminium

9. Flanges : RF , ANSI 150 , SS (3 Nos.)

10. Accuracy : ± 10 mm or better

11. Accessories : All mounting accessories including counter flange, nuts & bolts, suitable

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gasket etc. as applicable, SS Tag plate

4.03.00 GAUGE GLASS

1. Type : Reflex /Transparent
2. Material :
Glass : Toughened borosilicate resistant to thermal shock
Body Material : ~~Carbon Steel~~Stainless Steel
Enclosure : IP-65 (Explosion proof for NEC Class-1, Division 1 area)
3. Integral cocks & valves/Fittings : i. SS 316
ii. Rubber lined corrosion resistant
4. : ii. stainless steel (for DM/RO service)
5. Vessel Connection : ANSI Flanged SS316
6. Accessories : i. Integral cocks
ii. Drain Valves
iii. Companion Flanges, Bolts, nuts, gaskets, SS Tag plate
iv. Illuminating lamps, Mica shield as required
v. Calibrated scale
7. Pressure rating : Twice the maximum working pressure
8. Temperature : 300 °C
For larger lengths (greater than 1200mm), additional gauge glasses shall be provided with minimum of 50 mm overlap.
9. Other details :

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- 4.04.00 SLIGHT GLASS
1. Type : Flap-type.
 2. End connection : Screwed / Flanged
 3. Material
 - a) Body : SS- 304
 - b) Cover plate : SS- 304
 - c) Indicator : SS- 316
 4. Sight Glass : Toughened Borosilicate
 5. Gasket : Neoprene
 6. Bolts & Nuts : High tensile steel.
 7. Hydraulic Test Pressure : 1.5 times maximum working pressure
 8. Accessories : Companion Flanges, Bolts, nuts, gaskets as required, SS Tag plate.
- 4.05.00 ROTAMETER
1. Type : ON-LINE for line upto and including 50 mm NB.
: Borosilicate BY-PASS for line size above 50 NB
 2. Metering tube : Toughened Borosilicate
 3. Float : SS-316
 4. End fittings : SS-316
 5. Packing material : Teflon / PTFE
 6. Casing : Stainless Steel
 7. Gland Rings : Stainless Steel
/Followers/ Other :
wetted parts
 8. Orifice Plate : Stainless Steel (for bypass type)
 9. Operating Temperature : 0-50 Deg. c

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|------------------------|---|--|
| 10. Test Pressure | : | 200% of maximum operating pressure |
| 11. Scale | : | 250 mm nominal length |
| 12. Graduation | : | Direct reading |
| 13. Process Connection | : | Flanged (RF) to line size as per ANSI standards (150#) |
| 14. Tapping | : | D & D/2 |
| 15. Accuracy | : | +/- 2% of full scale reading |
| 16. Reproducibility | : | Within 0.5% of instantaneous reading |
| 17. Accessories | : | SS Tag Plate, orifice plate |

5.00.00 **TEMPERATURE ELEMENTS & ACCESSORIES**

5.01.00 RESISTANCE TEMPERATURE DETECTOR

- | | | |
|----------------------------------|---|--|
| 1. Type | : | Platinum (Duplex), Ungrounded |
| 2. Platinum (Duplex), Ungrounded | : | 100 ohm at 0 °C |
| 3. Base | : | Wound on ceramic (anti-inductive) |
| 4. Wiring | : | 3 Wire |
| 5. Protecting Tube | | |
| a) O.D. | : | 6 mm |
| b) Material | : | SS-316, Seamless |
| c) Filling | : | Magnesium oxide (Purity above 99.4%). |
| 6. Response time | : | a) 15 sec. (bare).
b) 30 sec. (with thermowell) |
| 7. Calibration | : | DIN 43760 |
| 8. Accuracy | : | ± 0.5% |
| 9. Head | | |
| a) Type | : | IP-65 universal screwed type |

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- b) Material : Stainless Steel
- c) Terminal blocks : Nickel plated Brass-screw type / silver plated
- d) Cable connection : ½" NPT gland and grommet
- e) Others : Terminal head cover with SS chain and suitable gasket.

Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable).

- 10. Accessories :
 - a) Adjustable nipple-union-nipple [1/2" Sch 80 X ½" NPT] with thermowell connection
 - b) Compression fittings/unions
 - c) Flanges etc. (for flanged connections only)
 - d) Thermowell (As specified below)
- 11. Thermowell connection : ½" NPT (M) or 150 RF Flanged
- 12. Nameplate : Tag number, service engraved in stainless steel tag plate

Note: The specifications for RTDs of winding/ bearing of motor/pump, can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However, the type of RTD shall be Pt-100.

5.02.00 THERMOCOUPLES

1. Type :
 - a) 16 SWG wire of Chromel Alumel) (Type-K)
 - b) Duplex
 - c) Ungrounded
2. Protecting Tube
 - a) O.D. : 6 mm
 - b) Material : SS-316, Seamless
 - c) Filling : Magnesium oxide (Purity above 99.4%).
3. Response time :
 - a) < 20 seconds for measurement
 - b) < 10 seconds for control
4. Accuracy : $\pm 1.1^{\circ} \text{C}$ up to 300°C & 0.4% of measured temperature range above 300°C
5. Head
 - a) Type : IP-65 universal screwed type
 - b) Material : Stainless Steel
 - c) Terminal blocks : Nickel plated Brass-screw type / silver plated
 - d) Cable connection : $\frac{1}{2}$ " NPT gland and grommet
6. Others : Terminal head cover with SS chain and suitable gasket.

Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable).

7. Accessories :
- a) Adjustable nipple-union-nipple [1/2" Sch 80 X 1/2" NPT] with thermowell connection
 - b) Compression fittings/unions
 - c) Flanges etc. (for flanged connections only)
 - d) Thermowell (As specified below)
8. Thermowell connection : 1/2" NPT (M) or 150 RF Flanged
9. Nameplate : Tag number, service engraved in stainless steel tag plate

5.03.00 TEMPERATURE GAUGE

1. Type : Expansion type (Liquid filled system)
2. Sensing Element Material : Bourdon – SS-316
3. Bulb and Capillary Material : SS-316
4. Capillary Tubing : Inner sheath - solid drawn Material
copper tube
Outer sheath - PVC tube
5. Movement Materials : Stainless Steel / Direct Bourdon tip connection to pointer spindle
6. Case Material : Stainless Steel stove enameled, black finish, threaded bezel ring, clear glass

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		cover conforming to IP 65.
7. Dial size	:	150 mm
8. Scale	:	Black lettering on white background in 270 Deg.C arc
9. Over range protection	:	125 percent of FSD
10. Capillary Glanding	:	1/2" NPT(M) x compression fitting (SS) to suit capillary
11. Instrument Connection	:	Bottom connection for local mounting, back connection for panel mounting
12. Process Connection	:	1/2" NPT (M) or 150 RF Flanged
13. Extension Neck Length	:	50 mm
14. Compensation	:	a) Capillary compensation
15.	:	b) Case compensation
16. Performance	:	a) Accuracy : + /- 1.0 percent of full scale Deflection
	:	b) Repeatability : Less than 0.5 percent of full range
	:	c) Response time: 15 seconds (max.).
17. Capillary length	:	3.0 meters (local) / 15.0 metres (local panel)
18. Other features	:	Shatter proof glass
19. Nameplate	:	Tag number, service engraved in stainless steel tag plate
20. Accessories	:	SS316 Thermowell

5.04.00 THERMOWELL

1. Material	:	SS-316
2. Manufacture	:	Drilled from bar stock, Hex Head, Tapered design (As per ASME PTC 19.3)

-
- | | | | |
|-----|------------------------|---|---|
| 3. | Process connection | : | M33x2 |
| 4. | Certification | : | Not applicable |
| 5. | Bore concentricity | : | +5% of wall thickness |
| 6. | Identification mark | : | Tag number punched on head |
| 7. | Surface treatment | : | Polish after machining |
| 8. | Element connection | : | ½" NPT (M) or 150 RF Flanged |
| 9. | Head | : | Hex |
| 10. | Length of the hex head | : | 31.75 mm (min.) |
| 11. | Accessories | : | SS Plug and chain for test thermo wells
SS Nameplate, Flange with companion
flange & all required accessories for
flanged connections. |

Note: Wake frequency calculations shall be furnished for all thermowells for approval.

Thermowells shall be designed such that the resonant frequency is above the exciting frequencies generated by vortex shedding in the process fluid.

5.05.00 METAL TEMPERATURE THERMOCOUPLE

- | | | | |
|----|----------------------------|---|---|
| 1. | Measuring medium | : | Metal temperature |
| 2. | Type | : | Chromel Alumel (Type-K)
Duplex, Ungrounded |
| 3. | Insulation | : | Mineral Insulation Magnesium Oxide |
| 4. | Wire gauge | : | 16 AWG |
| 5. | Protective sheath | : | SS |
| 6. | Protective sheath diameter | : | 8 mm O.D. |
| 7. | Characteristics | : | Special limits of error as in ANSI thermocouple MC 96.01 |
| 8. | Accessories | : | ½" BSP SS sliding end connector, weld pad, clamps of heat resistant steel |

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1. Type : Hydrometer Type
2. Mounting : On line
3. Accuracy : +/- 2% of range
4. Scale : Black letter on white scale
5. End connection : PVC flange

9.06.00 DENSITY/ CONCENTRATION METER

1. Wetted Part : Stainless Steel
2. Enclosure : Stainless Steel (IP-65)
3. Power Supply : 24 V DC
4. Output signal : 4-20 mA DC (isolated) into 600 ohms
5. Accuracy : ±0.001 g/cc
6. Indication : LCD display
7. Temp. Compensation : Integral
8. Accessories : Mounting hardware, integral amplifier (if required), cable glands, tag plate etc.

10.00.00 SOLENOID VALVES

1. Operating Principle : Electromagnetic (noiseless)
2. Coil voltage rating : 240 V AC /24 V DC (as required)
3. Ways : 2/3/4 way
4. Port size : 1/4" NPT all ports
5. Body : SS bar stock
- Trim : SS-316
6. Duty : Suitable for continuous energization
7. Sealing : Airtight and leak proof
8. Ambient Temperature : 0 - 50 ° C

DEVELOPMENT CONSULTANTS
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V VI/S-VII/SS-A: 42

Telangana State Power Generation Corporation Ltd.
1x800 MW Kothagudem TPS

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|-----|-------------------|---|--|
| 9. | Fluid Temperature | : | 0-150 ° C (approx.) |
| 10. | Coil Enclosure | : | Stainless Steel |
| 11. | Insulation | : | Class-H |
| 12. | Coil Casing | : | IP-65 (Explosion proof for NEC Class-
1, Division-1 area) |
| 13. | Mounting | : | On pipe or on panel |
| 14. | Cable Connection | : | ½" NPT |
| 15. | Accessories | : | Cable glands, SS Tag plate |

DEVELOPMENT CONSULTANTS
(PCT-K-03-2013-14_V-VI_S VII_SS A.DOC)

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- 4.04.00 SLIGHT GLASS
1. Type : Flap-type.
 2. End connection : Screwed / Flanged
 3. Material
 - a) Body : SS- 304
 - b) Cover plate : SS- 304
 - c) Indicator : SS- 316
 4. Sight Glass : Toughened Borosilicate
 5. Gasket : Neoprene
 6. Bolts & Nuts : High tensile steel.
 7. Hydraulic Test Pressure : 1.5 times maximum working pressure
 8. Accessories : Companion Flanges, Bolts, nuts, gaskets as required, SS Tag plate.
- 4.05.00 ROTAMETER
1. Type : ON-LINE for line upto and including 50 mm NB.
: Borosilicate BY-PASS for line size above 50 NB
 2. Metering tube : Toughened Borosilicate
 3. Float : SS-316
 4. End fittings : SS-316
 5. Packing material : Teflon / PTFE
 6. Casing : Stainless Steel
 7. Gland Rings : Stainless Steel
/Followers/ Other :
wetted parts
 8. Orifice Plate : Stainless Steel (for bypass type)
 9. Operating Temperature : 0-50 Deg. c

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| 10. Test Pressure | : | 200% of maximum operating pressure |
| 11. Scale | : | 250 mm nominal length |
| 12. Graduation | : | Direct reading |
| 13. Process Connection | : | Flanged (RF) to line size as per ANSI standards (150#) |
| 14. Tapping | : | D & D/2 |
| 15. Accuracy | : | +/- 2% of full scale reading |
| 16. Reproducibility | : | Within 0.5% of instantaneous reading |
| 17. Accessories | : | SS Tag Plate, orifice plate |

5.00.00

TEMPERATURE ELEMENTS & ACCESSORIES

5.01.00

RESISTANCE TEMPERATURE DETECTOR

- | | | |
|----------------------------------|---|--|
| 1. Type | : | Platinum (Duplex), Ungrounded |
| 2. Platinum (Duplex), Ungrounded | : | 100 ohm at 0 °C |
| 3. Base | : | Wound on ceramic (anti-inductive) |
| 4. Wiring | : | 3 Wire |
| 5. Protecting Tube | | |
| a) O.D. | : | 6 mm |
| b) Material | : | SS-316, Seamless |
| c) Filling | : | Magnesium oxide (Purity above 99.4%). |
| 6. Response time | : | a) 15 sec. (bare).
b) 30 sec. (with thermowell) |
| 7. Calibration | : | DIN 43760 |
| 8. Accuracy | : | ± 0.5% |
| 9. Head | | |
| a) Type | : | IP-65 universal screwed type |

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|-----|------------------------|---|--|
| 9. | Cold end sealing | : | SS pot weal with colour coded PTFE headed sleeve insulated flexible tails.
Sealing compound Epoxy resin |
| 10. | Minimum bending radius | : | 30 mm |
| 11. | Length of T/C | : | 30 Mtr. (minimum) |

Notes:

The specification for thermocouples of bearings metal temp measurements can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However, type of thermocouples shall be K-type.

6.00.00 **FLOW ELEMENTS**

6.01.00 ORIFICE PLATE

6.01.01 The orifice plate shall be either concentric square edge type or segmental bored type as per type of process .

6.01.02 Manufacturing, installation and use will be in accordance to the standard BS1042.

6.01.03 Orifice plates will be made of type 316 stainless steel.

6.01.04 The plate thickness of the orifice shall be 3 mm minimum. However the orifice thickness shall be determined by the actual process parameter.

ORIFICE FLANGE

6.01.05 Orifice flange rating will be the same as the piping class.

6.01.06 Flange shall be Standard / Slip on / socket weld/ weld neck raised face as per ANSI B 16.5

6.01.07 Gasket shall be CAF type depend on application.

CARRIER RING

6.01.08 Male female carrier ring of SS316 material shall be provided.

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- 6.01.09 Beyond line size 500 mm, disc type orifice plate will be used.
 PRESSURE TAP
- 6.01.10 Corner taps with Annular Grooves on Carrier Rings as per BS 1042
- 6.01.11 Numbers of tappings as per approved P&IDs of size ½" NPT shall be provided. However, one pair spare tapping shall also be provided with each orifice.
 VENT HOLE/ DRAIN HOLE
- 6.01.12 Suitable Vent hole for water service shall be provided.
 BETA RATIO
- 6.01.13 The ratio of throat diameter to inlet diameter (beta ratio) of the Orifice will be limited between 0.30 and 0.70.
 ACCURACY
- 6.01.13 Accuracy (uncertainties on discharge coefficient 'c') of flow measurement shall be +/-1% for orifice plates according to BS 1042 except for critical measurement (performance calculation).
 ISOLATION VALVES
- 6.01.14 Each tapping point shall be equipped with one primary isolating valve for low pressure and two primary isolating valves for high pressure installations (greater than 40 bar and/or 450 deg c).
- 6.01.15 Material of isolating valve shall be SS316
- 6.01.16 ½ inch NPT (M) SS316 Nipples shall be used to interface valve with orifice.
 NUTS/BOLTS/ GASKETS
- 6.01.17 Jack bolt shall be provided for easier removal.
- 6.01.18 Studs and nuts material shall be ASTM A193 Gr. B7 / A194 Gr. 2H
 TAGGING
- 6.01.19 Orifice plate will be provided with a Handle. Tag number, orifice plate material, measured bore and id of the pipe will be stamped or deep engraved on the upstream face of the Handle.

- 6.02.00 FLOW NOZZLE
- 6.02.01 The Flow Nozzle shall be ASME long radius type.
- 6.02.02 Manufacturing, installation and use will be in accordance to the standard ASME PTC CODE 19.5.
- 6.02.03 Nozzle shall be made of Forged 316 stainless steel.
- 6.02.04 Nozzle shall be machined on latest CNC machines to ensure accuracy.
- END CONNECTION
- 6.02.05 End connection shall be Butt Welded.
- BRANCH PIPE
- 6.02.06 Branch pipe material shall be of same process pipe material.
- 6.02.07 Length of the branch pipe shall be minm. 4D upstream and 2D downstream.
- 6.02.08 Branch pipe assemblies shall be properly machined to acquire required smoothness
- TAPPINGS
- 6.02.09 D & D/2 tapping on pipe shall be provided.
- 6.02.10 Tapping size shall be of 15 NB and number of tappings shall be as per approved PID. However, one pair of spare tapping for each element shall also be provided for each nozzle.
- BETA RATIO
- 6.02.11 Beta ratio shall be limited between 0.30 and 0.70.
- ACCURACY
- 6.02.12 Accuracy (uncertainties on discharge coefficient) of measuring flow measurement shall be equal or better +/-2 % except for critical measurement (Performance calculation)
- ISOLATION VALVES

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- 6.02.13 Each tapping point shall be equipped with one primary isolating valve for low pressure and two primary isolating valves for high pressure installations (greater than 40 bar and/or 450 deg c).
- 6.02.14 Material and size of SW isolating valve shall be SS316 and 15 NB respectively.
- 6.02.15 Suitable Nipples and adaptors shall be used to interface valve with Flow Nozzle .
- TAGGING
- 6.02.16 Nozzle tag no. , material, id , Flow direction will be stamped
- TEST & EXAMINATION
- 6.02.17 All orifices and Flow Nozzles shall be tested in accordance with the quality assurance programme, which shall meet the requirements of applicable codes.
- 6.02.18 Instruments offered shall be of type tested and proven type. Type test certificates for test conducted earlier on similar product shall be furnished. Routine tests, Acceptance tests and all special tests (if any) shall be carried out for all the instruments as per quality plan and applicable standards.
- 6.02.19 Calibration shall be done in reputed laboratory like IIT.
- 6.02.20 IBR certification shall be provided wherever the process pipes come under IBR regulation.
- 6.02.21 The type, routine & acceptance tests shall be witnessed by Inspection agency as per requirements given by the quality plan. Contractors shall give at least 15 days advance notice for witnessing the test. Copies of the certified reports of all tests carried out at the works should be furnished. The equipments shall be dispatched from works, only after receipt of purchasers' written approval of the test reports.
- Certified reports of all the tests carried out at the works shall be furnished for approval of Owner. Test reports shall be completed with all details and also contain specified limiting values, wherever applicable, to facilitate review. The instruments shall be dispatched from works only after receiving the owner's approval of the test reports. The bidders shall have to carry out all the tests within his quoted price and no extra payment can be claimed by bidders.
- 6.03.00 AEROFOIL

6.03.01 For airflow measurement, flow sensing element shall be aerofoil (steel) with ½” tappings.

7.00.00 **CHP RELATED SPECIAL INSTRUMENTS**

Technical specifications for some of the special instruments required for Coal Handling Plant are enumerated below.

7.01.00 ZERO SPEED SWITCHES

It shall be provided for all belt drives or indirectly driven equipment and shall be two-wire, inductive, proximity type. The probe housed in robust stainless steel enclosure of protection class IP 65 shall be installed either radially or axially. Sensing distance range shall be 1 to 25mm. The converter unit shall be dust & water tight, corrosion resistant and shall be mounted separately. The interconnecting cable length shall not be less than 3 meters. Following features shall be provided.

- | | | |
|---------------------------|---|--|
| a) Speed setting accuracy | : | Within $\pm 2\%$ of desired value. |
| b) Repeatability | : | Within $\pm 0.1\%$. |
| c) Differential | : | Within $\pm 5\%$ of set value |
| d) Contacts | : | 2 C/O |
| e) Preferred features | : | (i) Red LED for “Supply On”
(ii) Green LED for “Relay On”
(iii) Display of present speed
(iv) Display of speed set
(v) Alarm facility with
indication
(vi) Initial bypass time delay |

7.02.00 BELT SWAY SWITCHES

Auto reset type in IP 65 class enclosure shall be provided (in pairs) for protecting all non-self-aligning conveyor belts and can be installed in vertical or horizontal position at no more than 30 Mtr. Intervals. For any conveyor, however, minimum two pairs of switches shall be provided.

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**VOLUME : VI
SECTION-VII
SUB SECTION - B
CONTROL VALVES**

- 1.00.00 **GENERAL**
- 1.01.00 Control valves for regulating service shall normally be globe body, preferably cage guided, metal-to-metal seated, pneumatically operated and shall be provided with characterized plugs
- 1.02.00 Where high stroking speed , high actuation forces and accurate positioning is critical for the operation of the plant, as in case of HP or LP bypass valves, Separator Drain Valves , hydraulic actuators with electro-hydraulic interface shall be offered.
- 2.00.00 **GENERAL TECHNICAL REQUIREMENTS**
- 2.01.00 Bidder shall exercise caution in selecting severe service control valves like BFP recirculation, HP & LP bypass, superheater & reheater attemperator, PRDS for Boiler & Turbine, Feed control station ,Soot blower steam pressure, Fuel oil heating and pressurizing ,minimum economizer flow control ,DM make up (emergency / normal), control valves whose down stream are connected to vacuum such as HP/LP heater emergency level control, condenser make up water, separator level control , CEP minimum flow control etc. For such critical applications, Bidder shall offer valves which are proven for similar application. Above valves shall have leakage class equal or better than class-VI with metal-to-metal seating.
- 2.02.00 Valve with ANSI leakage class-V shall be provided for all applications except for the control valves indicated above.
- 2.03.00 Bidder shall provide redundant control valves for some services such as Main condensate flow control, Superheat attemperation control and Reheat attemperation control as a minimum for high availability. For other application, if the availability criteria for the plant cannot be met even with the best established product, redundant control valves shall be provided.
- 2.04.00 Control valves shall be located near floor or platform for ease of access and with adequate clearances for maintenance and lay-down and shall be placed as station with upstream motorized isolating valve, down-stream motorized isolating valve, inching duty motorized bypass valve and manual drain valves. Each redundant control valve shall have its upstream motorized and down-stream motorised isolating valves. Where quick shut off requirement is foreseen such as in case of SH & RH attemperation valves, upstream isolation valve shall be pneumatic type.
- 2.05.00 Wherever, steam conditioning calls for , Pressure reducing & desuperheating, combined PRDS type valves shall be offered.
- 2.06.00 Control Valve shall be furnished with IBR certification wherever required .
- 2.07.00 Valve Body / End Connections
- 2.07.01 Valve end to end dimension and connection shall be according to ANSI standard, straight through pattern. However, Bidder may offer angle body valve for high pressure drop applications. For high pressure drop applications, construction of the valve shall be such that the gland is not exposed to inlet pressure.
- 2.07.02 Control valves of 40 mm. size and above with line pressure up to 50 Kg / Sq. cm may have flanged or welded end connections.

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- 2.07.03 Control valves, used in high pressure services shall have butt welded end connections for size 65mm and above and socket weld end connection for size 50 mm or below.
- 2.07.04 Control valve body shall be selected as per the ISA GUIDeline. Generally control valve body shall be cast and machined for pressure rating up to 1500 lbs. Above 1500 lbs, valve body shall be of forged steel. For Demineralized Water application, valve body shall be Stainless Steel.
- 2.07.05 Bonnet joints for all control valves shall be of flanged and bolted type.
- 2.07.06 Flanged valve shall be rated at no less than class 300 lbs
- 2.07.07 The direction of flow shall be clearly engraved on the body . Valve tag no, , description or purpose, stroke time shall be painted on all control valve body with black letters on white background in Bold letters.
- 2.07.08 Valve Body Material shall match the process condition requirement as per ANSI. . General guideline shall be as follows

SR. NO.	SERVICE	MATERIAL
1.	Non corrosive, non-flashing and non cavitating service for fluid temperature up to 275°C	: Cast carbon steel ASTM A216 Gr. WCB , Trim material - 316 SS stellited faced GUIDe posts and bushings.
2.	Non corrosive, non-flashing and non cavitating service for fluid temperature above 275°C	: Cast alloy steel ASTM A217 Gr. WC9 Trim material - 316 SS stellited faced GUIDe posts and bushings.
3.	Severe flashing / cavitating services	: Alloy steel ASTM A217 Gr. WC9 , Trim material - 440C
4.	Low flashing / cavitating services	: Alloy steel ASTM A217 Gr. WC6 , Trim material - 17-4 PH SS
5.	DM water application (condenser hotwell normal, emergency make up etc.)	: 316 stainless steel

- 2.07.09 Bidder may supply valves with body and trim materials with superior quality than specified material and in such cases Bidder shall furnish the comparison of offered material properties , such as cavitation resistance , , hardness , tensile strength , strain energy , corrosion and erosion resistance etc. , with specified material for Owner's approval.
- 2.08.00 Valve Size
- The control valve sizing (Cv / Kv) shall be based on following guidelines :
- a) The valves shall pass normal flow (MCR condition) with 60 to 70 percent opening for linear characterised valves and between 70 to 80 percent opening for equal percentage characterised valves.

- b) The valves shall have adequate rangeability to pass the minimum and maximum flows at 10% and 85% of the valve opening respectively. Valve stem travel range from minimum to maximum flow condition shall not be less than 50% of the total valve stem travel.
 - c) Valve Cv shall be selected in such a way that the valve shall be capable of handling at least 120% of required maximum flow.
 - d) The valve selection shall be based on the highest size dictated by the above considerations unless noise, flashing or other factors dictate the final selection.
 - e) Trim exit outlet velocity as defined in ISA handbook does not exceed 8 m / sec for liquid services , 150 m/sec for steam services and 50% of sonic velocity for flashing services The sizing procedure followed shall be as per latest edition of ANSI/ISA or equivalent standard.
- 2.09.00 Valve Top work
- 2.09.01 Top work shall be sized so that the valve shall operate properly when upstream pressure is 10 percent above maximum inlet pressure and downstream pressure is atmospheric.
- 2.09.02 Extended bonnet/ bonnet when maximum temperature fluid is greater than 280⁰ C shall be provided and high temperature packing shall also be used for high temperature application.
- 2.09.03 The gland material shall be chosen to suit the operating temperature. PTFE may be chosen for lower temperature application (232°C maximum) and for high temperature application graphited asbestos glands are to be provided. For vacuum services,. All valves connected to vacuum on downstream side shall be provided with packing suitable for vacuum applications eg. double vee type chevron packing.
- 2.10.00 Valve Trim
- 2.10.01 Valve trim for applications up to leakage class-V shall be stainless steel 316 SS for pressure drop up to 7 Kg/ Sq. cm. For pressure drops above 7 Kg/Sq. cm hard trim (stelliting or equivalent) shall be used. Other alloys or treatment such as nitride shall be used if severe erosion is expected.
- 2.10.02 Balanced trim valves shall be offered for high shut-off pressure or high pressure drop condition to reduce the size of the actuators.
- 2.10.03 For flashing services and two stage mixtures, the trim material shall be 17-4 PH SS or equivalent.
- 2.10.04 If cavitating condition is foreseen, Bidder shall offer multistage or labyrinth trims valves. Trim of severe service valves shall be of multistage and multipath design with number of discrete pressure drop stages to eliminate the chances of erosion, cavitation, noise and vibration throughout the control range of the valve.
- 2.10.05 Quick replacement type trim shall be considered for easy maintenance.
- 2.10.06 Plug shall be one-piece construction cast , forged or machined from solid bar stock .Plug shall be screwed or pinned to valve stems or shall be integral with the valve stems.

- 2.11.00 Noise Level
The equivalent sound level measured at 1.5M above nearest floor level in elevation and 1 M horizontally from the control valve expressed in decibels to a reference of 0.0002 microbar shall not exceed 85 dBA. The noise abatement shall be achieved by valve body & trim design and not by use of silencers. Valve Actuators
- 2.12.00 Actuator
- 2.12.01 Spring-diaphragm type actuators shall generally be used. Piston type actuators shall be offered in case of high shut-off pressure & quick response requirement. Hydraulic actuation system shall be provided for Critical valves as described elsewhere in the specification.
- 2.12.02 The actuator shall be designed for 150% thrust required for the valve (at shut-off pressure) at an air line supply pressure of 5.5 Kg/Sq. cm.
- 2.12.03 Diaphragms shall be designed for 200% maximum operating pressure.
- 2.12.04 Nylon reinforced neoprene is preferred as diaphragm material.
- 2.12.05 Valve actuators shall be capable of operating at 80⁰ C ambient, continuously.
- 2.12.06 Entire actuator assembly shall be painted with corrosion inhibiting paint.
- 2.12.07 Air connection size shall be 1/4" NPT (F) unless otherwise dictated by process response time. Integral tubing shall be stainless steel.
- 2.12.08 Bidder shall indicate the stroking time of the valve assemblies with positioned and ensure that the stroke time shall meet the process and equipment dynamics and shall be better than 10 seconds.
- 2.12.09 All actuators shall be of fail safe design signifying that the spring direction will tend to move the valve (open or close) in a direction safe for the process. "Failure to Open" or "Failure to Close" shall be marked on the actuator.
- 2.12.10 Hydraulic actuation system
The system shall consist of , but not limited to , Hydraulic cylinder , proportional valve with blocking unit , SMART positioner with position transmitter , SOVs , safety bypass unit , safety control unit , Hydraulic supply unit and local controller cubicle with controller unit
- 2.13.00 Valve Positioners
- 2.13.01 All regulating service valves shall be offered with HART protocol based Smart Electro Pneumatic Positioners to ensure accuracy and repeatability of response.
- 2.13.02 Positioners shall have integral non contact type position transmitter, input and output gauges, local keypad & display and 4-20 mA DC output to DDCMIS in CCR.
- 2.13.03 Positioners shall be capable of functioning under hot, humid and vibrating conditions.
- 2.13.04 Positioner casings shall be dust tight, corrosion resistant and weatherproof to IP 65 .and explosion proof in hazardous areas.

- 2.13.05 In general, positioner shall operate at signal range 4 – 20 mA DC for the full travel of the valve. Split range operation in few cases may be required.
- 2.13.06 Remote calibration from control room shall be possible through HART management station.
- 2.14.00 Performance
- 2.14.01 Performance of the complete assembly of the control valves shall be better than +/- 1% of FS for linearity , +/- 0.5 % of FS for hysteresis , 1% for accuracy.
- 2.15.00 Valve Accessories
- 2.15.01 Accessories shall include side mounted hand wheels, open & close , intermediate (as applicable) limit switches for both regulating and On off valves ,, junction boxes with 20 % spare terminals , Air filter regulators , airlock relays , volume chambers etc. Solenoid valve (SOV) wherever required shall be furnished. Each limit switch shall have not less than 2 NO & 2 NC contacts with contact rating 5A , 240 V AC / 0.5 A , 220 V DC . SOV shall have SS bar stock body , SS316 Trim , SS coil enclosure , Class H insulation Air filter regulator shall have sintered bronze filter element with maximum 5 microns filter size & 2 inch dial size pressure gauges. .Protection class of all Limit switches , junction boxes , SOV etc. shall have protection class IP 65 and explosion proof for hazardous areas.
- 2.15.02 Air distribution line to all final control elements like control valves, pneumatic dampers (both regulating / on-off type) , SOV operated valves shall be through SS manifolds and SS isolating valves only. These valves shall be properly tagged also with KKS tag no. and description of final control element / instrument for which they are intended.
- 2.16.00 Test and Examination
- All valves shall be tested in accordance with the Quality Assurance programme agreed between the Owner and Bidder , which shall meet the requirements of IBR and other applicable codes mentioned elsewhere in the specification . The test shall include but not be limited to Non destructive test , Hydrostatic shell test prior to seat leakage test , Seat leakage test , Valve closure test , Functional test of fully assembled valves including actuators and accessories. CV test etc. For all control valves Cv test shall be witnessed by Owner.

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5.01.00 Alarms shall be available in the local monitor in the dry room for each unit covering the entire SWAS system, with repeat facility in DDCMIS.

6.00.00 **ANALYZERS**

All Analyzers shall be of microprocessor based design. The general technical specification of the analyzers is provided in this section. Bidder in his offer shall indicate the sample flow requirement of each analyzer and the total quantity of cooling water required for the system.

6.01.00 **CONDUCTIVITY ANALYZER**

A. Sensor

1. Type of Cell : Flow thru'
2. Conductivity Range : As per process
3. Cell Constant : 0.01 / 0.1 / 1.0 depending upon range
4. Temp. Compensation : Manual and Automatic (Integral) 0-100°C
5. Process Connection : Screwed
6. Wetted Parts : Electrodes-SS 316L/ Insulators KYNAR/ Viton
7. Pressure Rating : 10 kg/cm²
8. Accessories : Vessel (SS 316) with ½" NPT connection
9. Cable : Upto transmitter in flexible conduct

B. Transmitter

1. Type : Microprocessor based, Single stream
2. Mounting : 2" pipe
3. Protection Class : IP-65 or better
4. Output : 4-20 mA DC (isolated)
5. Display : Digital Display in Engineering Unit, Alarm Status.
6. Zero/Span Adjustment : Front Panel Membrane type Keyboard

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|-----|--------------------|---|---|
| 7. | Temp. Compensation | : | Automatic |
| 8. | Diagnostic | : | Self diagnostic for electronics, electrode etc |
| 9. | Alarm | : | Dual set point, hysteresis and time delay adjustable |
| 10. | Enclosure | : | Die cast aluminum, epoxy coated |
| 11. | Cable Termination | : | Internal (cable entry through conduit) |
| 12. | Accuracy | : | ± 1.0 % of measured range |
| 13. | Response time | : | Less than 5 sec |
| 14. | Stability | : | ± 1.0 % of output range / month non-cumulative |
| 15. | Accessories | : | a.2" pipe mounting bracket, Sensor cable with flexible conduit (as required), ½" NPT Cable Gland, SS Tag plate, For cation conductivity- Dual Ion-Exchange column, resin, etc. (minimum 12 months' requirements).

b. Retractable type conductivity sensor along with flow chamber and other accessories shall be provided for vacuum application. Transmitter (local) along with 4-20 Ma output to SWAS room & DDCMIS shall also be provided. |

6.02.00 **pH ANALYZER**

A. Sensor

- | | | | |
|----|---------------------|---|---|
| 1. | Type of Cell | : | Flow thru' |
| 2. | Range | : | 0-14 pH |
| 3. | Type of measurement | : | Combination electrode |
| 4. | Temp. Compensation | : | Manual and Automatic (Integral) 0-100°C |
| 5. | Process Connection | : | Screwed |

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|-----|---------------------|---|---|
| 6. | Measuring Electrode | : | Glass, high independence, thin electrode in one housing |
| 7. | Pressure Rating | : | 10 kg/cm ² |
| 8. | Accessories | : | Vessel (SS 316) with ½" NPT connection |
| 9. | Cable | : | Upto transmitter in flexible conduct |
| 10. | Preamplifier | : | Integral or separate |
| 11. | Liquid Junction | : | Ceramic / Kyner or equivalent |

B. Transmitter

- | | | | |
|-----|--------------------|---|---|
| 1. | Type | : | Microprocessor based, Single stream |
| 2. | Mounting | : | 2" pipe |
| 3. | Protection Class | : | IP-65 or better |
| 4. | Output | : | 4-20 mA DC (isolated) |
| 5. | Display | : | Digital Display in Engineering Unit, Alarm Status. |
| 6. | Accuracy | : | ± 0.2% of FSD or better |
| 7. | Response time | : | Less than 5 sec |
| 8. | Stability | : | ± 0.001 pH /week |
| 9. | Repeatability | : | ± 1% or better |
| 10. | Temp. Compensation | : | Automatic (Pt-100 sensor) |
| 11. | Diagnostic | : | Self diagnostic for "Calibration required"/ "Calibration O.K.", electrode checking etc. |
| 12. | Alarm | : | Dual set point, hysteresis and time delay adjustable |
| 13. | Enclosure | : | Die cast aluminum, epoxy coated |
| 14. | Cable Termination | : | Internal (cable entry through conduit) |
| 15. | Accessories | : | 2" pipe mounting bracket, Sensor cable |

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with flexible conduit (as required), ½”
NPT Cable Gland, SS Tag plate, ,
Ultrasonic Electrode Cleaner, Buffer
solution tablets

6.03.00 **SILICA ANALYZER**

1. Type : Colorimetric monitor, gravity / pumped feed Microprocessor based
2. No. of Streams : Multi-stream with atleast one stream as spare
3. Output : 4-20 mA DC (isolated) into 600 ohms
4. Readout : Digital Indicating meter for direct readout
5. Accuracy : ± 1% of F.S.D or better
6. Reproducibility : ± 2% of F.S.D. or better
7. Calibration : Manual & automatic
8. Cycle time : Less than 10 min or better
9. Operating temperature : 0-50 °C
10. Temperature Compensation : (Pt-100 Sensor)
11. Mounting : 2” pipe
12. Life of light source : 10,000 hours (approx.)
13. Alarm Facility : 2 HI & 2 LO independently adj. over span.
14. Enclosure Protection : IP-65
15. Accessories : Reagent cabinet , Sample strainer, Reagent Reservoir etc., Phenolic name plate, Reagents & consumables, Special cables.

6.04.00 **SODIUM ANALYZER ASSEMBLY**

1. Type of Cell : Flow Through ion-selection electrode
2. Flow Chamber : Plexi Glass Body or equivalent

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- | | | | |
|-----|----------------------|---|--|
| 3. | Measuring Electrode | : | Sodium Selective Glass Electrode |
| 4. | Output | : | 4-20 mA DC (isolated) into 600 ohms |
| 5. | Temp. Compensation | : | Automatic upto 45 deg.C |
| 6. | Read Out | : | Digital Indicating meter |
| 7. | Accuracy | : | < 5% of reading |
| 8. | Response Time | : | 2 minutes or better |
| 9. | Mounting | : | Flush Panel |
| 10. | Calibration | : | Automatic |
| 11. | Alarm Facility | : | 2 HI and 2 LO independently adj. over span. |
| 12. | Enclosure Protection | : | IP-65 or better |
| 13. | Accessories | : | Phenolic tag plate, Sample filter, Pressure regulator & flow meter, Automatic calibration kit, Reagents and consumables, Special cables, 1/2" NPT cable gland. |

6.05.00 **HYDRAZINE ANALYZER**

- | | | | |
|-----|--------------------|---|--|
| 1. | Type | : | Electrochemical |
| 2. | Output | : | 4-20 mA DC linear |
| 3. | Readout | : | Digital Indicating Meter, linear read-out |
| 4. | Accuracy | : | ± 2% of FSD or better |
| 5. | Reproducibility | : | 2% of FSD or better |
| 6. | Drift | : | 2 ppb/month or better |
| 7. | Temp. Compensation | : | Automatic up to 45 ° C |
| 8. | Response Time | : | 1 minutes or better |
| 9. | Mounting | : | Flush Panel |
| 10. | Alarm Facility | : | 2 HI and 2 LO independently adj. over span |

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- 11. Preferred Feature : 2 Hi and LO alarm LED visible from front , Power supply on/failure LED
- 12. Enclosure Protection : IP-65/ NEMA 4 or better
- 13. Accessories : Sample Conditioning kit, Phenolic nameplate, Special cable upto transmitter with flexible conduit Chemical reagents for 12 months, . ½” NPT Cable Glands

6.06.00 DISSOLVED OXYGEN ANALYZER

- 1. Type : Electro-chemical, Microprocessor based.
- 2. Range : As per process.
- 3. Type of Cell : Flow through sampling type (continuous)
- 4. Enclosure : IP-65 or better
- 5. Output : 4-20 mA DC isolated to a load of 600 Ohms (minimum)
- 6. Temp.Compensation : Automatic up to 45°C
- 7. Readout : Digital Indicating meter
- 8. Accuracy : Better than $\pm 2\%$ of full scale for Transmitter
- 9. Sensor Response Time : 90% in 30 seconds or better
- 10. Mounting : Flush panel
- 11. Alarm Facility : 2 HI & 2 LO independently adj. over span.
- 12. Preferred Feature : HI & LO Alarm LED visible from front, Power supply on/failure LED, In-built calibration facility.
- 13. Accessories : Phenolic nameplate, Special cable upto transmitter with flexible conduit, ½” NPT Cable Glands

6.07.00 CHLORIDE ANALYZER

- 1. Type : Electro-chemical, Microprocessor based.

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- | | | | |
|-----|---------------------|---|--|
| 2. | Type of cell | : | Chloride ion selective electrode |
| 3. | Enclosure | : | IP-65 or better |
| 4. | Output | : | 4-20 mA DC isolated to a load of 600 Ohms (minimum) |
| 5. | Temp.Compensation | : | Automatic with Pt 100 |
| 6. | Ambient temperature | : | 45°C |
| 7. | Readout | : | Digital Indicating meter |
| 8. | Accuracy | : | Better than $\pm 2\%$ |
| 9. | Reproducibility | : | <3% |
| 10. | Detection limit | : | 0.5 mg/ L or better |
| 11. | Analysis time | : | 5 minutes (max). |
| 12. | Cycle time | : | Adjustable |
| 13. | Calibration | : | Manual or automatic |
| 14. | Mounting | : | Flush panel |
| 15. | Alarm | : | 1 HI, 1 LO & 1 system alarm |
| 16. | Control accessories | : | Sample level detector, Reagent level detector, Calibration solution level detector, Automatic sample, rinse and drain valve, Pump for calibration solution, Pump for reagent solution. |
| 17. | Accessories | : | Reagent solution tank, Calibration solution tank |

6.08.00 TURBIDITY ANALYZER

- | | | | |
|----|-----------|---|---|
| 1. | Type | : | Nephelometric (Light reflection principle) |
| 2. | Range | : | 0.001-100 NTU |
| 3. | Body | : | Corrosion resistant polystyrene |
| 4. | Enclosure | : | IP-65 or better |

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- | | | | |
|----|---------------|---|--|
| 5. | Output | : | 4-20 mA DC isolated to a load of 600 Ohms (minimum) |
| 6. | Readout | : | LCD Display |
| 7. | Accuracy | : | Better than $\pm 2\%$ of full scale |
| 8. | Repeatability | : | $\pm 1\%$ of reading or ± 0.002 NTU (which ever is greater) |
| 9. | Accessories | : | Phenolic nameplate, Special cable upto transmitter with flexible conduit, $\frac{1}{2}$ " NPT Cable Glands, 2" pipe mounting bracket, Calibration kit & standard solution etc. |

6.09.00 IRON ANALYZER

- | | | | |
|----|-----------------------|---|--|
| 1. | Type | : | Colorimetric |
| 2. | Range | : | 0-100 ppb, 0-2 ppm |
| 3. | Material | : | Kynar (Probe), Hastelloy C (Reflector) |
| 4. | Enclosure | : | IP-65 or better |
| 5. | Output | : | 4-20 mA DC isolated to a load of 600 Ohms (minimum), 2NO+NC Contacts |
| 6. | Readout | : | LCD Display |
| 7. | Operating Temperature | : | 45 Deg. C |
| 8. | Accessories | : | As required. |

6.10.00 SAMPLE CONDITIONING SYSTEM

Sample conditioning system shall be designed and constructed to receive and condition all samples as required by the respective analyzers. This shall include all conditioning equipment mentioned herein:

- a) Sample filtering
- b) Primary and final sample cooling and temperature control
- c) Pressure reduction and control, as required
- d) Flow rate control
- e) Pressure and Temperature Protection

FORM NO. PEM-6686-0



Technical specification for
CONTROL & INSTRUMENTATION
1X800 MW KOTHAGUEDEM

SPEC NO.: **PE-TS-410-145-I**

VOLUME

SECTION

REV. NO. 00

DATE : 10.03.2015

SHEET OF

Instrumentation Quality Plan



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

CHECK LIST FOR PRESSURE SWITCH

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			
	1.1 MODEL NO/TAG NO								
	1.2 RANGE								
	1.3 END CONN								
1.4 NO. OF CONTACT									
2	CALIBRATION					P	V	V	
	2.1 REPEATABILITY								
	2.2 SET POINT ADJUSTMENT								
	2.3 DIFFERENTIAL								
3	OVER PR & LEAK TEST			P	V	V			
4	ELECT. INSULATION/HV TEST	ONE			P	V	V		
5	REVIEW OF TC FOR MATERIALS OF	FOR LOT			V	V	V		
	5.1 SENSOR								
	5.2 MOVEMENT								
	5.3 PROCESS CONNECTION								
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST			V	V	V		
	REVIEW OF TC OF MICROSWITCH	FOR LOT			V	V	V		

** 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 carry out ROUTINE TEST on 100 %.
- Contractor to provide compliance certificate for tests/checks verified by contractor and 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 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 PRESSURE & DP GAUGE

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

Legend :

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Note :

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



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

CHECK LIST FOR LEVEL GAUGE

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

Legend :

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Note :

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



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

CHECK LIST FOR ANNUNCIATORS

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

Legend :

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Note :

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



Technical specification for
CONTROL & INSTRUMENTATION

1X800 MW KOTHAGUEDEM

SPEC NO.: **PE-TS-410-145-I**

VOLUME

SECTION

REV. NO. 00

DATE : 10.03.2015

SHEET OF

LCP and JUNCTION BOXES SPECIFICATION

- 1.00.00 **GENERAL REQUIREMENT**
- 1.01.00 **ENCLOSURES FOR INSTRUMENTS AND OTHER EQUIPMENT**
- 1.01.01 All panels, cabinets, distribution boxes, junction boxes, terminal boxes and all other field mounted equipment / enclosures shall have suitable environmental protection as detailed in Section-I of this volume of the specification.
- 1.02.00 **SURFACE PREPARATION & PAINTING**
- 1.02.01 All sheet metal panel/ desk exterior steel surfaces shall be sand blasted, ground smooth and painted as specified below.
- 1.02.02 Suitable filler shall be applied to all pits, blemishes and voids in the surface. The filler shall be sanded so that surfaces are level and flat; corners are smooth and even. Exposed raw metal edges shall be ground burr-free. The entire surface shall be blast clean to remove rust and scale and all other residue due to the fabrication operation. Oil, grease and salts etc. shall be removed from the panels by one or more solvent cleaning methods prior to blasting.
- 1.02.03 Two spray coats of inhibitive epoxy primer surfacer shall be applied to all exterior and interior surfaces, each coat of primer surfacer shall be of dry film thickness of 1.5 mil. A minimum of two spray coats of final finish color (Catalyzed epoxy or polyurethane) shall be applied to all surface of dry film thickness 2.0 Mil. The finish colors for exterior and interior surfaces shall conform to the following shades:
- Exterior – Opaline green shade 275 of IS: 5 or equivalent international code..
 - Interior - Brilliant White.
- 1.02.04 Paint films, which show sags, cheeks, blisters, teardrops, fat edges or other painting imperfections, shall not be acceptable.
- 1.03.00 **WIRING**
- 1.03.01 All spare contacts of relays, switches and push buttons shall be wired up to the terminal blocks. All intercommunications between sections of panels/desks shall be furnished.
- 1.03.02 Each wire shall be identified at both ends with wire designation as per approved wiring diagram. Heat shrinkable type ferrules with indelible computerized ink print shall be used with cross- identification.
- 1.03.03 All wire termination shall be made with insulated sleeve and crimping type lugs. Wire shall not be spliced or tapped between terminals. Open-ended terminal lugs will not be accepted. Wires shall not be looped around the terminal screws or studs.

- 1.03.04 Internal wiring should be terminated uniformly on one side of the terminal block leaving the other side available for termination of outgoing cables. Internal wiring shall be grouped so that all outgoing wiring to each particular remote location is terminated on adjacent terminal blocks. Interior wiring and jumperings shall be arranged so that external connections can be made from internal side of terminal blocks. Common connections shall be limited to two (2) wires per terminal.
- 1.03.05 Wiring shall be arranged to ensure free access to all instrument or devices for maintenance. No wire shall be routed across the face or rear of any device in a manner, which will impede the opening of covers or obstruct access to leads, terminals or devices
- 1.03.06 Wires shall be dressed and run in trays or troughs with clamp-on type covers. Wirings may be neatly bunched in groups by non-metallic cleats or bands. Each group shall be adequately supported along its run to prevent sagging or strain on termination.
- 1.03.07 Shield wires shall be terminated on separate terminal blocks. Common connections shall be limited to two wires per terminal. Signal circuit shields shall be grounded at the power supply end only or as recommended by manufacturer.
- 1.03.08 All low level signal cables shall be separately bundled to from control cable and maintained at 300 mm minimum spacing from control bundles.
- 1.03.09 Panel internal wiring shall follow distinct color-coding to segregate different voltage levels viz. 24V DC, 48V, 110V AC, 240V AC, 220V DC etc.
- 1.03.10 Thermocouple lead wires, analyzer measuring lead wires, or any other lead wires carrying measuring signal of the order of low milli volt or micro volt shall be electrically and physically isolated from other AC and DC wiring. Shielded wires used in such cases for panel internal wiring shall be continuous and ungrounded with the shield terminated individually and separately in panel terminal block.
- 1.03.11 Wiring to door mounted devices shall be provided with multi-strand wires of (49 strands minimum) adequate loop lengths of hinge-wire so that multiple door openings will not cause fatigue failure of the conductor.
- 1.03.12 Internal wiring in factory pre-wired electronic systems cabinets may be installed according to the Contractor's standard wire size, insulation, and method of termination on internal equipment. Insulation for all wiring, including circuit board wiring, back panel wiring, power supply wiring and interconnecting cables between devices shall pass the vertical flame test per IPCEAS-1981. Identification of conductors may be done by insulation color-coding identified on drawings or by printed wiring lists.

- 1.04.00 TERMINAL BLOCKS
- 1.04.01 All terminal blocks shall be rail mounted/ post mounted type, cage clamp type with high quality non-flammable insulating material of melamine suitable for working temperature of 105 Deg C. The terminal blocks in field mounted junction boxes, instrument enclosures racks etc. shall be suitable for cage clamp connections. The terminal blocks in Control Equipment Room termination/ marshalling cubicles shall be suitable for post mounted cage clamp connection at the field input end. The exact type of terminal blocks to be provided by Bidder shall be subject to Owner.
- 1.04.02 All terminal blocks shall be provided complete with all required accessories including assembly rail, locking pin and section, end brackets, small partitions, transparent covers, support brackets, distance sleeves, warning level, marking etc. For RTDs ring - tong type lugs shall be used at Junction Boxes.
- 1.04.03 The characteristics of the terminal blocks shall be as follows.
- i) High contact force, independent of conductor cross-section and large contact surface area.
 - ii) Integrated self-loosening protection to avoid shifting of contact surface that may allow contamination of connection point.
 - iii) Inspection and maintenance free (resistant to thermal aging and vibration)
 - iv) Low and constant voltage drop
- 1.04.04 The insulation of the terminal blocks shall be of suitable thermoplastic material.
- 1.04.05 The spacing between Terminal blocks channels in panels and cubicles shall be adequate for routing the cable troughs and to allow adequate free workspace for termination and removal of wires. The terminal blocks shall be arranged with atleast 100 mm clearance between two sets of terminal blocks and junction box walls.
- 1.04.06 Signals of different voltage levels shall be clearly segregated by providing separate rows to each type of signal and by using terminal blocks of different color for each type of signal and by providing barrier strips between them.
- 1.04.07 Terminal blocks shall be provided with white marking strips / self-adhesive marker cards and where permitted by the safety codes and standards, shall be without covers. Power terminals and high voltage (above 48 volts) terminals shall have protection covers. All terminals shall be provided with permanent terminal identification numbers on both sides.
- 1.04.08 At least 20% spare unused terminals shall be provided on each terminal block for circuit modifications and for termination of all conductors in a multi-conductor control cable.

- 1.04.09 The bottom of the terminal block shall be at least 200 mm above the cable gland for bottom entry type panels.
- 1.04.10 For extending 24 V DC supply to panels, the size of the terminals shall be decided based on voltage drop and not based on current.
- 1.04.11 Other requirements of the terminal blocks are as follows:
- i) The last terminal in a rail-mounted assembly shall be closed with an end plate and end bracket.
 - ii) For visual and electrical separation of terminal groups, partition plates shall be provided, which can be push fitted after forming an assembly.
 - iii) Design shall permit testing of incoming and outgoing signals by using suitable test plug and socket without disconnecting the cable connections.
 - iv) It shall be possible to use jumper plugs through the above test plug socket to connect adjacent terminals. Adequate number of short circuit jumper plugs shall be provided for the purpose.
 - v) Where more than one connection to a terminal block is required, two tier terminals shall be used.
- 1.05.00 **GROUNDING**
- 1.05.01 Separate Protective and Electronic system ground as required shall be provided.
- 1.05.02 All panels, desks, cabinets shall be provided with a continuous bare copper ground bus (Frame ground), bolted to the panel structure at bottom on both sides and effectively ground the entire structure. The bolts shall face inside of panels.
- 1.05.03 For electronic system cabinets the electronic system ground bus (Electronic ground) shall be similar but insulated from the cabinet and shall be separately connected to the system ground .The same ground may be used to earth the shield of shielded signal cables, otherwise a separate ground bus shall be provided for connecting the signal cable shields. Cable shields shall be grounded at the panel end only and shall never be left open .The electronic ground between panels of a shipping section shall be firmly looped.
- 2.00.00 **CONTROL DESKS & PANELS**
- 2.01.00 **GENERAL**
- 2.01.01 All control desk, panels etc. shall be furnished fully wired with necessary provision for convenience outlets, internal lighting, utility receptacles, grounding, ventilation, space heating, anti-vibration pads, internal piping &

- accessories as required for completeness of the system.
- 2.01.02 The design shall conform to the EN ISO 11064 (Ergonomical design of Control Room), Part 1, 2 and 3.
- 2.01.03 The exact dimensions, material, construction details, grounding, general arrangement etc. shall be as per actual requirement and shall be finalized during detail engineering and subjected to Owner's approval.
- 2.01.04 Incoming power supply feeders shall be duplicated. Alarm shall be provided for failure of a power supply feed.
- 2.01.05 For Control desk/ panel mounted instruments/ devices etc. which are to be powered from UPS, all required conversion of interface equipments/ accessories to make such devices compatible with UPS supply shall be provided. All necessary hardware like input switches/ fuse unit for each feeder as well as switch fuse unit for each instrument/ device on the power supply line shall be provided. From UPS redundant feeders shall be provided with suitably rated MCB and provision of fast auto changeover of UPS feeders.
- 2.01.06 Crating of the panels and desks shall be suitable for protection against shock, vibration, inappropriate handling and inclement weather conditions during transportation and warehousing. Mounted equipment shall have adequate protection against damage during handling, transit and storage. Suitable desiccant shall be used inside the packing case.
- 2.01.07 Nameplate
- a) Nameplate shall be provided for instrument or device mounted on the panel.
 - b) Nameplates for panels shall be provided both in front and rear.
- 2.02.00 CONTROL DESK
- 2.02.01 Control desk shall be free standing, floor mounting, table top type with doors at back and shall be constructed of 3 mm thick (minimum) CRCA steel or Aluminium extrusion. Aluminium structure shall be anodized or powder coated paint finish. The top surface of control desk shall be 30 mm (minimum) thick with the top 12 mm (minimum) of acrylic solid surface and the remaining 18 mm of laminated medium density fibre (MDF) board.
- 2.02.02 Monitors with retractable keyboard shall be provided on the desk. Desk shall be arranged in arc-like shape without any sharp edges. Edges shall be extruded PVC or rounded post-formed laminate.
- 2.02.03 Desks shall be of modular, scalable and industrially ruggedized design and shall have connections for PA system handsets & telephone sets.
- 2.02.04 Desks shall have concealed cable trays for wire dressing. Both Horizontal & Side Managers (2 separate horizontal cable routing wire baskets for power & data cables) shall be provided.

Each User station will be provided with 2 separate power distribution units (1 for Main line & 1 for UPS line). Each power distribution unit will have 6 points of 5/13 Amp sockets, Mains MCB On/Off Switch & Indicator.

Adequate heat management provision for Exhaust of heat from within the Console Desk Assembly shall be provided. There will be multiple fans provided in the Main Control Desk. Each Fan will be of 230 VAC 250 CFM Ball Bearing based. Ventilation louvers will be provided on both Front & Rear Modesty with special Air Filters. Adequate space for CPU & Other equipments placed with in the desk.

- 2.02.05 Design shall include Earthing bolts.
- 2.02.06 Back installed items shall be suitably concealed from front view.
- 2.02.07 All operator workstations for SG, TG, Auxiliaries & Off-site Plants shall be mounted on this Control Desk. The cabling / wiring between OWS & CPUs, power supply cables etc. shall be aesthetically routed and concealed from view.
- 2.02.08 **HARDWIRED DEVICES ON CONTROL DESK (DRAW OUT SECTION)**
- Release and Lamp Test push buttons shall be provided for a set of push buttons (decided during detail engineering stage). Depending on the type of control/ function, required number of push buttons/ indicating LEDs & their color, push button stations shall be selected. The size of push button stations shall be 24 x 48 mm or 25 x 50 mm and shall have service inscription details at the front. Emergency push buttons (with cover) shall be mounted on top of Control Desk.
- 2.03.00 **BACK UP PANEL**
- 2.03.01 Construction shall be from CRCA steel of thickness not less than 3mm.
- 2.03.02 Upright back-up panel shall be provided where hardwired devices shall be mounted on a mosaic grid type console. The mosaic grid tiles shall be of 24 mm x 48 mm (or 25 mm x 50 mm) size, made of heat & flame retardant, self extinguishing and non-hygroscopic material with flat matt finish without glare and non reflecting type.
- 2.03.03 DDCMIS Back-up Panel (referred as Unit Control Panel-UCP) shall also mount annunciation fascia (minimum 500 nos.) and the flame monitoring cameras along with other hardwired devices as decided during detail engineering stage by Owner. Color coding shall also subject to Owner's approval.
- 2.03.04 Colored Mimic for different Off-site plant control systems (as enumerated elsewhere in this specification) and hardwired annunciation system shall also

be mounted on the back up panels.

2.04.00 PANELS/CABINETS

2.04.01 All DDCMIS system modules, power supply components and other Local Control panels (PLC/Relay based) shall be housed in cabinets as specified below.

2.04.02 The cabinet mounted equipments shall be fully assembled, installed in mounting racks, wired and fully tested as per specification requirements and Owner approved drawings prior to shipment to the project site.

2.04.03 The Bidder shall ensure that the cabinets are complete & ready for installation before dispatch from manufacturing works. The installation work at project site for these cabinets shall only involve connections through multi-pair cables from marshalling cabinets (wherever provided) to system cabinets and inter-cabinet/cabinet to Control Desk/ Back up Panel.

2.04.04 All electronic cards, network components, power supply modules etc. located shall be suitably housed in cabinets and shall be neatly arranged in sub-racks. Network components shall be visible in door closed condition (e.g. Glass doors etc.) as approved by Owner.

2.04.05 Bidder shall design the cabinet internal arrangement, floor cutout and cable gland plate such that all the cables entering or leaving the cabinet can be properly glanded in the gland plate.

2.04.06 The packaging density of panels shall be such that the temperature rise within the panels shall never exceed 10°C above ambient even under worst operating conditions. Cooling Fans shall be provided wherever required and this shall be of industrial grade.

2.04.07 TECHNICAL PARTICULARS

- | | | | |
|----|--------------------------|---|--|
| 1. | Material of Construction | : | Cold Rolled Coal Annealed (CRCA) steel sheet |
| 2. | Thickness of Sheet | : | a) 2.0 mm for faces supporting instruments / terminals |
| | | : | b) 1.6 mm for other sides and top |
| 3. | Construction | : | Welded throughout as per approved National Standards |
| 4. | Post welding operation | : | a) Grounding of all welds to smoothness |
| | | : | b) Rounding of corners |

- : c) Cleaning of weld spatters
- 5. Panel height : 2300 mm (approx)
- 6. Corners : 7 mm inner radius
- 7. Dimensional Tolerances :
 - a) In height & length - 3 mm
 - b) In height between adjacent sections - 2 mm
 - c) Total for a group - 6 mm
- 8. Doors : Double, recessed, turned back edges, full height front & rear
 - i) Thickness of Sheet : 2 mm
 - ii) Hinges : Stainless steel
 - iii) Door latches : Three point type
 - iv) Door gaskets : Neoprene rubber on fixed frame to result dust proof/weatherproof enclosure
 - v) Opening of the doors : Outward
 - vi) Louvers : With removable wire mesh to ensure dust and vermin proof
- 9. Gland plates : Removable in sections
4 mm thick (bottom)
- 10. Cable entry : Bottom
- 11. Hardware :
 - a) Anti vibration pad- 15 mm
 - b) Predrilled base channel ISMC – 100 or equivalent for all sides
 - c) Stainless steel buff- finished 2 mm thick kick plate for all sides
 - d) Stainless steel scratch strips along desk edges fixed with pan-head recessed screws
 - e) Rubber strips to ensure air

- tightness between kick plate and finished floor
- f) Lifting hook / Eye bolt
- g) Drawing pocket
- h) Door switch, lamps, thermostat, heaters and industrial grade cooling fans,, illumination fixtures
12. Name Plate : Both at front and back surface of the panel
13. Fixing of name plate : Stainless steel pan head screws
14. Name plate material : Laminated phenolic (3 layers)
15. Lettering : Black with white engraved
16. Mounting of terminal blocks : Vertical angle support bracket tack welded on sheet steel plate, screwed on internal wall of enclosure

2.05.00 FURNITURE

All the furnitures in the Central / Local control Room (s), Engineers' rooms, Instrument laboratory , SWAS Room & any other rooms with C&I equipments located in different plant buildings under Bidder's scope shall be included in Bidder's scope of supply. Bidder shall provide following industrial grade furniture items as a minimum from reputed manufacturers/suppliers meeting International Standards. The furniture shall be modular and latest with ease of operational features. The furniture shall be modern, aesthetically designed, modular, flexible, space saving and future safe.

2.05.01 WORK STATION FURNITURE

Modular work station furniture, suitable for mounting servers & historians, programmer stations, PC based systems, printers (A4/A3 color laserjet) etc. shall be provided.

2.05.02 PC RACK

PC Racks shall be provided to mount CPUs of workstations/PCs of OWS/LVS etc. in control room. For each PC / workstation / monitor at least one chair shall be included.

2.05.03 CHAIRS

Industry standard revolving chairs with wheels and with provision for adjustment of height (hydraulically/gas lift) shall be provided for the operators, unit-in-charge & other personnel in control room area. These shall be designed for sitting for long duration such that these are comfortable for the back.

2.05.04 TABLES

Industry standard computer tables shall be provided & shall be as approved by Owner during detailed Engineering. Glass top teak wood horse shoe shaped table with vertical file mounting arrangement (two layers to house approx. 40 Nos of files and lockable drawers at both ends) for Engineering Room shall be provided.

2.05.05 ALMIRAHs

Steel Almirahs shall be provided for keeping documents in the documentation room. Glass doors for each rack shall be provided such that the documents are visible from outside. Size of the rack shall be sufficient to easily fit technical manuals. The exact details shall be approved by Owner during detailed Engineering.

2.05.06 KEYPAD

One keypad per unit shall be provided for the storing of keys of relevant areas of the unit in the control room.

2.05.07 LOCKERS

Suitable lockers shall be provided in the room adjacent to the control room for storing of personal articles of control room personnel. Also, lockers of bigger size shall be provided in documentation Room for storing of personal documents. Details shall be finalized and approved by Employer during detailed engineering.

3.00.00 **LVS PANEL**

3.01.00 An arc shaped Large Video Screen (LVS) panel shall be supplied for mounting large video screens in number of tiers in various Control rooms as specified elsewhere in this specification.

Bidder shall provide and fix ACP cladding around the LVS screen including covering the LVS back side and LVS stand. The cladding will be from floor finish to 600 mm above LVS screen like a self-standing partition with necessary openings for system requirement. ACP paneling shall be with 304 grade & approx. 0.5 mm mirror finish SS strip.

3.02.00 The profile, dimensions and the general arrangement shall be finalized & approved by Owner during detailed engineering. Recommendations, if any, for the control room lighting in order to ensure continuous proper viewing of the LVS screen by the operator & shift incharge (without any fatigue) shall be

- clearly brought out by the Contractor in his offer, alongwith all relevant details/basis.
- 3.03.00 Any other requirement for proper LVS mounting & functioning & viewing shall also be specifically brought out by the Contractor in his offer, along with all relevant details.
- 4.00.00 **LOCAL INSTRUMENT RACK (LIR) & LOCAL INSTRUMENT ENCLOSURE (LIE)**
- 4.01.00 GENERAL
- 4.01.01 Devices (Transmitters/ Switches) located in the field shall be suitably grouped together to the extent possible and installed in the LIE (Closed Rack) and LIR (Open Rack) in Boiler/TG Building and Off-site plant areas.
- 4.01.02 Racks and enclosure shall be factory prefabricated & painted and shall complete with internal piping, tubing, manifold, isolation valves, blowdown valves, integral junction box, illumination etc.
- 4.01.03 No more than six instruments shall be grouped in a single rack / enclosure.
- 4.01.04 Racks shall be installed above the tapping points for air, flue gas and coal air mixture application whereas for applications such as for water and steam, racks to be installed below the source point.
- 4.01.05 Attention shall be paid in the layout to avoid air traps in liquid piping and water accumulation in air /gas piping.
- 4.01.06 Racks used for furnace, flue gas and air application shall be provided with intermittent & continuous air purging
- 4.01.07 Welding of impulse lines shall comply with the provisions of the latest applicable ANSI Code for Pressure Piping.
- 4.01.08 Earth stud shall be furnished at rack for safety grounding.
- 4.02.00 LOCAL INSTRUMENT ENCLOSURE (LIE)
- 4.02.01 Enclosure shall be free standing type. Racks shall be adequately reinforced to ensure true surfaces and to provide support. Major load - bearing posts shall be suitably supported by gusset plates or moment members.
- 4.02.02 Enclosure outer shall be constructed from at least 3 mm thick steel plate and epoxy painted to shade gray. Base frame shall be made of ISMC 100 and black colour finish.
- 4.02.03 2" NB galvanized pipes shall be laid horizontally and supported at two end channels to mount transmitters at accessible height. Center posts or any

- member, which would reduce access, shall be avoided.
- 4.02.04 Double leaf interlocking front opening doors with three point locking shall be provided and shall be arranged for maximum possible access to the interior. Key shall be of identical for all enclosures.
- 4.02.05 Doors shall have concealed quick removal type pinned stainless steel hinges and locking handles. Gaskets shall be used between all mating sections to achieve dust and weather proof enclosure rated for IP-65 including the internal junction box. All enclosures shall have access doors on front side.
- 4.02.06 Removable type bulkhead plates of thickness not less than 6 mm shall be mounted at the racks with suitable high temperature gasket. Impulse lines within the enclosures shall be properly clamped.
- 4.02.07 All internal wirings between the instruments and junction box shall run through flexible conduits. No exposed wirings within transmitter racks both open and closed type, is admissible.
- 4.02.08 Racks shall have a common blowdown drain header, which will connect individual instrument blowdown line after suitable pressure breaking through regulating globe type blowdown valves. Covered funnels shall be used for saturated liquid and steam service, whereas, open funnels may be used for cold liquid services. Header (2" NB ASTM A 106, Sch-80 Gr. C) shall be suitably sloped and shall have one end flanged and extending beyond the rack for connection to plant drain header..
- 4.02.09 Each rack shall be provided with one receptacle, light fixtures with wire guard and one lighting switch each at instrument & Junction box compartments with wire guard. Lighting switches may be door actuated & mounted inside the panel. Outlet box, switch box and device covers shall be of galvanized stamped steel. Light switches and 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.
- 4.02.10 Power supplies for miscellaneous devices shall be provided with 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.
- 4.02.11 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 manufacturer's recommendations
- 4.03.00 LOCAL INSTRUMENT RACK (LIR)
- 4.03.01 Rack shall be free standing type constructed from 6 mm thick steel channel frame provided with a canopy to protect the instrument from dripping water or

falling objects and shall be epoxy painted. Canopy shall be of CRCA steel sheet of at least 3 mm thickness.

4.03.02 Rack 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. Center posts or any member, which would reduce access, shall be avoided.

4.03.03 2" NB galvanized pipes laid horizontally and supported at two end channels shall be employed at working accessible height for mounting of instruments.

4.03.04 All internal wirings between the instruments and junction box shall run through flexible conduits. No exposed wirings are admissible.

4.03.05 Racks shall have a common blowdown drain header, which will connect individual instrument blowdown line after suitable pressure breaking through regulating globe type blowdown valves. Covered funnels shall be used for saturated liquid and steam service, whereas, open funnels may be used for cold liquid services. Header (2" NB ASTM A 106, Sch-80 Gr. C) shall be suitably sloped and shall have one end flanged and extending beyond the rack for connection to plant drain header..


Each rack shall be provided with one receptacle, one light fixture with wire guard and one lighting switch. Outlet box, switch box and device covers shall be galvanized stamped steel. Light fixtures shall be installed on the canopy of the rack


4.03.06 Power supplies for miscellaneous devices shall be provided with 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.

4.04.00 JUNCTION BOX


- | | | |
|----------------------|---|--|
| 1. Type of Enclosure | : | Dust tight & weatherproof conforming to IP 65 |
| 2. Material | : | 3 mm sheet steel / fiberglass reinforced polyester(UV stabilized) |
| 3. Type of Cover | : | Solid unhinged with retention chain / Screwed at all four corners |
| 4. Paint | : | i) Exterior : Opaline green shade 275 of IS: 5
ii) Interior - Brilliant Glossy White. |

- Surface / Two (2) inch Pipe stanchion
5. Mounting : (At a dry compartment at one side of the enclosure / rack with front opening type door)
6. Cable Entry : 3 mm (min) Bottom / side Gland plate
7. Gasket : Neoprene
8. Grounding : Brass earth lug with green screw head
 External-2 nos , Internal-1no. (M6)
9. Number of Drain Holes : Two at bottom capped
10. Identification : Label for JB and Tags for cable
11. Accessories : Rail mounted cage clamp type screwless terminals (suitable for conductor size up to 2.5sq.mm of suitable voltage grade) with markers and 20% spare terminals
- a) conductor size up to 2.5sq.mm of suitable voltage grade) with markers and 20% spare terminals
- b) Cable gland (Brass) & raceways
- c) Ferrules & lugs (Brass)
- d) Aluminum back panel
- e) Canopy at top
- f) Mounting brackets
- g) bolts and nuts made of brass etc.

	DATA SHEET FOR LOCAL PANELS		SPECIFICATION NO.: PE-SS-999-145-054A		
			VOLUME		
			SECTION		
			REV. NO. 02	DATE: 16.09.2013	
			SHEET 1	OF 3	
TAG No. Qty.....		Data Sheet No.: PES-145A-DS1-0			
Data Sheet A & B					
DATA SHEET-A FOR LOCAL PANEL (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)		
GENERAL	MANUFACTURER				
	CONSTRUCTION		<input checked="" type="checkbox"/> FOLDED <input type="checkbox"/> WELDED		
	ENCLOSURE SHEET THICKNESS (As per Section 8.13, Volume V of contract specification)	FRONT	<input type="checkbox"/> 2.0 mm		
		OTHER	<input type="checkbox"/> 2.0 mm		
		DOOR	<input type="checkbox"/> 1.6 mm		
		HEIGHT	<input type="checkbox"/> 2365 mm for stand alone panels. <input type="checkbox"/> Other		
	OTHER	<input type="checkbox"/> Load bearing sheet front shall have 3mm thickness			
TECHNICAL	INPUT POWER SUPPLY * (As per Electrical specification) (ANY OTHER POWER REQUIREMENT TO BE DERIVED FROM THIS SUPPLY ONLY)		<input type="checkbox"/> 240V 50 Hz AC <input type="checkbox"/> 220V DC <input checked="" type="checkbox"/> 415V 3 PHASE 3W <input type="checkbox"/> 400V 3 PHASE 4W		
	NO. OF FEEDERS (As per Electrical specification)		<input type="checkbox"/> ONE <input type="checkbox"/> TWO		
	STARTER WITH MCC		<input type="checkbox"/> REQUIRED <input checked="" type="checkbox"/> NOT REQUIRED		
	IPR POSITION		<input checked="" type="checkbox"/> MCC <input type="checkbox"/> RELAY PANEL		
	CONTACT RATING OF RELAY		<input checked="" type="checkbox"/> 5 Amp, 230 V AC <input checked="" type="checkbox"/> 0.25 Amp, 220V DC		
	CONTROL SUPPLY		<input type="checkbox"/> 110V AC <input type="checkbox"/> 220V AC <input type="checkbox"/> 220V DC <input type="checkbox"/> Other. (As per requirement)		
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)		_____ NOS. (AS REQUIRED)		
	TEMP SCANNER (IF REQUIRED –NO. OF CHANNELS TO BE SPECIFIED UNDER SEC-C)		<input type="checkbox"/> REQUIRED <input checked="" type="checkbox"/> NOT REQUIRED		
	PAINT TYPE (As per Annex-1, Section 7.6, Volume IV of contract specification)		<input type="checkbox"/> EPOXY ENAMEL <input type="checkbox"/> EPOXY POWDER COATED		
	MIMIC (TYPE OF MIMIC- MATERAIL, THICKNESS TO BE SPECIFIED DURING DETAILED ENGG.)		<input checked="" type="checkbox"/> REQUIRED <input type="checkbox"/> NOT REQUIRED		
	PANEL COLOUR (EXTERNAL) (As per Annex-1, Section 7.6, Volume IV of contract specification)		<input type="checkbox"/> LIGHT GREY <input type="checkbox"/> OPALINE GREEN		
	FINISH (EXTERNAL) (As per Annex-1, Section 7.6, Volume IV of contract specification)		<input type="checkbox"/> MATT <input type="checkbox"/> GLOSSY <input type="checkbox"/> SEMI GLOSSY		
	PANEL COLOUR (INTERNAL) (As per Annex-1, Section 7.6, Volume IV of contract specification)		<input type="checkbox"/> WHITE <input type="checkbox"/> CREAM <input type="checkbox"/> OFF WHITE		
	FINISH (INTERNAL) (As per Annex-1, Section 7.6, Volume IV of contract specification)		<input type="checkbox"/> MATT <input type="checkbox"/> GLOSSY <input type="checkbox"/> SEMI GLOSSY		
	CLASS OF PROTECTION		<input checked="" type="checkbox"/> IP-55 (FOR INDOOR SERVICE) <input checked="" type="checkbox"/> IP-67 (FOR OUTDOOR SERVICE) <input type="checkbox"/> ANY OTHER		
	CONTROL HARDWARE		<input checked="" type="checkbox"/> RELAY BASED		
FOUNDATION ARRANGEMENT		<input type="checkbox"/> FOUNDATION BOLTS <input type="checkbox"/> ANCHOR FASTENERS			
WEIGHT OF PANEL (Kg.)	(Vendor to specify)			


	DATA SHEET FOR LOCAL PANELS			SPECIFICATION NO.: PE-SS-999-145-054A	
				VOLUME	
				SECTION	
				REV. NO. 02	DATE: 16.09.2013
				SHEET 2	OF 3
TAG No. Qty.....			Data Sheet No.: PES-145A-DS1-0		
Data Sheet A & B					
DATA SHEET-A FOR LOCAL PANEL (TO BE FILLED BY PURCHASER)				DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
	PANEL TYPE	<input type="checkbox"/> PRESSURISED <input type="checkbox"/> UNPRESSURISED As per Requirement			
	CABLE GLAND	<input checked="" type="checkbox"/> DOUBLE COMPRESSION			
	AMMETER (TYPE OF INPUT) *	<input type="checkbox"/> 1 Amp CT <input type="checkbox"/> 4-20 mA			
	SCOPE OF SUPERVISION FOR ERECTION & COMMISSIONING	<input type="checkbox"/> APPLICABLE <input checked="" type="checkbox"/> NA			
	* TO BE CO-ORDINATED WITH PEM ELECTRICAL				
NAME DESIGNATION SIGNATURE DATE	PREPARED BY	CHECKED BY	APPROVED BY	COMPANY SEAL NAME: SIGNATURE: DATE:	
	AANCHAL CHOUDHARY	SACHIN SRIVASTAVA	MA MANSOORI		
	SR.ENGR	DY.MNGR	D. GM		
	16.09.2013	16.09.2013	16.09.2013		

FORM NO. PEM-6866-0

	<h2 style="margin: 0;">DATA SHEET FOR LOCAL PANELS</h2>	SPECIFICATION NO.: PE-SS-999-145-054A			
		VOLUME			
		SECTION			
		REV. NO.	02	DATE:	16.09.2013
		SHEET	3	OF	3
TAG No. Qty.....		Data Sheet No.: PES-145A-DS1-0			
<h3 style="margin: 0;">Data Sheet C</h3> <p style="margin: 0; font-size: small;">DATA SHEET-C FOR LOCAL PANEL (TO BE FILLED BY CONTRACTOR AFTER AWARD OF CONTRACT)</p>					

GENERAL	MANUFACTURER			
	CONSTRUCTION	<input type="checkbox"/> FOLDED <input type="checkbox"/> WELDED (As per requirement EDN)		
	ENCLOSURE SHEET THICKNESS	FRONT		
		OTHER		
		DOOR		
		HEIGHT		
OTHER				
TECHNICAL	INPUT POWER SUPPLY			
	NO. OF FEEDERS			
	CONTACT RATING OF RELAY			
	TEMP SCANNER			
	CONTROL SUPPLY			
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)			
	PAINT TYPE			
	PANEL COLOUR (EXTERNAL)			
	FINISH (EXTERNAL)			
	TYPE OF MIMIC MATERIAL OF MIMIC THICKNESS OF MIMIC			
	PANEL COLOUR (INTERNAL)			
	FINISH (INTERNAL)			
	CLASS OF PROTECTION			
	CONTROL HARDWARE			
	FOUNDATION ARRANGEMENT			
	WEIGHT OF PANEL (Kg.)			

FORM NO. PEM-6866-0

	DATA SHEET FOR LOCAL PANELS			SPECIFICATION NO.: PE-SS-999-145-054A	
				VOLUME	
				SECTION	
				REV. NO. 02	DATE: 16.09.2013
				SHEET 3	OF 3
TAG No. Qty.....			Data Sheet No.: PES-145A-DS1-0		
Data Sheet C					
DATA SHEET-C FOR LOCAL PANEL (TO BE FILLED BY CONTRACTOR AFTER AWARD OF CONTRACT)					
	PANEL TYPE				
	CABLE GLAND				
	AMMETER (TYPE OF INPUT)				
	SCOPE OF SUPERVISION				
NAME SIGNATURE DATE	PREPARED BY	CHECKED BY	APPROVED BY	COMPANY SEAL NAME: SIGNATURE: DATE:	
	AANCHAL CHOUDHARY	SACHIN SRIVASTYAVA	MA MANSOORI		
	16.09.2013	16.09.2013	16.09.2013		



Technical specification for
CONTROL & INSTRUMENTATION

1X800 MW KOTHAGUEDEM

SPEC NO.: **PE-TS-410-145-I**


VOLUME

SECTION

REV. NO. 00 DATE : 10.03.2015

SHEET OF


LCP Quality Plan

 PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL										STD QUALITY PLAN NO.: PE-QP-999-145-1056	
		VOLUME IIB		SECTION D		REV. NO. 01		DATE: 22-02-2008		SHEET 1 OF 7		Agency \$	
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	P	W	V		
1.0	INCOMING Sheet Steel (CRCA & HR)	1. Chemical Composition 2. Bend Test 3. Surface finish 4. Waviness 5. Thickness 6. Mill marking	MA CR MA MA MA MA	Chemical analysis Mech. test Visual Visual Measurement Visual	Sample Sample 100% 100% 100% 100%	Relevant standard Relevant standard Factory Standard / Sample Factory Standard BHEL Spec. Factory Standard	Relevant standard Relevant standard Factory Standard / Sample No Waviness BHEL Spec. Factory Standard	Test Certificate Log Book Log Book Log Book Log Book Log Book	3 2 2 2 2 2	---	---	2 --- --- --- --- 1	
2.0	Flats / Angles / Channels	1. Dimensions 2. Surface Defects 3. Straightness 4. Mill marking	MA MA MA MA	Measurement Visual Measurement Visual	Sample 100% 100% 100%	Relevant standard Factory Standard / Sample Factory Standard Relevant standard	Relevant standard Factory Standard / Sample Factory Std. Relevant standard	Log Book Log Book Log Book Log Book	2 2 2 2	---	---	--- --- --- 1	
3.0	Cables / Wires	1. Visual / Surface defects 2. IR and HV	MA MA	Visual Electrical	100% 100%	BHEL Spec. and Relevant standard BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard BHEL Spec. and Relevant standard	Log Book Log Book	2 2	---	---	--- ---	

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

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


1 - BHEL
 2 - Vendor
 3 - Sub-vendor

 PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL										STD QUALITY PLAN NO.: PE-QP-999-145-1056				
		VOLUME IIB		SECTION D		REV. NO. 01		DATE: 22-02-2008		SHEET 2		OF 7		Agency \$		Remarks
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	P	W	V					
		3. Conductor a) Resistance b) Size c) Sheet colour	MA MA MA	Electrical Measurement Visual	100% 100% 100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	2	---	---					
		4. Type / Routine Test Certificates	MA	Verification	100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	3	---	2					
4.0	Electrical Components like Annunciator Transformers Lamps Switches PBs Contactors Relays Timers Space Heaters Thermostat Indicating meters etc.	1. Verification at make and Type 2. Verification of Test Certificates 3. Operation / Functional check 4. I.R. 5. H.V. 6. Calibration 7. Pick up / Drop off Voltage	CR CR CR MA MA MA MA	Visual Scrutiny of Type / Routine T.Cs. Electrical Electrical Electrical Electrical	Sample 100% Sample+ 100% 100%	BHEL Spec. and BOM Relevant standard Relevant standard & Catalogue Relevant standard & Catalogue Relevant standard & Catalogue Relevant standard & Catalogue Relevant standard & Catalogue	BHEL Spec. and BOM Relevant standard Relevant standard & Catalogue Relevant standard & Catalogue Relevant standard & Catalogue Relevant standard & Catalogue Relevant standard & Catalogue	Log Book Log Book Log Book Log Book Log Book Log Book Log Book	2 2 2 2 2 2 2	---	---	---	---	---	---	+ for relay & contactors only @ for all components except relays & contactors.

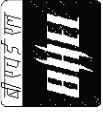
LEGEND: * CR - Critical characteristics
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 STD QUALITY PLAN NO.: PE-QP-999-145-1056 VOLUME IIB SECTION D REV. NO. 01 DATE: 22-02-2008 SHEET 3 OF 7		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL										
		Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$	
									P	W	V	
5.0	Misc. Components like Gaskets, Terminal Blocks etc.	1. Verification of Type / Make 2. Surface defects 3. IR / HV on Terminal Blocks	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
6.0	IN PROCESS Blanking / Bending / Forming	1. Dimensions 2. Surface defects after bending	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
7.0	Nibbling / Punching	1. Cutout Sizes 2. Deburring	MA	Visual	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
8.0	ASSEMBLY Frame Assembly & Sheet fixing	1. Dimensions 2. Alignment 3. Welding Quality 4. Surface defects	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
			MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
			MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
			MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	


* CR - Critical characteristics
 MA - Major characteristics
 MI - Minor characteristics
 P - Agency Performing the Test.
 W - Agency Witnessing the Test.
 V - Agency Verifying the Test.
 \$ 1 - BHEL
 2 - Vendor
 3 - Sub-vendor

 PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL										STD QUALITY PLAN NO.: PE-QP-999-145-1056					
		VOLUME		SECTION		REV. NO.		SHEET		OF		7		IIB		D	
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	P	W	V	Agency \$	Remarks				
9.0	Pre-treatment and Painting	1. Pretreatment Process 2. Process parameters like bath temp. concentration etc. 3. Dipping / Removal Time 4. Surface quality after every dip 5. Primer after phosphating 6. Putty Application & Rubbing after primer 7. Paint first coat 8. Putty Application and Rubbing after first coat of paint 9. Paint second coat	MA	Visual	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	---					
			MA	Measurement	Periodic	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	---					
			MA	Measurement	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	---					
			MA	Visual	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	---					
			MA	Visual, Thickness	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	---					
			MA	Visual	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	---					
			MA	Visual, Thickness	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	---					
			MA	Visual	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	---					
			MA	Visual, Thickness, Scratch test Colour adhesion	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1	---					

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

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


1 - BHEL
 2 - Vendor
 3 - Sub-vendor

 PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL										STD QUALITY PLAN NO.: PE-QP-999-145-1056		
		Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks
										P	W	V		
10.	Panel Wiring	1. Wiring Layout 2. Wiring Termination (Crimped Lugs) 3. Ferrule numbers 4. Colour of wiring 5. Size of Conductor	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	---		
			MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	---		
			MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	---		
			MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	1		
			MA	Measurement	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---	1		
11.	Component Mounting	1. Correct components 2. Fixing	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	---		
			MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---	---		
12.	FINAL Final Inspection	1. Workmanship 2. Component layout (neatness, accessibility & safety) Mounting / Proper fixing of all components 3. Components identification Marking / Name plates	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.	
			MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	1		
			MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1	1		

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 PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL										STD QUALITY PLAN NO.: PE-QP-999-145-1056		
		Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks	
Sl. No.									P	W	V			
		5. Dimensions	MA	Measurement	100%	BHEL approved drg. / Spec., BOM	BHEL approved drg. / Spec., BOM	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.		
		6. Door functioning	MA	Functional	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1			
		7. Paint Shade	CR	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1			
		8. Paint Thickness	CR	Measurement	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1			
		9. Workmanship of Gaskets	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1			
		10. Wiring Layout	MA	Visual	100%	BHEL approved drg.	BHEL approved drg.	Inspection Report	2	1	1			
		11. Wire Termination	MA	Pulling manually	Sample	-----	Firm termination	Inspection Report	2	1	1			
		12. Continuity	MA	Electrical	100%	-----	Continuity OK	Inspection Report	2	1	1			

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 PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL										STD QUALITY PLAN NO.: PE-QP-999-145-1056		
		Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks	
Sl. No.									P	W	V			
13.	TYPE TEST	Degree of Protection	CR	Mech. Protection	Sample	BHEL approved spec., drg relevant IEC-60947, IEC-60079	BHEL approved spec., drg relevant IEC-60947, IEC-60079	Type Test Certificate	3	---	1			
14	ROUTINE TEST	IR before & after HV Test	CR	Electrical	100%	BHEL approved spec., drg., BOM & relevant standard	BHEL approved spec., drg., BOM & relevant standard	Test Report	2	1	1			
15	FUNCTIONAL TEST	1. Control Logic Operation 2. Instrument Calibratio 3. Temperature rise	CR	Electrical	100%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1			
			CR	Electrical	100%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1			
			CR	Electrical	100%	BHEL approved spec/drg. & relevant standard	BHEL approved spec/drg & relevant standard	Inspection Report	2	1	1			

LEGEND: * CR - Critical characteristics
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1 - BHEL
 2 - Vendor
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FORM NO. PEM-6686-0



Technical specification for
CONTROL & INSTRUMENTATION
1X800 MW KOTHAGUDEM

SPEC NO.: **PE-TS-410-145-I**

VOLUME

SECTION

REV. NO. 00

DATE : 10.03.2015

SHEET OF

CABLE BOQ

CABLE SIZES FOR 1X800 MW KOTHAGUDEM TPS	
Sl no.	Cable Type
	G-TYPE
1	2P X 0.5 sqmm
2	4P X 0.5 sq mm
3	8P X 0.5 sqmm
4	12P X 0.5 sqmm
5	2P X 1.5 sqmm
	F-TYPE
1	4P X 0.5 sqmm
2	8P X 0.5 sqmm
3	12P X 0.5 sqmm
4	20P X 0.5 sqmm
	CONTROL CABLE
1	3C X 2.5 sqmm
2	5C x 2.5 sq mm
3	12C x 2.5 sqmm

ERECTION HARDWARES

1.00.00 GENERAL TECHNICAL REQUIREMENTS

This section provides the general technical guidelines for the erection materials for instruments. All erection materials shall be of good quality and conform to the operating environment of the corresponding instrument.

However, any item required for erection of Bidder supplied system but not categorically indicated in this section, shall be supplied by the Bidder and all these items shall conform to International / National standards / codes.

1.01.00 Electrical Accessories

Electrical conduit and associated materials shall conform to the requirements of the articles which follow :

- a) Rigid Steel Conduit
 - i) Conduits up to and including 25 mm shall be of 16 SWG and conduits above 25 mm shall be of 14 SWG. Minimum size of conduits shall be 19 mm.
 - ii) Each piece of conduit shall be straight, free from blister and other defects and covered with capped bushing at both ends.
 - iii) All rigid conduit couplings and elbows shall be hot dip galvanized rigid mild steel in accordance with IS:9537 Part-I (1980) and Part-II(1981).. The conduit interior and exterior surfaces shall have a continuous zinc coating with an over coat of transparent enamel lacker or zinc chromate. Conduits shall be furnished in standard length of 3 meters, threaded at both ends.
 - iv) All rigid conduit fittings shall conform to requirements of IS:2667,1976. Galvanised steel fittings shall be used with steel conduit. All flexible conduit fittings shall be liquid tight, galvanized steel. The end fitting shall be compatible with the flexible conduit supplied.
- b) Flexible Conduit
 - i) Flexible conduit shall be of three layer construction of very high quality of lead coated steel. Outside and inside layer shall be reinforced with heat resistant material.
 - ii) Lead coating outside and inside of the conduit steel surface shall provide a non-corrosive characteristic particularly in acidic atmosphere. Besides flexibility, this shall be strong enough to stay at the desired profile without support and shall be durable and strong so as to offer sufficient mechanical protection. It shall also be fully liquid dust and air tight and shall withstand a continuous hydraulic pressure up to 2 Kg/Sq. cm and temperature up to 200 °C.
- c) Special Fittings
 - i) Conduit sealing and fittings shall be provided as required and shall be consistent with the area and equipment with which they are installed.
 - ii) Double locknuts shall be provided on all conduit terminations not provided with threaded lugs and couplings. Locknuts shall be designed to securely bond the conduit to the enclosure when tightened. Locknuts shall not loosen due to vibration.

- 1.02.00 Electrical Junction Box:
Please refer to Section VII , Subsection – D of this volume of the Specification.
- 1.03.00 Cable Gland
1. Type : Double compression
 2. Entry Thread : NPT / ET
 3. Material : Brass
 4. Finish : Cadmium Plated.
 5. Protection : IP 54 or better
 6. Accessories : Neoprene gasket, locknuts, reducers etc
- 1.04.00 Cable Tray
1. Material : Mild steel, slotted
 2. Thickness : not less than 2.0 mm
 3. Finish : Hot dip galvanized
 4. Perforation : As per MFR standard
 5. Cover : Suitable for tray
- 1.05.00 Process Hook Up Accessories & specification
Material and rating of the hook up items shall suit the piping and fluid condition. Hook up materials shall be IBR certified for applicable cases. Bidder shall furnish hook up drawings and the drawings for open racks & closed racks for owner's approval.
- 1.05.01 Seamless Stainless Steel Pipe
1. Reference : ASTM A-312 TP 316
 2. Material Grade : TP 316
 3. Type : Seamless /Plain end
 4. Size : As applicable (e.g. 1/2" NB etc)
 5. Schedule : 40
 6. Standard Length : 5 meter
- 1.05.02 Stainless Steel Pipe Fittings

1. Reference : ASTM A-182 F 316 / ANSI B16.11
2. Type : Forged
3. Rating : 3000 lbs / 6000 lbs / 9000 lbs
4. Size : To suit related SS pipe.
5. End connection : Generally socket weld
6. Type of Fittings : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.

1.05.03 Seamless Stainless Steel Tube

1. Reference : ASTM A-213 , ASTM A-249 or ASTM A-269
2. Material Grade : TP 316
3. Size : As applicable (e.g. ½” OD X 0.083” wall thickness / ¼” OD X 0.049” wall thickness etc.)
4. Type : Cold drawn annealed, pickled, passivated, de-scaled, hydraulically cleaned seamless tube.
5. Properties : The tube shall be free from scratches and suitable for bending and capable of being flared by hardened and tapered steel pin. The expanded tube shall show no crack or rupture. Hardness shall be RB 80.
6. Test Pressure : 400 Kg/Sq. cm (minimum)
7. Tolerance : ± 0.13 mm for outside diameter
: ± 15 % for wall thickness
8. Standard Length : 5 meter
9. Test : Flare, Hardness, Ball and Bubble Test

1.05.04 Stainless Steel Tube Fittings

1. Reference : ASTM-A-182
2. Type : Double ferrule double compression
3. Material : 316 Stainless steel forged
4. Ferrule : 316 Stainless Steel

**Telangana State Power Generation Corporation Ltd.
1x800 MW Kothagudem TPS**

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5. Type of Fittings : Male / female connector, elbow, cross /equal tee, straight connector, bulkhead union, ferrule etc. as required to suit installation.
6. Size : To suit SS tubing and NPT end connection
- 1.05.05 C.S. Pipe
1. Reference : ASTM-A 106 Gr. C
2. Material : Cold drawn seamless black C.S.
3. Type : Seamless / Plain ends
4. Size : As applicable (e.g. ½” NB etc)
5. Schedule : 80, 160, XXS as required
6. Standard Length : 5 meter
- 1.05.06 C.S. Pipe Fittings
1. Reference : ASTM-A 105 / ANSI B16.11
2. Type : Forged
3. Rating : 3000 lbs / 6000 lbs / 9000 lbs
4. Size : Suitable to related C.S.Pipe
5. End connection : Generally socket weld
6. Type of Fittings : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.
- 1.05.07 A.S. Pipe
1. Reference : ASTM-A 335 P22 AS PER ANSI B 36.10
2. Material : Cold drawn seamless A.S.
3. Type : Seamless / Plain ends
4. Size : As applicable (e.g. ½” NB etc)
5. Schedule : XXS
6. Standard Length : 5 meter
- 1.05.08 A.S. Pipe Fittings

- | | | | |
|---------|----|--------------------------|--|
| | 1. | Reference | : ASTM-A 182 F22 AS PER ANSI B 16.11 |
| | 2. | Type | : Forged |
| | 3. | Rating | : 9000 lbs |
| | 4. | Size | : Suitable to related A.S.Pipe |
| | 5. | End connection | : Generally socket weld |
| | 6. | Type of Fittings | : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc. |
| 1.05.09 | | G.I.Pipe | |
| | 1. | Reference | : IS-1239, Part-I |
| | 2. | Type | : Medium grade, threaded at both ends protected with end caps |
| | 3. | Material | : Continuous ERW galvanized MS pipe |
| | 4. | General | : Pipe shall be galvanized both inside and outside |
| | 5. | Size | : As applicable (e.g 1/2"/3/4"/1" etc.) |
| 1.05.10 | | G.I.Pipe Fittings | |
| | 1. | Reference | : IS-1239, Part-II for material, dimension, thread etc. |
| | 2. | Style | : Threaded |
| | 3. | Type of Fittings | : Equal tee, three piece union, unequal tee, straight socket, 90 Deg. elbow, reducing socket cap. etc. to suit installation. |
| | 4. | Size | : Suitable to related G.I.Pipe |
| 1.05.11 | | Carbon Steel Globe Valve | |
| | 1. | Reference | : ASTM A-105 |
| | 2. | Type | : Globe |
| | 3. | Construction | : Forged Body Cadmium Plated |
| | 4. | End Connection | : As applicable (eg. 1/2" Socket Weld etc.) |
| | 5. | Rating | : Cl. 800 / CL. 2500 |

- | | | |
|---------|-----------------------------|--|
| 6. | Material | : Body - Carbon steel
: Stem - Hardened Steel
: Plug - AISI 316 SS
: Seat- Stainless steel stellited |
| 7. | Packing | : Teflon / Grafoil as required |
| 8. | Yoke | : ASTM A105 |
| 9. | Hand wheel | : Carbon steel |
| 10. | Design standard | : As per ANSI B 16.34 |
|
 | | |
| 1.05.12 | Stainless Steel Globe Valve | |
| 1. | Reference | : ASTM A-182 F316 |
| 2. | Type | : Globe |
| 3. | Construction | : Forged Body |
| 4. | End Connection | : As applicable (eg. ½” Socket Weld etc.) |
| 5. | Proof Pressure | : 400 Kg/Cm2 |
| 6. | Material | : Body - Stainless steel
: Stem - Hardened Steel
: Plug - AISI 316 SS
: Seat- Stainless steel stellited |
| 7. | Packing | : Teflon as required |
| 8. | Yoke | : ASTM A182 F316 |
| 9. | Handwheel | : Carbon steel |
| 10. | Design standard | : As per ANSI B 16.34 |
|
 | | |
| 1.05.13 | Alloy Steel Globe Valve | |
| 1. | Reference | : ASTM A-182 F22 |
| 2. | Type | : Globe |
| 3. | Construction | : Forged Body |

- | | | |
|-----|-----------------|--|
| 4. | End Connection | : As applicable (eg. ½” Socket Weld etc.) |
| 5. | Rating | : CL. 2500 |
| 6. | Material | : Body - Alloy steel |
| | | : Stem - Hardened Steel |
| | | : Plug - AISI 316 SS |
| | | : Seat- Stainless steel stellited |
| 7. | Packing | : Grafoil as required |
| 8. | Yoke | : ASTM A182 F22 |
| 9. | Handwheel | : Carbon steel |
| 10. | Design standard | : As per ANSI B 16.34 |

1.05.14 Structural Steel

Steel supports for JB's, trays; tubes and related equipments shall not be limited to the following:

- | | |
|----|---------------------------------------|
| a) | MS Angle |
| b) | MS Channel |
| c) | I-Beam |
| d) | Hexagonal head Bolt & Nut with washer |
| e) | Foundation Bolt & Nut |
| f) | Expansion Bolt |
| g) | Steel Plates / Flats |
| h) | CRCA sheet |
| i) | 50 NB Pipe |
| j) | Pipe clamps, U Bolts & Nuts |
| k) | Checker plate |

1.05.15 Condensate Pot

- | | | |
|----|----------------|--|
| 1. | Reference | : ASTM A182 F22 /ASTM A105 |
| 2. | Material | : Alloy steel / carbon steel as per application |
| 3. | Construction | : Drilled from barstock |
| 4. | End connection | : As applicable (e.g 3 nos. ½” socket weld end etc.) |

	5. Accessories	: Vent valves
1.05.16	Instrument Valve Manifold	
	1. Type	: Two valve manifold : Five valve manifold
	2. Mounting	: Remote 2" Pipe Mounting / Transmitter Rack mounting
	3. Construction	: Single block (bar stock)
	4. Material	: Forged body and bonnet AISI 316 stainless steel
	5. Ports	: Mfg std. (e.g 1/2 " NPT (F) etc.)
	6. Rating	: 420 Kg/Sq. cm at ambient
	7. Operating Temperature	: (-)30 to (+)170 Deg C
	8. Packing	: PTFE Wafer
	9. Seat & Stem	: AISI 316 SS
	10. Plug	: AISI 316 SS free to turn on stem / 17-4 PH
	11. Handle Bar	: AISI 316 SS
	12. Connection	: Straight
	13. Accessories	: Plugs for all ports, Mounting Bracket , bolts , nuts

1.06.00 Pneumatic Hook Up Accessories

1.07.00 Air Header

Technical Particulars	For Panel	For Field
Material of Construction	: Stainless steel	: Stainless steel
Inlet Connection	: 2" NPT (M)	: 1" NPT (M)
Header Take-off Material	: Stainless steel	: Stainless steel
Take off connection	: 1 / 2" NPT (M)	: 1/ 2" NPT (M)
Take-off Valves Material	: stainless steel	: stainless steel

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Tube Take-off	: Tube adapter on valve	: Tube adapter on valve
Drain	: SS drain valve at lowest point	: SS drain valves at lowest point

FORM NO. PEM-6686-0



Technical specification for
CONTROL & INSTRUMENTATION
1X800 MW KOTHAGUEDEM

SPEC NO.: **PE-TS-410-145-I**

VOLUME


SECTION

REV. NO. 00

DATE : 10.03.2015

SHEET OF

KKS PHILOSOPHY

	DOCUMENT TITLE
	KKS NUMBERING PHILOSOPHY 1X800MW KOTHAGUDEM

KKS NUMBERING PHILOSOPHY

For identifying (tagging) an instrument / equipment in Power plant KKS numbering scheme is used. The purpose is to assign a unique number to every equipment in the power plant. For C&I equipment unique number are to be provided up to the signal level so that a unique number Input / Output exist in DCS for every signal.

Normally KKS number is a 10 digit alpha-numeric code and is typically split into the following:


X	X	X	A A Y			Y B B		
---	---	---	-------	--	--	-------	--	--

First three digits indicate the Sub-System. The Code for the major system are given as per **Annexure-1**.

Fourth and Fifth digits are the **Numerical Keys at System Code Level** and used to distinguish between main systems having same Alpha Codes.

Sixth and Seventh digits are the **Equipment / Apparatus / Measuring Circuit Code**. The code of various Equipment / Apparatus / Measuring Circuit is shown in **Annexure-2**

Eight, Nine and tenth digits are the **Numerical Keys at Equipment / Apparatus / Measuring Circuit Code** and used to distinguish between various instruments in the same sub-group. Numerical keys at System / Equipment / Apparatus / Measuring Circuit is shown in **Annexure-3**.

	DOCUMENT TITLE
	KKS NUMBERING PHILOSOPHY
1X800 MW KOTHAGUDEM	

ANNEXURE-1

List of System / Sub-System Codes used in Power Plant:

- 1) Compressed air system : QEA, QEC
- 2) Ventilation System : SAA TO SAZ
- 3) Fire Detection & Protection System + Fire Water pumps : SGM, SGN, SGO, SGP
- 4) Sewage Treatment : SJA TO SJZ
- 5) Pre-treatment Plant : GBI, GBM, GBV
- 6) RO DM Plant : GCI, GCM, GBV


ANNEXURE-2

Standard Equipment Codes:

AA	Valves including drives, also hand operated
AB	Seclusions, Lock, Gates, Doors
AC	Heat Exchanger
AE	Turning, Driving, Lifting equipment
AF	Continuous conveyors, Feeders
AG	Generator Units
AH	Heating and Cooling Units
AK	Pressing and Packaging equipment
AM	Mixer, Stirrer
AN	Blower, Air Pumps / Fans, Compressor Units
AP	Pump Units
AT	Purification, Drying, Filter
AV	Combustion Equipment e.g. grates

Standard Apparatus Codes:

BB	Vessels and Tank
BF	Foundation
BG	Boiler Heating Surfaces
BN	Injector, Ejector
BP	Flow and throughput limitation equipment (Orifice)
BQ	Holder, Carrying Equipment, Support
BR	Piping, Ducts, Chutes, Compensator
BS	Sound Absorber
BU	Insulations, Sheatings

	DOCUMENT TITLE
	KKS NUMBERING PHILOSOPHY
1X800 MW KOTHAGUDEM	

Standard Measuring Circuits Codes:

CD	Density
CE	Electrical Quantities
CF	Flow, throughput
CG	Distance, Length, Position
CK	Time
CL	Level
CM	Humidity
CQ	Analysis (SWAS)
CS	Speed, Velocity, Frequency
CT	Temperature
CY	Vibration, Expansion

ANNEXURE-3

Numerical Keys

A) Numerical Keys at System Code Level


- i) Use 10, 20, 30, To distinguish between main systems having same Alpha Codes. Examples:
 - a) Main Steam (Left) and Main Steam (Right)
 - b) BFP – A/B/C
 - c) ID Fan – A/B, FD Fan A/B, AH – A/B
- ii) For branch off from main system path having code say 10, keep the same alpha code and use 11, 12, 13 etc. Similarly for other branch off from main system path having code say 20, keep the same alpha code and use 21, 22, 23 etc and shall carry on further in the same way.
- iii) If the branch off from main system / sub system path is used for some other system, where different alpha codes can be applied, then in that case the said branch line will be designated by the alpha codes of the system to which it is providing the input.

B) Numerical keys at Equipment Code level:

There are three numerical keys available for each type of equipment code. Following has been agreed upon considering present practice, better flexibility and ease in sorting.

- i) Valves and Dampers --- *Equipment Code – AA*

N1 N2 N3

DOCUMENT TITLE	
	KKS NUMBERING PHILOSOPHY
1X800 MW KOTHAGUDEM	
<p>Motorised (<i>on/off duty</i>) - 0 01 to 50</p> <p>Motorised (<i>inching duty</i>) - 0 51 to 99</p> <p>Pneumatic (Control) - 1 01 to 50</p> <p>Motorised (<i>thyrestor Control</i>) - 1 51 to 99</p> <p>Sol. Operated - 2 01 to 99</p> <p>(Open / Close duty (Valves, NRVs, Gate)</p> <p>Hydraulic - 3 01 to 99</p> <p>NRV (Without actuation) - 4 01 to 99</p> <p>Manual - 5 01 to 99</p> <p>Manual - 6 01 to 99</p> <p>Relief & Safety Valves - 7 01 to 99</p> <p>Reserve - 8 01 to 99</p> <p>Reserve - 9 01 to 99</p> <p>ii) Field Instruments</p> <p>Field Transmitters & Analog Signals - 0 01 to 99</p> <p>Field Switches & Binary Signals - 1 00 to 99</p> <p>PG Test Point - 4 00 to 99</p> <p>Gauges - 5 00 to 99</p> <p>Automatic Turbine Tester (ATT)-HWR - 2 00 to 99</p> <p>(Reserved for protection Signals used by Hardwar)</p>	
<p>Example of Numerical Key Usage:</p> <p>In line with the philosophy adopted for Valves / Dampers /instruments etc. pumps and fans in the main systems (having different system code) can be numbered as AP/N100 and as AP/N101, 102, Where system code is same.</p>	



TITLE:

TECHNICAL SPECIFICATION FOR
CONDENSATE POLISHING UNIT
1X800 MW TSGENCO KOTHAGUDEM TPS
STAGE -VII, PALONCHA

SPEC NO: PE-TS-410-155A-A001

VOLUME: II-B

SECTION: D1

REV NO: 00

DATE:

SECTION – D1
GENERAL TECHNICAL REQUIREMENT- MECHANICAL



TITLE:

**TECHNICAL SPECIFICATION FOR
CONDENSATE POLISHING UNIT
1X800 MW TSGENCO KOTHAGUDEM TPS
STAGE –VII, PALONCHA**

SPEC NO: PE-TS-410-155A-A001

VOLUME: II-B

SECTION: D1

REV NO: 00

DATE:

1.00.00 GENERAL

- 1.01.00 The proposed Condensate Polishing Plant (CPP) shall treat the condensate of the respective Turbine-Generator (TG) Unit of the power station. The system shall be as per tender drawing titled P&ID of Condensate polishing Plant.
- 1.02.00 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 for guidance 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.
- 1.03.00 The Condensate polishing Plant shall consists of one set of Condensate polishing Units (CPU) for TG unit inside TG Building and a regeneration system. CPU shall consist of three (3) service vessels of 50% capacity for TG Unit.
- 1.04.00 The regeneration system shall be external for the TG unit. For regeneration, resin from the exhausted exchanger vessel will be transferred hydraulically to this facility. The exhausted resin charge will be cleaned, separated, regenerated, mixed and rinsed before being stored for the next use.
- 1.05.00 The common influent and effluent headers of each CPU, will be connected to an automatic bypass line (s) to be provided by Contractor. 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).
- 1.06.00 Make-up water to the turbine cycle will be added to the condenser hotwell as required. The analysis of the cycle makeup water (DM Water) is exhibited in the section B of tender specification.
- 1.07.00 In the event of a tube failure in the condenser, circulating water will enter the condensate system and will contaminate it. Typical composition of the circulating water is exhibited elsewhere in the technical specification and the condensate polishing plant shall be designed for such tube leakage condition as mentioned.
- 1.08.00 The condensate polisher service vessel will be located near corresponding units. All the components of the CPP plant shall be located indoor and regeneration system equipments shall be kept under shed and neutralizing pit shall be located outdoor.
- 1.09.00 All the instruments associated with condensate polishing plant shall be provided with proper enclosures by Bidder. All vessels, pumps & blowers and their drives and other electrical and C&I equipments/accessories of regeneration system shall be suitable for outdoor duty and enclosures class of all the equipments shall be suitably selected by the bidder.

2.00.00 SYSTEM REQUIREMENT

- 4.01.00 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.
- 4.02.00 The bidder shall include inert resin in the system if they feel that it helps in better resin separation.
- 4.03.00 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.

4.04.00 Exchange Resins

- i. The bidder shall include with the plant adequate resins for all the condensate polisher service vessels. In addition separate charge of resin shall also be included for using the resins during commissioning stage of unit. Therefore, total number of charges supplied by bidder shall include total resin charges for TG units plus one spare charge plus commissioning charge plus one charge to be stored in additional regenerated resin storage vessel.



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- ii. First fill of resins for all Condensate Polisher Mixed Beds, Mixed Resin Storage Vessel and Makeup Resin Hopper for all the units complete with make-up resin for first three years of operation (Quantity of make-up resins shall be calculated on the basis of 3% and 5% attrition loss per annum for cation and anion resin respectively).
- iii. Cation-anion resin ratio shall be 2.0 parts Cation to 1.0 part anion by volume. In case the process require any non ionic resin the same shall represent at least 10% of the bed volume, but not less than 15 cm of the bed depth in the resin separation / cation regeneration tank of the external regeneration facility.
- iv. After Separation anion resin in the cation resin shall be less than 0.1 % and cation resin in the anion resin shall be less than 0.1%.
- v. Dearation factor of 10% for all resins shall be considered while calculating the quantity of resin to be supplied.
- vi. The resins 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 macroreticular 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 : 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.

vii. Physical Properties:

- i. 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.
- ii. 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.

viii. Chemical Properties:

- i. 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

- ii. 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.
- iii. Cation-Anion resin ratio shall be 2.0 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 tank of the external regeneration facility.
- iv. 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



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adequate past record of successful service for not less than 3 years in similar application.

- v. 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. Duolite C -26 TR & A - 161 TR Rohm and Hass 252 C & TRA-900C.
2. Dowex MSC-1, MSA-1 C grades.
3. Inert resin – Duolite sec, Rohm & Hass 359 or Dow-buffer beads.

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.

- ix. 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.

4.05.00 Condensate Polishing Units

4.05.01 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 and as per Datasheet-A.

4.05.02 Design temperature of the service vessel shall take care of all operating regimes including HP-LP bypass operation. Maximum temp. expected during all loads at CEP discharge is 60 Deg C.

4.06.00 Emergency bypass system :

- 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 set of control valve with its isolation valves on the upstream and downstream sides of the control valve.
- 2) In the event of pressure differential 0.35 Mpa between the condensate inlet and outlet headers, the control valve will open automatically to bypass requisite quantity of condensate to prevent this pressure differential from exceeding a preset limit when two vessels, one vessel or no vessel is in operation.
- 3) When condensate temperature exceeds 53 Deg C the bypass valve shall be 100% opened automatically and the inlet / outlet of the condensate polisher mixed bed shall be closed to protect elements and resins inside the polisher.
- 4) Bidder to provide 1x100% control valve to achieve proper control under all operating conditions as per Customer/BHEL's approval of Engineering Documents.
- 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) 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 and 100% of flow when all the service vessels are out of service.
- 7) 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.



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4.07.00 External Regeneration Facility (Regeneration Plant)

4.07.01 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. Condensate polisher/Mixed bed polisher-100%
- ii. Mixed resin Storage vessel (if applicable) - 100%
- iii. Resin separation vessel- 100%
- iv. Cation regeneration vessel- 100%
- v. Anion regeneration vessel- 100%
- vi. Resin make up hopper – 80%
- vii. 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.

4.07.02 Design pressure of the condensate Polisher Service Vessels is indicated elsewhere. For all other Pressure vessels the design pressure shall be at least 8 kg/sq. cm (g).

4.07.03 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.

3.00.00 TECHNICAL REQUIREMENT OF EQUIPMENTS

5.01.00 Hot water tank (for alkali)

For heating of alkali diluent water, 2x50% electrical heating coil in a tank of mild steel rubber lined construction 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 switches, temperature indicator etc. The heater shall be controlled by the temperature switches provided on the tank. The heaters shall be sized for heating the water from a temperature of 15 Deg.C to 50 Deg.C at the outlet. The water shall be heated to the required temperature within 5 hours.

5.02.00 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 not be less than 1.2 meter.

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



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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.

5.03.00 Resin Injection Hopper

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

a) Capacity

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

b) Material

The resin make-up hopper tank shall be fabricated of mild carbon steel having a minimum thickness of 6 mm and lined.

5.04.00 Piping

5.04.01 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.

5.04.02 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.

5.04.03 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.

5.04.04 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.

5.04.05 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.

5.04.06 The resin transfer pipeline shall be sized for a flow velocity of between 2.3 and 3.0 meters/sec.



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- 5.04.07 The condensate pipeline shall be sized for a flow velocity between 3 and 5 m/sec.
- 5.04.08 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.
- 5.04.09 All lined vessel connections and connections in unlined vessels (25 Nb and larger) shall be flanged to ANSI 125 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.

5.05.00 Valves

- 5.05.01 All valves shall be designed as per applicable AWWA/BID/BS or equivalent international standard / codes.
- 5.05.02 The isolation valves on the resin transfer line shall be of eccentric plug type/ball valve (full bore type) of stainless steel construction.
- 5.05.03 Emergency bypass control valve shall be of double flanged butterfly type. Isolation valves of wafer (lugged) type butterfly valves (resilient material seated, to ensure bubble-tight shut off) shall be provided on the upstream and downstream sides of the control valve.
- 5.05.04 Isolation Valves handling Acid, Alkali, Ammonia etc. shall be diaphragm type in MSRL (mild steel rubber lined) construction.
- 5.05.05 Isolation Valves handling DM water shall be Butterfly or gate or globe type and shall be SS construction.
- 5.05.06 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.
- 5.05.07 All valves in service vessels area where pressure may attain same as service vessel shall be designed for 300 lb class.
- 5.05.08 MOC of butterfly valve at inlet of service vessel seat CS, Disc- SS and outlet of service vessel seat – SS, disc- SS

5.06.00 Pressure Vessels, Atmospheric tanks & Miscellaneous Items

- 5.06.01 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 8 kg/cm²(g).
- 5.06.02 Design of all vertical cylindrical atmospheric storage tanks containing water, acid, alkali and other chemicals shall conform to IS: 803.
- 5.06.03 Design of all horizontal cylindrical storage tanks containing water, acid, alkali and other chemicals shall conform to BS -2594
- 5.06.04 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.
- 5.06.05 In case, tank is subjected to vacuum, the same shall be taken care in designing the tank.
- 5.06.06 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 torospherical type.
- 5.06.07 Spherical vessels for CPU service vessels are acceptable.



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5.06.08 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. Further, a minimum 100 mm free board shall be provided above the top of overflow level to the top of tank.

5.06.09 Material:

- i All pressure vessels shall be designed and constructed in strict accordance with the ASME code Section VIII or IS 2825 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 torospherical type.
- ii 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 atleast 6 mm thickness.
- iii All pressure vessels(Mixed bed polisher) shall be fabricated from carbon steel plates to Carbon steel plates to SA 516 Gr. 60 /SA 516 Gr. 70 and lined internally. Pressure vessels other than mixed bed polisher/condensate polisher vessel shall be fabricated from (Carbon steel plates to IS 2062 / SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70 for shell and Carbon steel plates to IS 2002 Gr. 2A / SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70 for Head) 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.
- iv Vessel internals 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: Same as above with screened laterals with internal perforated pipes and rubber lined flat bottom. For resin separation/regeneration/mixed resin vessels, it may have fully screened bottom (NEVA - clog type with porous septanurese screen, fully supported by subway grid or equal).
 - 3) All internal fasteners shall be of SS-316 and heavy duty locknuts shall be used throughout.
- v 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 shall be of rubber lined steel construction and internals (cord & screen) shall 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.
- vi Carbon Trap (for ACF): Outlet of each Activated Carbon filler on Carbon trap (media trap) shall be provided.



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4.00.00 CONTROL & OPERATION

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 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 operator 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 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 front of the panel. For all other steps it shall be possible to adjust the time setting from inside the panel.
- 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/control panel.
- 6.01.010 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.
- 6.01.011 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.
- 6.01.012 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.
- 6.01.013 Wherever standby equipments are provided, it shall be possible to select each of the drive on 'standby' duty.
- 6.01.014 The detailed logic for the sequence and for each of the drive shall be subject to the BHEL/Customer's approval.
- 6.01.015 Start, progress and stop of each of the sequence shall be annunciated.
- 6.01.016 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.



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6.02.00 Control & Operation of the Condensate Polishing Unit

6.02.01 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.

6.02.02 It shall be possible to select each of the CPU vessel for any of the following operations or mode :

- (1) Standby (Applicable for where spare service vessel (s) are provided)
- (2) Service
- (3) Isolation from service.
- (4) Exhausted Resin Transfer from CPU vessel to Regeneration plant.
- (5) Regenerated Resin Transfer from Regeneration plant to CPU vessel
- (6) Rinse mode.

Each mode or operation is described as below:

6.02.03 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

6.02.04 Service mode:

- (1) Service flow rate for each polishing vessel shall be monitored. 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 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) 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 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 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 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.



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6.02.05 Isolation from Service: Normally "Service Vessel" once exhausted shall be isolated from service till the "Resin Transfer" operation is initiated. In addition, provision to be kept for isolation of one or all the vessels from service if required by operator from the panel.

6.02.06 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) The transfer of resin from the service vessel shall include operations such as isolation of the service vessel, hydraulic transfer of the resin to the external regeneration system (resin separation vessel) and the complete drain down of the service vessel.
- (3) The sequence of "Resin Transfer" operation shall be initiated from the Control system in panel of CPP and shall be controlled in the regeneration Panel.
- (4) The completion of the operation shall be exhibited in the panel.

6.02.07 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 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 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.

6.02.08 Rinse mode :

- (1) After transfer of regenerated resin from the regeneration plant to the empty condensate 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 mode shall be a manually initiated full automatic sequence. This sequence shall include the rinse down step using condensate at a suitable 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) Cation conductivity values shall be monitored and interlocked to prevent advancing of the automatic sequence until the rinse down is complete.
- (5) 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.



TITLE:

TECHNICAL SPECIFICATION FOR
CONDENSATE POLISHING UNIT
1X800 MW TSGENCO KOTHAGUDEM TPS
STAGE –VII, PALONCHA

SPEC NO: PE-TS-410-155A-A001

VOLUME: II-B

SECTION: D1

REV NO: 00

DATE:

6.03.00 External Regeneration Control System

- 6.03.01 A manually initiated automatic sequence for physical cleaning and chemical regeneration of the resin shall be provided. Control for chemical dosing system and alkali preparation facility shall also be provided in it.
- 6.03.02 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.
- 6.03.03 The chemical regeneration is a many step sequence. This will include hydraulic reclassification of the resins and the transfer of the resins to the respective regeneration vessels. 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, 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.
- 6.03.04 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.
- 6.03.05 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 Balance of 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.
- 6.03.06 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.
- 6.03.07 Demineralized water shall be used throughout the regeneration process for backwashing, diluting the regenerant, rinsing and resin transfer.
- 6.03.08 A conical bottom hopper having a water ejector will be used for resin make-up.
- 6.03.09 At any time only one of the sequence shall be in progress.

6.04.00 Interlocks

- 6.04.01 All interlocks for safe operation of the plant shall be provided. They shall specifically include the following as minimum requirement.
- 6.04.02 Service vessels can be back in service, only after they have been pressurized.
- 6.04.03 Service vessels can be taken up for resin transfer only after they have been completely isolated from the condensate system and depressurized.
- 6.04.04 Resin can be transferred to and from only one service vessel at a time.
- 6.04.05 Resin transfer between the service and the regeneration skids shall be permitted only when the receiving vessel is initially empty.



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**TECHNICAL SPECIFICATION FOR
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- 6.04.06 Regeneration sequence can commence, only when the level in the waste neutralisation pit is low enough to receive the entire waste quantity of waste water from the regeneration operation.
- 6.04.07 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 over ride sequence, if required. 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.
- 6.04.08 The regeneration sequence shall be prevented from advancing further in the event of tripping of a running motor or other fault condition, which do not permit the various desired parameter of this step to be achieved. A manual override for this shall also be provided.
- 6.04.09 Annunciation logic shall be carefully designed so that the alarms are activated only under abnormal conditions. As for example, low flow of diluent water is only relevant when the chemical dosing is in progress. All other times, when no diluent water flow is required, this annunciation should be blocked. In general, Normal and trouble free operation of the plant shall not activate any of these alarms.
- 6.04.10 Adequate diluent water flow shall be established before starting of the ejectors/ dosing pumps for acid and alkali.
- 6.04.11 The immersion heater in the hot water tank can be put on only when there is adequate water level in the tank.
- 6.04.12 CPU service vessel inlet & isolate values will close automatically in the event of tripping of condensate extraction pump.

**CONDENSATE POLISHING SYSTEM
(CONT.)**

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1.00.00 SYSTEM DESCRIPTION

- 1.01.00 On line Condensate Polishing System (CP System) is envisaged to achieve high order of availability of various power cycle equipment as well as to ensure quick start up of the unit & continue the unit operation without any restriction by maintaining desired quality of condensate water as recommended by Boiler manufacturer. The CP System should also be capable of maintaining specified condensate quality with condenser tube leakage (clarified water).
- 1.02.00 The proposed CP System shall comprise of 4 x 33 (1/3) % Condensate Polisher Mixed Beds for 1 x 800 MW Unit and One (1) no. common External Regeneration System for 1 X 800 MW Unit.
- 1.03.00 The Condensate Polisher Mixed Beds and associated pipe works, valves, instruments, control panels etc. shall be located at ground floor of Power House.
- 1.04.00 The regeneration facilities comprising of Regeneration Vessels, Measuring Tanks and Pumps shall be located in a separate place near and outside the Power House. The resins will be transferred to the Regeneration Area from the Condensate Polisher Mixed Beds and vice versa through a pipeline.

2.00.00 SCOPE OF SUPPLY AND SERVICES

It is not the intent to completely specify all the details of design, construction and installation herein. Nevertheless, the equipment along with accessories and installation shall conform to a high standard of engineering design and workmanship and capable of performing continuous and satisfactorily. Details not furnished here shall be subject to approval.

The Bidder shall be responsible for providing all material, equipment and services, specified or otherwise which are required to fulfill the intent of ensuring operability, maintainability and the reliability of the complete work covered under this specification.

The equipment and accessories of CP System shall be complete to ensure the recommended condensate water quality both in terms of physical & chemical properties.

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

- 2.01.00 Four (4) nos. Condensate Polisher Mixed Beds (4 x 33 (1/3) %) for 800 MW Unit, each complete with condensate inlet and outlet connections, connections for resin transfer to and from vessels, bed support-cum-under drain system, inlet water distributors, all accessories and appurtenances etc. as required.

- 2.02.00 Resin transfer lines of stainless steel construction between the Condensate Polisher Mixed Beds and the External Regeneration Vessels along with all accessories for 800 MW Unit.
- 2.03.00 External resin traps at the outlet of each of the Condensate Polisher Mixed Beds each designed for in-place manual back wash facility.
- 2.04.00 Condensate inlet and outlet headers for Condensate Polisher Mixed Beds of 800 MW Unit within the boundary limits.
- 2.05.00 Resin transfer lines of stainless steel construction between the External Regeneration Vessels and the Condensate Polisher Mixed Beds along with all necessary supports, anchors etc for 800 MW Unit.
- 2.06.00 Rinse water outlet header from Condensate Polisher Mixed Beds of 800 MW Unit.
- 2.07.00 Two (2) nos. Rinse Recycle Pumps each complete with electrical drive motor and all other accessories as required.
- 2.08.00 All necessary valves and fittings along with the actuators necessary for operation from CP System Control Panel of 800 MW Unit. These shall include suitable 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.
- 2.09.00 A common drain header for the Condensate Polisher Mixed Beds of 800 MW Unit.
- 2.10.00 All necessary drains, vents and sampling points along with isolation valves as required.
- 2.11.00 Two (2 x100%) nos. blowers for 800 MW Unit for Condensate Polisher Mixed Beds (if required), each complete with electrical drive motor and all other accessories as required.
- 2.12.00 Emergency bypass system between the condensate inlet and outlet headers with its automatic valve, isolation valves on both sides and controls for each of Condensate Polisher Mixed Beds for 800 MW Unit.
- 2.13.00 External Regeneration System

The equipment and accessories for external regeneration of ion-exchange resins as addressed below are tentative and for 1 x 800 MW Unit.

However, any other proven alternative scheme of external regeneration as per the standard practice of Supplier of CP System may also be

adopted subject to suitability of the same in all respects for satisfactory operation and performance of Condensate Polisher Mixed Beds.

- 2.12.01 One (1) no. Resin Separation Vessel complete with all accessories.
- 2.12.02 One (1) no. Anion Resin Regeneration Vessel complete with all accessories.
- 2.12.03 One (1) no. Cation Resin Regeneration Vessel / Mixed Resin Storage Vessel complete with all accessories.
- 2.12.04 One (1) no. Resin Hopper, complete with a water ejector system for resin make-up complete with all accessories.
- 2.12.05 One (1) no. Hose Station for Transfer of Hydrochloric Acid. The hose station shall have two (2) nos. each 80 mm NB rubber hose connections.
- 2.12.06 Two (2) nos. Hydrochloric Acid Transfer Pumps each complete with electrical drive motor and all other accessories as required.
- 2.12.07 One (1) no. Hydrochloric Acid Storage Tank complete with integral pipe works, valves and all other accessories as required.
- 2.12.08 One (1) no. Hydrochloric Acid Measuring Tank for regeneration of Cation Resins, complete with integral pipe works, valves and all other accessories as required.
- 2.12.09 Two (2) nos. Hydrochloric Acid Dosing Pumps each complete with electrical drive motor and all other accessories as required
- 2.12.10 Two (2) nos. Alkali Transfer Pumps, each complete with electrical drive motor and all other accessories as required.
- 2.12.11 One (1) no. Activated Carbon Filter for Alkali, complete with internals, integral pipe works, valves and all other accessories as required.
- 2.12.12 One (1) no. Alkali Storage Tank, each complete with integral pipe works, valves and all other accessories as required.
- 2.12.13 One (1) no. Alkali Measuring Tank for regeneration of Anion Resins, complete with integral pipe works, valves and all other accessories as required.
- 2.12.14 Two (2) nos. Alkali Dosing Pumps each complete with electrical drive motor and all other accessories as required
- 2.12.15 Two (2) nos. air blowers, each with electric motor drives, V-belt drive with belt guard, air filters, silencers, for supply of process air required for regeneration of the resins.

- 2.12.16 Two (2) nos. DM Water Regeneration / Resin Transfer Pumps each with electric drive motor, one normally operating and the other standby, for water supply for chemical preparation / dosing and transfer of resin from Condensate Polisher Mixed Beds to Regeneration vessels and vice-versa, backwash etc.
- 2.12.17 One (1) no. Water Heater for regeneration of Anion Resins, complete with integral pipe works, valves and all other accessories as required.
- 2.12.18 One (1) no. Neutralization Pit with two (2) compartments, each complete with all accessories.
- 2.12.19 One (1) no. Acid Measuring Tank for neutralization, complete with integral pipe works, valves and all other accessories as required.
- 2.12.20 One (1) no. Alkali Measuring Tank for neutralization, complete with integral pipe works, valves and all other accessories as required.
- 2.12.21 Two (2) nos. Neutralized Waste Transfer Pumps, each complete with electrical drive motor and all other accessories as required.
- 2.14.00 All integral and interconnected pipe works, necessary valves complete with the actuators as necessary for their remote automatic operation (These need to include all drains, vents, and sampling points with isolation valves as required) and fittings, sumps, gates, all types of pipe supports, pipe and cable racks, pipe and cable bridges, etc. for the entire System.
- The above shall include DM water piping for dilution, resin transfer, backwashing, flushing, rinsing etc. including the DM water piping along with all supports and hangers between the Regeneration Facility and the CP System.
- 2.15.00 Operating platforms, ladders, supports and other structural works as required to facilitate accessibility for operation and maintenance for all the Condensate Polisher Mixed Beds, Regeneration Vessels, Storage Tanks and other equipment.
- 2.16.00 First fill of resins for all Condensate Polisher Mixed Beds, Mixed Resin Storage Vessel and Makeup Resin Hopper for all the units complete with make-up resin for first three years of operation (Quantity of make-up resins shall be calculated on the basis of 3% and 5% attrition loss per annum for cation and anion resin respectively).
- 2.17.00 Supply and application of shop painting and final painting at manufacturer's works and at site for the entire system as specified elsewhere in Volume III-C of this Bid Document.
- 2.18.00 All instrumentations and controls complete with accessories as addressed in Technical Specifications for Instrumentation and Control - Volume -VI of this Bid Document.

- 2.19.00 All electrical equipment and accessories as addressed in Technical Specifications for Electrical Equipment & Accessories - Volume -V of this Bid Document.
- 2.20.00 All civil as well as structural design, construction and architectural works as addressed in General Specification and Design Criteria for Civil and Structural Work - Volume –VII/A, General Specification and Design Criteria for Architectural Work - Volume –VII/B & Technical Specification for Civil, Structural and Architectural Work - Volume –VII/C of this Bid Document.
- 2.21.00 All equipment and accessories as addressed in Specifications for Ventilation and Air Conditioning System - Volume III-D of this Bid Document.
- 2.22.00 All consumables (lubricating oil, inhibitor for oil), mandatory spares, recommended spares, spares required for erection and commissioning of complete system, new set of special tools and tackles, fixtures etc. required for regular operation and maintenance of the system as addressed in Lead Specification - Volume II-A of this Bid Document.
- 2.23.00 Services included under this Specification**
- All services as addressed in Lead Specification - Volume II-A of this Bid Document need to be considered as included with reference to Condensate Polishing System, under the scope of Specification:
- 3.00.00 **EXCLUSIONS**
- Following items shall be considered as excluded from the scope:
- 3.00.01 Supply of river water.
- 3.00.02 All consumables, bulk chemicals like Hydrochloric Acid, alkali etc.
- 3.00.03 Supply of construction water and construction power.
- 3.00.04 For exclusions with reference to instrumentations and controls, Bidder may please refer to Technical Specifications for Instrumentation and Control - Volume -VI of this Bid Document.
- 3.00.05 For exclusions with reference to electrical equipment and accessories, Bidder may please refer to Technical Specifications for Electrical Equipment & Accessories - Volume -V of this Bid Document.
- 3.00.06 For exclusions with reference to civil as well as structural design, construction and architectural works, Bidder may please refer to General Specification and Design Criteria for Civil and Structural Work - Volume –VII/A, General Specification and Design Criteria for Architectural Work - Volume –VII/B &

Technical Specification for Civil, Structural and Architectural Work - Volume – VII/C of this Bid Document.

4.00.00 INTERFACE POINTS

Not Applicable.

5.00.00 SALIENT DESIGN FEATURES

5.01.00 The system shall be designed for 100% condensate polishing for 800 MW Unit corresponding to the maximum mass flow rate established with VVO condition of turbine with suitable bypass arrangement plus maximum heat cycle make-up, with due consideration of redundancy as described elsewhere in this specification.

5.02.00 Each of the Condensate Polisher Mixed Beds shall be designed to handle maximum fifty percent [33(1/3)%] of the system design flow rate for 800 MW Unit as addressed above and to suit the system design pressure as well as temperature.

5.03.00 Condensate Polisher Mixed Beds making up the system of each of 1 x 800 MW Units will be connected to the condensate cycle of respective units and will treat the entire flow. The Condensate Polisher Mixed Beds should be capable of operating without any prior filtration of the condensate.

5.04.00 When condensate temperature exceeds 50°C for a particular 800 MW Unit or bypass pressure difference reaches 0.35 Mpa, the bypass valve shall be 100 % opened automatically and the inlet/outlet of the Condensate Polisher Mixed Beds shall be closed to protect elements and resins inside the polisher.

5.05.00 After the bypass valve is 100 % opened, the bypass valve shall be closed manually. Before closing the bypass valve, one needs to ensure that Condensate Polisher Mixed Beds of 800 MW Unit have been put into operation.

5.06.00 Pressure differential across a Condensate Polisher Mixed Bed may also be judged by the flow value. When the flow of one Condensate Polisher Mixed Bed under service is less than that of the other, it indicates that pressure differential inside the Condensate Polisher Mixed Bed with small flow is high and the resin inside it shall be regenerated.

5.07.00 The Bidder shall provide all instrumentations and controls to analyze the condensate as per the requirements for safe and satisfactory operation of boiler. The system should be capable of producing the output characteristics which will be better than or equal to the specified conditions as prescribed by the Boiler Manufacturer or as specified elsewhere in this document whichever

is more stringent. The system should be also capable of monitoring and maintaining the characteristics during unit start up, load variations and condenser tube leakage.

5.08.00 The minimum design concentrations of various contaminants envisaged to be present in the condensate at inlet of CP System, shall be considered as per Annexure – I.

5.09.00 The CP System shall be designed to deliver the treated condensate as per the requirements of Annexure – II or as recommended by the Boiler manufacturer whichever are more stringent.

5.10.00 CP System shall operate in hydrogen cycle. The volume ratio of cation resin to anion resin shall be 2: 1. A minimum total bed depth of 1100 mm for resins is envisaged for each Condensate Polisher Vessel.

Under the normal conditions of operation as addressed above, the continuous service period between two successive regenerations is envisaged to be not less than 240 hours of continuous operation.

Continuous service period between two successive regenerations in course of Start Up as well as Condenser Tube Leakage shall be not less than 48 hours.

5.11.00 The bed cross section shall be such that the average velocity of condensate through it does not exceed 120 m/hour at the design flow rate.

5.12.00 At the design flow rate, the pressure drop between inlet and outlet flanges of the Condensate Polisher Mixed Beds with clean resin bed shall not exceed 2.0 bar. 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 will be restricted to about 3.5 bar including the pressure drop across effluent resin traps.

5.13.00 Exchange Resins

The Bidder shall provide suitable resins for the Condensate Polisher Mixed Beds, Mixed Resin Storage Vessel and Resin Makeup Hopper.

The cation resin shall be strong acid, with sulfonic acid functional group to the regenerated with Hydrochloric Acid.

The anion resin shall be strong base, with quaternary ammonium (Type-I) functional group to be regenerated with Sodium Hydroxide.

Insert resin, if used, shall be non-ionic compatible with the above resins.

After separation, anion resin in the cation resin shall be less than 0.1 % and cation resin in the anion resin shall be less than 0.1 %.

Deration factor of 10% for all resins shall be considered while calculating the quantity of resin to be supplied.

The resin strength and other physical properties shall be suitable to withstand the design pressures in the system.

The resins selected must have been in use in Condensate Polishing Systems capable of producing water as specified or better, for a period of not less than three (3) years.

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

Cation resins shall be regenerated by dilution of technical grade hydrochloric acid (concentration 30-33%) and anion resins by dilution of sodium hydroxide, rayon grade available as (concentration 40-48%) lye. For calculations regeneration temperature should be taken as 25°C.

5.14.00 It is proposed that the external regeneration facility be common to each Condensate Polisher Vessel and shall be located in the vicinity of Power House.

The regeneration process offered by the Bidder, shall be of proven design and shall essentially be the same process for which the Bidder have experience and shall give proper resin separation compatible with the desired treated water quality. The Bidder shall include inert resin in the system if it is felt that it helps in better resin separation.

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

The guaranteed chemical consumption figures must be supported by relevant published data such as performance of the resin system, statistical data on resin losses and actual field performances of Systems using a similar technique, indicating the quantity of chemicals required for regeneration, in particular, besides other parameters. The data on the chemical consumption figures and the calculations furnished by the Bidder shall be the primary basis of checking the guaranteed parameters during evaluation. The operating exchange capacity and regeneration levels shall be vetted by resin manufacturer and the Bidder must furnish the resin performance curves specially applicable for this project.

- 5.15.00 The minimum free board in various vessels are to be as follows:
- | | | |
|----|--|--------------------|
| a) | Mixed Bed Polisher | Not less than 100% |
| b) | Resin separation vessel | Not less than 80% |
| c) | Anion regeneration vessel | Not less than 100% |
| d) | Cation regeneration cum Mixed resin storage vessel | Not less than 100% |
- 5.16.00 The common influent and effluent header of Condensate Polisher Mixed Beds will be connected to an automatic bypass line to be provided. This bypass line shall include a differential pressure device which on a high signal will cause an automatic valve to open, bypassing the Condensate Polisher Mixed Beds. Automatic bypass line shall be provided with a butterfly type control valve and wafer type butterfly isolation valves (resilient material seated, to ensure bubble-tight shut off) on the upstream and downstream sides of the control valve. In the event of excessive pressure differential 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 both Beds/one Bed/no Bed are/is in operation.
- 5.17.00 The control system shall be so designed that the Control valve is able to bypass 33 (1/3) % flow when any of the Condensate Polisher Mixed Beds is out of service and 100% of flow when all the Condensate Polisher Mixed Beds are out of service.
- 5.18.00 Under normal conditions, Condensate Polisher Mixed Bed will hold a complete charge of freshly regenerated and mixed resin, ready for use. For regeneration, resin from the exhausted Condensate Polisher Mixed Bed will be transferred hydraulically. The empty Condensate Polisher Mixed Bed will then be filled up with already regenerated resin available in the regeneration facility. This Condensate Polisher Mixed Bed shall come into service soon after prerequisite condition is satisfied or as and when desired by the operator. In the meantime, the exhausted resin charge will be cleaned, separated, regenerated, mixed and rinsed before being stored for the next use.
- 5.19.00 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 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 led to the resin regeneration vessels. Demineralized water shall be used throughout for the resin transfer. Piping of the resin make-up system shall be under the scope of the Bidder as a part of the external resin regeneration system.

- 5.20.00 Each Condensate Polisher Mixed Bed shall be provided with resin trap on effluent line. The resin trap in these lines shall be flanged at one end and will be connected at the end of the respective pipeline. The other end shall be open to the drain so that the flow can be seen to check the choking of the trap.
- 5.21.00 All nuts, bolts etc. in submerged and corrosive application shall be of SS-316.
- 5.22.00 Rubbers used for rubber lining of equipment and piping shall be of natural rubber with shore hardness $65 \pm 5^\circ$ in Scale-A.
- 5.23.00 Further specific salient design features of major equipment and accessories have been furnished under Annexure- I to III.
- 5.24.00 In addition to above, required general technical features for Pressure Vessels, Storage Vessels, Piping, Fittings, Valves, Miscellaneous Pumps, Protective Lining, Painting, Mechanical Erection, Testing and Commissioning have been addressed under Sections VI to XIII as attached elsewhere in Volume III-C of this EPC Bid Document.
- 5.25.00 The Condensate Polisher Vessels along with Air Blowers are located indoor at ground floor of the Power House.
- Resin Separation Vessel, Anion Resin Regeneration Vessel, Cation Regeneration Vessel / Mixed Resin Storage Vessel, Resin Hopper, Air Blowers, Acid Measuring Tank, Alkali Measuring Tank and Hot Water Tank are located indoor in the vicinity Power House Area.
- Resin Transfer Pumps cum Regeneration Water Pumps are located outdoor in Demineralized Water System area.
- 6.00.00 OPERATION AND CONTROL PHILOSOPHY**
- 6.01.00 The operation CP System shall be semi-automatic through plant DDCMIS, except addressed otherwise. There shall be provision for remote manual operation also.
- 6.02.00 The CP System, shall be operated for service and resin transfer from concerned Service Area - Equipment Control centre (ECC) to be located indoor in the vicinity of Condensate Polisher Vessels.
- Operation from this ECC can only be undertaken under authorization from Regeneration Area – ECC addressed hereinafter.

The regeneration of ion-exchange resins of CP System shall be carried out from Regeneration Area - ECC to be located in the vicinity of Power House area.

Remote Terminal Unit (RTU) as an extended node of DDCMIS shall be considered in the vicinity of the CPU regeneration area along with a dedicated work station for control and monitoring of the Regeneration System.

6.03.00 The Control System shall provide safe operation of CP System and provide all necessary protections and interlocks to prevent mal-functions of different equipment/drives and to ensure long term unattended safe and reliable operation.

6.04.00 The remote operation of all pumps, blowers and agitators shall be made through DDCMIS workstation.

Further to above, all drive motors shall have the facility of local Start/Stop. Local starting shall be possible through local / remote selector switch to be located in MCC. Tripping of drive motors shall be permissible by local lockable stop irrespective of local / remote selector switch position.

6.05.00 The salient features of operation of CP SYSTEM in different modes are as follows:

In the AUTO MODE, the state of Service, Resin Transfer or Regeneration shall be initiated by the operator and all subsequent steps in the sequence shall proceed in automatic manner. The system shall be based on sequential operation of various equipment such as valves, pumps, etc.

In the REMOTE MANUAL MODE, the operator has to initiate each step or sequence of regeneration.

6.06.00 The control of the CP System i.e. service and standby status of Polisher Vessels as well as Resin Transfer from Condensate Polisher Mixed Beds to Regeneration Area and vice versa will be achieved through the DDCMIS. DDCMIS shall show the operating mode of each Condensate Polisher Mixed Bed (in service, on standby, resin transfer, rinsing down etc.) the position of all automatic valves, operating parameters (such as flow, conductivity, silica levels, differential pressure etc.) and alarm conditions.
Condensate Polisher Mixed Bed Operation

Service flow rate for each Condensate Polisher Mixed Bed shall be monitored. During periods of low condensate flow the operator may select to remove one of the vessels from service by a manually initiated automatic sequence. A differential pressure transmitter installed between the influent and effluent headers on a high signal will cause an annunciation alarm. By observing the individual vessel flow indications, 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/regeneration.

Conductivity analyser shall monitor the polishing system influent and effluent streams as well as the discharge of each Condensate Polisher Mixed Bed. A high influent conductivity annunciation alarm will alert the System operator that a problem condition such as air or condenser cooling water leakage has occurred. This conductivity analyser shall also provide contacts for an alarm at the DDCMIS. A high conductivity annunciation alarm on outlet of Condensate Polisher Mixed Bed will alert the operator to the need for regeneration of a Condensate Polisher Mixed Bed.

Condensate Polisher Mixed Bed shall be automatically placed in service following manual pushbutton initiation from the control panel. The automatic sequence shall include steps for pressurisation of the Condensate Polisher Mixed Bed, a pre-service rinse and placing in service.

The pre-service rinse shall be time controlled. If the conductivity of the Condensate Polisher Mixed Bed effluent is not acceptable at the end of the pre-service rinse, a rinse overtime alarm shall be sounded and the pre-service rinse continued for a second timed period. If an acceptable Condensate Polisher Mixed Bed effluent is not reached by the end of the second pre-service rinse, a pre-service rinse failure alarm shall be sounded and the vessel shall be automatically returned to standby. If acceptable conductivity at outlet of Condensate Polisher Mixed Bed is attained at the end of the first rinse or during the second rinse, the vessel shall automatically be placed in service. Interlocks shall be provided to prevent placing a vessel into the service mode while resin is being transferred.

The rinse recycle shall be manually initiated full automatic sequence. This sequence shall include a rinse down step using condensate at a suitable rate until effluent quality is acceptable for boiler feed water. The effluent quality shall be determined by conductivity monitoring of the rinse water outlet, which is for recycle. Conductivity parameter shall be interlocked to prevent advancing of the automatic sequence until the rinse down is complete.

Condensate Polisher Mixed Beds shall be automatically removed from service following manual push button initiation from the DDCMIS work station.

Exhaustion of a Condensate Polisher Mixed Bed shall be annunciated by any of the following:

- a) High differential pressure across the polisher battery.
- b) High effluent conductivity from an operating vessel.
- c) High effluent silica from an operating vessel.
- d) Pre-set volume of condensate treated in an operating vessel.

When the differential pressure across the Condensate Polisher Mixed Bed header reaches the high set point level an alarm shall sound and by pass valve shall be automatically opened by a signal from the control system.

The alarms for a Condensate Polisher Mixed Bed shall be disabled when the Condensate Polisher Mixed Bed is not in service or pre-service rinse.

Resin Transfer Mode

Resin transfer from a Condensate Polisher Mixed Bed to the regeneration vessel shall be automatic from DDCMIS following manual pushbutton initiation from the DDCMIS work station.

Manually initiated automatic sequences shall be provided for transferring resin from a Condensate Polisher Mixed Bed to the remote regeneration facility for physical cleaning and chemical regeneration and for returning fresh resin to that Condensate Polisher Mixed Bed.

The transfer of resin from the Condensate Polisher Mixed Bed shall include isolation of the Condensate Polisher Mixed Bed, hydraulic transfer of the resin to the Regeneration Area.

The return of fresh resin to the empty Condensate Polisher Mixed Bed shall include the hydraulic transfer from the resin separation vessel of the external regeneration system using demineralized water. After receiving fresh resin the Condensate Polisher Mixed Bed will remain in the 'Off' position until returned to service by the operator.

The resin transfer sequence shall be interlocked to prevent resin transfer in any of the following situations:

- a) Unsuccessful completion of a previous chemical regeneration of physical cleaning sequence in the external regeneration system.
- b) The Condensate Polisher Mixed Bed condensate inlet and outlet valves not closed.
- c) High pressure in the polisher Condensate Polisher Mixed Bed.

6.07.00 The control for the external regeneration system shall be from the Operation workstation with DDCMIS RTU located in a separate Control Room at Regeneration Area. This shall clearly show the status of each concerned Condensate Polisher Mixed Bed. This Console will provide a manually initiated automatic sequence for physical cleaning and chemical regeneration of the resins and show the status of the cycle at all times. This shall also provide all controls and operation facilities for the acid and alkali solution preparation and dosing system. The Regeneration Area Operation Console shall also control the sequences of Resin Transfer – i.e. to transfer resin from the Condensate Polisher Mixed Bed to the external regeneration facility and to receive freshly regenerated resin from the regeneration facility– this

involves depressurisation of the Condensate Polisher Mixed Bed, water sluicing of exhausted resins to the regeneration system, draining the Condensate Polisher Mixed Bed to the condenser hotwell, receiving a water slurry of fresh resin from the regeneration system and finally completely filling the vessel with condensate.

7.00.00 QUALITY CONTROL & SURVEILLANCE

The System / equipment to be supplied under this specification shall have assured quality and workmanship. In the proposal, the Bidder shall submit the Quality Assurance Plan containing quality assurance programme and quality assurance documents for Purchaser's approval. The Bidder shall be bound to conduct all stage inspections on various equipment / material during manufacturing process in accordance with the approved copy of this document. Purchaser shall have the right to carry out Quality Audit and Quality Surveillance by witnessing any or all such tests to be carried out at Bidder's / Sub-Bidder's works as and when desired. The procedure applicable to Bidder's works will also apply to the works of his sub-Bidders. For items coming under the purview of any Statutory Regulation during the course of manufacture, all stage inspections and tests shall be witnessed by an inspecting authority recognized under the statutory regulation. All unpriced copies of Bids of all major bought-out items giving technical details shall be sent to Purchaser for approval prior to placement of orders on sub-vendors.

These audit/surveillance/approvals shall however, do not relieve the manufacturer / sub-vendors of their responsibility of the Quality Assurance of their product and overall guarantee and responsibility shall wholly be confined on the Bidder.

Tests/inspections shall be carried out during and after the completion of manufacture of different components and assembly as applicable in accordance with relevant codes and standards. Test Certificates for all such tests/inspections shall be made available to the Purchaser for approval.

Purchaser or his authorised representative shall have his full access to witness any or all tests/inspections to be carried out at manufacturer's shop. In case, the job is sub-contracted, it will be Bidder's responsibility to make all arrangements so that Purchaser or his authorised representative can attend such tests at Sub-Bidder's premises. Inspection (including interstage inspection) and other tests shall be done as per Approved Quality Plan.

After erection at site, Condensate Polishing System shall be operated for a period of at least two (2) weeks to prove satisfactory, performance and guarantee data.

8.00.00 INSPECTION, TESTING, COMMISSIONING AND PERFORMANCE GUARANTEE TESTS

The equipment, parts and materials shall be tested and inspected, but not limited to the following

8.01.00 Shop Tests

Shop tests shall include all tests to be carried out at Bidder's works, works of their sub-vendors and at works where materials to be used for fabrication of equipment are manufactured. The tests to be carried out shall include but not be limited to the following:

- a) Composition of all material, castings, forgings, etc.
- b) Hydraulic tests for pressure vessels, pipes, valves, pump casing etc.
- c) Tests to check faults in protective lining and painting.
- d) Static balancing test for agitators, stirrers, paddles etc.
- e) Static and dynamic balancing tests on all impellers.
- f) Performance tests (Head, Capacity and Power) for each of pumps and blowers.
- g) All tests with reference to instrumentations and controls complete with accessories as addressed in Technical Specifications for Instrumentation and Control - Volume -VI of this Bid Document.
- h) All tests with reference to electrical equipment and accessories as addressed in Technical Specifications for Electrical Equipment & Accessories - Volume -V of this Bid Document.

8.02.00 Tests before Trial Run

Bidder shall carry out tests at site to prove to the Purchaser that individual equipment of all the System complies with the requirements stipulated and is erected in accordance with requirements specified. Before the System is put on trial run, the Bidder will be required to conduct tests to demonstrate to the Purchaser that each individual item is capable of correctly performing the functions for which it has been designed for. These tests may be conducted concurrently with those required under commissioning sequence. Tests required shall in general be as follows:

- a) The tests to be carried out for the fabricated storage vessels shall include:
 - i. During fabrication and before lining:
 - a) Bottom testing for leakage by soap solution, after the bottom and at least the bottom course of the shell plate have been welded.

- b) Hydraulic shell testing for leakage.
- c) Fixed roof test for leakage by soap solution.
- ii. After lining:
 - Water leakage test for storage tank shall be carried out by filling it with water up to the overflow level.
- b) All piping and valves, after installation, will be tested hydrostatically at one and half times of the maximum attainable pressure in the system to check against leak tightness.
- c) All valves/isolation gates shall be operated throughout 100% of the travel and these should function without any trouble whatsoever.
- d) Each of all pumps and blowers shall be run with the specified fluid from shut off condition to valve wide-open condition. Head developed will be checked from the discharge pressure gauge reading. Capacity may be checked from flow indicator where available. Otherwise capacity shall be checked from the volume of fluid handled (determined from level indicator reading of concerned tank) wherever applicable and duration of test.
- e) Each of pumps and blowers shall be tested at site to run smoothly without undue vibration, flow pulsation, temperature rise in bearing parts, noise etc.
- f) Each of all the agitators and other rotating/moving devices shall be run at the rated speed with water/chemicals up to the normal water level for a period of twenty four (24) hours. During this period all the components shall function smoothly without any unbalance, vibration, overheating at bearing parts etc.
- g) All the rubber lining are to be subjected to the following tests as per relevant code:
 - i. Adhesion test
 - ii. Resistance to bleeding
 - iii. Thickness measurement
 - iv. Shore hardness
 - v. High voltage spark test
- h) Epoxy painting shall be checked by dry type thickness gauge.
- i) All monorail hoists shall be subjected to full working load during all motions without showing any sign of defect.
- j) Visual check on all structural components, welding, painting etc.

- i) All tests with reference to instrumentations and controls complete with accessories as addressed in Technical Specifications for Instrumentation and Control - Volume -VI of this Bid Document.
- j) All tests with reference to electrical equipment and accessories as addressed in Technical Specifications for Electrical Equipment & Accessories - Volume -V of this Bid Document.

8.03.00 Performance Guarantee Test Procedure

- a) The duration of the test shall not be less than 72 hours on continuous basis. These tests will be carried out within a reasonable period from the date of commissioning of the plant. The tests shall be conducted by the Bidder to prove beyond doubt the guaranteed performance of the plant to the satisfaction of the Purchaser.
- b) The test procedures shall be as per applicable Indian Standards. Where Indian Standard is not available or applicable, the test procedures shall be as per standards from recognized origins. The test procedures shall be furnished for review and approval by Purchaser.
- c) Necessary pumps shall be started and flow shall be established through all the streams. Valves be adjusted so as to have equal and rated distribution of flow through all the streams.
- d) One (1) Condensate Polisher Mixed Bed shall be taken under service. Samples of water will be drawn every hour from the outlet and then tested in the laboratory. The results shall be compared against the required parameters stipulated elsewhere under this specification.
- e) Exhaustion of each Condensate Polisher Mixed Bed shall be indicated by the features addressed under 'Operation and Control Philosophy'. The resins of Condensate Polisher Mixed Bed shall then be backwashed / regenerated at the specified regeneration level. Total amount of chemicals required for regeneration and the duration of chemical injection /regeneration shall be noted against the guaranteed figures.
- f) The regenerated Condensate Polisher Mixed Bed shall be again put into service and tests addressed above will be continued. At the end of run, total amount of water treated will be noted from the flow integrators.
- g) Inlet water analysis is determined by making arithmetic average of all hourly readings of feed water taken during the test.
- h) Based on this inlet water analysis, design exchange capacity of resins and resin volume provided, the capacity of each Condensate Polisher Mixed Bed in terms of total volume of treated water (m^3) between two (2) successive regenerations shall be calculated. Resin volume shall not include the buffer and inert layers provided. The calculation shall be

approved by the Purchaser / Engineer.

- i) Quantity of treated water as determined by tests as in above shall be checked against calculated quantity of treated water during regeneration as in above and must be equal to or more than the calculated amount.
- j) All the above mentioned tests shall be separately done for each of the Condensate Polisher Mixed Beds of the complete Condensate Polishing System.

8.04.00 **Performance Guarantee parameters**

- a) Each pump shall be guaranteed for capacity, total dynamic head and power consumption.
- b) All blowers shall be guaranteed for head and power consumption.
- c) Condensate Polisher Mixed Beds
 - i) Each Condensate Polisher Mixed Bed will have a rated continuous treated water output capacity of not less than design value. Each Condensate Polisher Mixed Bed Unit shall be regenerated once after every 240 hours of continuous service run.
 - ii) Net output from each of Condensate Polisher Mixed Beds shall be not less than design volume of treated water for the design water analysis as exhibited in Annexure-I. In case water analysis is different from the design values, guaranteed quantity shall be calculated as indicated elsewhere in this Specification and guarantee shall be applicable on this calculated quantity.
 - iii) Chemical consumption of the Condensate Polisher Mixed Bed as indicated by the Bidder shall be guaranteed against the regeneration level employed and resin volume provided without any tolerance.
 - iv) Qualities of treated water from Condensate Polisher Mixed Bed shall be as per treated water analysis as exhibited in Annexure-II.

9.00.00 **BID EVALUATION CRITERIA**

With reference to Bid Evaluation Criteria, Bidder may please refer to Lead Specification - Volume I of this EPC Bid Document.

10.00.00 **PERFORMANCE GUARANTEE TOLERANCE AND PENALTY**

- 10.01.00 Liquidated Damages (LD) for Additional Power Consumption
- With reference to Additional Power Consumption, Bidder may please refer to Lead Specification - Volume II-A of this Bid Document.
- 10.02.00 Liquidate Damages (LD) for Non Achievement of Specific Performance:
- The performance Guarantee parameters for Condensate Polishing System have been indicated elsewhere in this specification.
- No negative tolerance in respect flow, head and other performance guarantee parameters are acceptable to the Purchaser. In case, any equipment of Condensate Polishing System is not able to achieve the performance guarantee parameters during the Performance Guarantee Tests, Bidder shall make necessary modifications or replace the Equipment/ Plant or any part within three months period from the date of conducting PG test. If even after rectification, the Equipment/Plant is not able to achieve the guaranteed performance parameters, the Purchaser shall have right to reject the Equipment/Plant. In such case, the Bidder shall pay back the total amount paid to them with reference to the Equipment/Plant (with all taxes and duties as applicable) to the Purchaser.
- 10.03.00 **LIQUIDATED DAMAGES FOR DELAY IN DELIVERY & COMMISSIONING**
- With reference to Liquidated Damages for Delay in Delivery & Commissioning, Bidder may please refer to Conditions of Contract - Volume I of this Bid Document.
- 11.00.00 **SPARES**
- With reference to Spares, Bidder may please refer to Lead Specification - Volume II-A of this Bid Document.
- 12.00.00 **TOOLS & TACKLES**
- With reference to Tools and Tackles, Bidder may please refer to Lead Specification - Volume II-A of this Bid Document.
- 13.00.00 **DRAWINGS / DOCUMENTS TO BE FURNISHED BY THE BIDDER**
- The Bidder's formal proposal must be accompanied by the following Documents/Drawings/Information:
- 13.01.00 All the details as addressed under Bid Proposal Sheets under Volume-III of the EPC Bid Document.

- 13.02.00 Process and Instrumentation Diagram for the complete system.
- 13.03.00 Dimensional General Arrangement Drawing for the complete system.
- 13.04.00 Electrical Load List for the complete system.
- 13.05.00 Schedule of terminal points and their characteristics.
- 13.06.00 Quality assurance plan.
- 13.07.00 Requirement of construction power & water with the required characteristics, quantum etc.
- 13.08.00 Experience list addressing the details complete with the locations where Bidder have supplied and commissioned similar systems for similar application under similar duty conditions as specified under this EPC Bid Document.
- 13.09.00 List of imported items, if any.
- 13.10.00 List of proposed Sub-Vendors.
- 13.11.00 In case Bidder is offering equipment/plant/test procedures as per International Standards not mentioned specifically in the Bid Documents, he should furnish at least three (3) copies of English Version of the same along with the offer, for consideration.
- 13.12.00 All Documents/Drawings/Information as addressed in Technical Specifications for Instrumentation and Control - Volume -VI of this Bid Document.
- 13.13.00 All Documents/Drawings/Information as addressed in Technical Specifications for Electrical Equipment & Accessories - Volume -V of this Bid Document.
- 13.14.00 All Documents/Drawings/Information as addressed in General Specification and Design Criteria for Civil and Structural Work - Volume VII/A, General Specification and Design Criteria for Architectural Work - Volume -VII/B & Technical Specification for Civil, Structural and Architectural Work - Volume - VII/C of this Bid Document.
- 13.15.00 All Documents/Drawings/Information as addressed in Specifications for Ventilation and Air Conditioning System - Volume IIID of this Bid Document.
- 14.00.00 DRAWINGS / DOCUMENTS TO BE FURNISHED AFTER AWARD OF CONTRACT**
- The Bidder need to comply with all Documents/Drawings/Information already furnished in their Bid and subsequent correspondences/clarifications if any till the date of issue of notice of award of Contract. Revision of any data must meet the approval of the Purchaser.
- Requirements of Documents/Drawings/Information (not limited to) from the successful Bidder after finalization of contract in respect of individual equipment

as well as the complete system covered under the specification are furnished below:

Requirements of Documents/Drawings/Information under 'Approval' category

- 14.01.00 Process Design Calculations, Mechanical Design Calculations (Sizing Calculations for each equipment, miscellaneous Hydraulic Calculations, miscellaneous Pressure Drop Calculations, miscellaneous Thickness Calculations, etc).
- 14.02.00 Process and Instrumentation Diagram for the entire system complete with all kinds of details.
- 14.03.00 Dimensional General Arrangement Drawing for the entire system complete with all kinds of applicable details.
- 14.04.00 Dimensional General Arrangement and Cross Sectional Drawing for each of all major equipment and each of all buildings complete with all kinds of applicable details.
- 14.05.00 Indoor and Outdoor Piping Layout with suitable sectional views for the complete system.
- 14.06.00 Procedures for Performance Guarantee Tests.
- 14.07.00 All Documents/Drawings/Information as addressed in Technical Specifications for Instrumentation and Control - Volume -VI of this Bid Document.
- 14.08.00 All Documents/Drawings/Information as addressed in Technical Specifications for Electrical Equipment & Accessories - Volume -V of this Bid Document.
- 14.09.00 All Documents/Drawings/Information as addressed in General Specification and Design Criteria for Civil and Structural Work - Volume -VII/A, General Specification and Design Criteria for Architectural Work - Volume -VII/B & Technical Specification for Civil, Structural and Architectural Work - Volume -VII/C of this Bid Document.
- 14.10.00 All Documents/Drawings/Information as addressed in Specifications for Ventilation and Air Conditioning System - Volume III-D of this Bid Document.

Requirements of Documents/Drawings/Information under 'Information' Category

- 14.11.00 Pipe Schedule for the complete system.
- 14.12.00 Valve Schedule for the complete system.
- 14.13.00 Isometric Piping Drawings the complete system.
- 14.14.00 Data Sheets, Dimensional General Arrangement and Cross Sectional Drawing

for each of pumps, blowers, agitators, valves, isolation gates, monorail hoists, etc.

14.15.00 Following test certificates/test curves/data shall be furnished :

- a) Material test certificates.
- b) Performance tests results and characteristics curves of pumps, fans and electric drive motors.
- c) Hydraulic test results of pressure vessels, pipes, valves, fittings, etc.
- d) Test results to anticorrosive coatings.
- e) Nondestructive test results as applicable.

14.16.00 All Documents/Drawings/Information as addressed in Technical Specifications for Instrumentation and Control - Volume -VI of this Bid Document.

14.17.00 All Documents/Drawings/Information as addressed in Technical Specifications for Electrical Equipment & Accessories - Volume -V of this Bid Document.

14.18.00 All Documents/Drawings/Information as addressed in General Specification and Design Criteria for Civil and Structural Work - Volume –VII/A, General Specification and Design Criteria for Architectural Work - Volume –VII/B & Technical Specification for Civil, Structural and Architectural Work - Volume –VII/C of this Bid Document.

14.19.00 All Documents/Drawings/Information as addressed in Specifications for Ventilation and Air Conditioning System - Volume III-D of this Bid Document.

The Bidder shall submit a complete list of documents and drawings along with the category for review/approval by Purchaser.

Before manufacturing of the equipment, the Bidder shall have to take approval of the relevant design calculations/drawings from the Purchaser. Any manufacturing done prior to approval of the of the relevant design calculations/drawing shall be at risk of the Bidder and in case of any discrepancy with reference to approved design calculations/drawings rectification shall be made by the Bidder at their own cost without any violation of delivery schedule.

It is to be noted by the Bidder that approval or release of Documents / Drawings by Purchaser does not include the checking for drafting and other errors, but only review of basic concepts and general principles involved. Approval does not relieve the Bidder from responsibility for correctness of design, details and dimensions.

15. 00.00 **DEVIATION**

15. 01.00 Should the Bidder opt to deviate from this specification in anyway, specific notice to such deviation shall be drawn by the Bidder.
15. 02.00 All such deviations along with reference clauses of the specification shall be clearly mentioned on the deviation sheet(s) as addressed under Bid Proposal Sheets under Schedule IX-B of Volume-IX. The deviation listed elsewhere in the text of the Bid will not be considered by the Purchaser.
15. 03.00 Unless the deviations are addressed in the deviation sheet(s) and submitted with Bid, it will be taken for granted that the Bid is in conformity with this specification in all respects.

ANNEXURE-I
DESIGN ANALYSIS OF CRUDE CONDENSATE

Contaminants	Unit	Normal Condition	Start Up Condition
Ammonia	ppb	250	1500
Copper	ppb	5	5
Total Ferrous Iron	ppb	50	1000
pH value (polisher runs at 25 ⁰ C with H / OH mode)	ppb	8.5-9.0	9.0-9.6
Chloride (as Cl)	ppb	20	100
Sodium (as Na)	ppb	10	20
Silica (as SiO ₂)	ppb	30	500
Crud (mostly black oxide of iron)	ppb	50	1000

NOTE:

Under condenser tube leak condition, the CP System shall be designed for ingress of 2000 ppb TDS in addition to the influent contaminants under Normal Condition as stated above. The cation and anion load distribution for 2000 ppb TDS shall be based on cooling water composition.

ANNEXURE-II
DESIGN ANALYSIS OF TREATED CONDENSATE

Contaminants	Unit	Normal Condition	Start Up Condition	Tube Leakage Condition
Total Dissolved Solids (ammonia excluded)	ppb	Less than 25	Less than 50	
Ammonia	ppb	Below detectable limit	Below detectable limit	
Silica (as SiO ₂)	ppb	Less than 5	Less than 20	Less than 20
Total Ferric Iron	ppb	Less than 2	Less than 10	
Total Copper	ppb	Less than 1	Less than 1	
pH value (runs in H/OH mode)	ppb	6.5 - 7.5	6.5 - 7.5	
Electric Conductivity after hydrogen column (25 ^o C)	μS/cm	Less than 0.1	Less than 0.2	
Chloride (as Cl)	ppb	Less than 2	Less than 10	
Sodium (as Na)	ppb	Less than 2	Less than 5	Less than 20
Crud (mostly black oxide of iron)	ppb	Less than 5	Less than 100	

ANNEXURE-III
MAJOR EQUIPMENT AND ACCESSORIES FOR
CONDENSATE POLISHING SYSTEM

1.0 0.00 CONDENSATE POLISHER MIXED BEDS	
Number of unit	Four (4) [4 x 33(1/3) % for 800 MW Unit]
Description of each unit	
Design flow per unit (Net), m ³ /hr	Not less than 33(1/3) % of total condensate at VWO condition of turbine with suitable bypass arrangement plus maximum heat cycle make-up for 800 MW Unit
Design continuous service period between two successive regenerations under different conditions, hrs	As per Tender Specification
Treated water quality	As per Tender Specification
Media inside the vessel	Strongly acidic high capacity polystyrene resin and Type-I strongly basic high capacity.
Percentage deration to be considered on design exchange capacity for design of the system	Minimum 10 %
Depth of the bed, mm	As per Tender Specification
Free Board % of Bed Depth	Not less than 100%
Regenerant Chemical	Dilute Hydrochloric Acid and Dilute Sodium Hydroxide
Design flow velocity, m/hr	Not more than 120
Design Temperature	60°C
Design Pressure	Design pressure should be the maximum expected pressure to which the vessels 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, if any.
Material of construction	
Shell	SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
Head	SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
Inside protection	Inside lined with Natural Rubber [4.5 mm thick in (3) layers]
2.00.00 RESIN SEPARATION VESSEL	
Number of unit	One (1) no. vessel for 1 x 800 MW Unit

Depth of the bed, mm	As per Tender Specification
Free Board % of Bed Depth	Not less than 80%
Design Temperature	60 ^o C
Design Pressure	Design pressure should 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, if any.
Material of construction	
Shell	SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
Head	SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
Inside protection	Inside lined with Natural Rubber [4.5 mm thick in (3) layers]
3.00.00 ANION RESIN REGENERATION VESSEL	
Number of unit	One (1) no. vessel for 1 x 800 MW Unit
Depth of the bed, mm	As per Tender Specification
Free Board % of Bed Depth	Not less than 100%
Design Temperature	60 ^o C
Design Pressure	Design pressure should 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, if any.
Material of construction	
Shell	SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
Head	SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
Inside protection	Inside lined with Natural Rubber [4.5 mm thick in (3) layers]
4.00.00 CATION RESIN REGENERATION / MIXED RESIN STORAGE VESSEL	
Number of unit	One (1) no. vessel for 1 x 800 MW Unit
Depth of the bed, mm	As per Tender Specification
Free Board % of Bed Depth	Not less than 100%
Design Temperature	60 ^o C

Design Pressure	Design pressure should 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, if any.
Material of construction	
Shell	SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
Head	SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
Inside protection	Inside lined with Natural Rubber [4.5 mm thick in (3) layers]
5.00.0 NEUTRALISATION PIT	
Number required	One (1) no. Pit with two (2) compartments for 1x800 MW Unit
Type	Necessary air grid arrangement of polypropylene construction shall be provided in each compartment for effective neutralization of the waste effluent.
Effective Capacity of each compartment	Adequate to hold the quantity of waste effluent generated due to single regeneration of a Condensate Polisher Mixed Bed plus 20% overall margin.
MOC	RCC. minimum Inside lined with PVC sheet (3 mm thick).

6.00.00 MISCELLANEOUS TANKS FOR ACID			
	Hydrochloric Acid Storage Tank	Hydrochloric Acid Measuring Tank for Condensate Polisher Mixed Bed	Acid Measuring Tank for Neutralization Pit
Number required	One (1)	One (1)	One (1)
Description (for each Unit)			
Type	Horizontal cylindrical with dished ends, over-ground	Vertical cylindrical with flat bottom, over-ground	Vertical cylindrical with flat bottom, over-ground
Type of fluid to be handled	30 - 33 % Hydrochloric Acid	30 - 33 % Hydrochloric Acid	30 - 33 % Hydrochloric Acid
Effective Capacity of each Tank	Adequate to hold the quantity of acid required for thirty(30) days of operation.	Adequate to hold the quantity of acid required for single regeneration of a Condensate Polisher Mixed Bed with 20% overall margin.	Adequate to hold the quantity of acid required for neutralization of excess alkali in waste effluent due to single

			regeneration of a Condensate Polisher Mixed Bed with 20% overall margin.
MOC	Shell - SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70. Dished Ends- SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70. Inside lined with Natural Rubber [4.5 mm thick in (3) layers].	SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70. Inside lined with Natural Rubber [4.5 mm thick in (3) layers].	SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70. Inside lined with Natural Rubber [4.5 mm thick in (3) layers].

7.00.00 MISCELLANEOUS TANKS FOR ALAKLI

	Alkali Storage Tank	Alkali Measuring Tank for MB	Alkali Measuring Tank for Neutralization Pit
Number required	One (1)	One (1)	One (1)
Description (for each Unit)			
Type	Horizontal cylindrical with dished ends, over-ground	Vertical cylindrical with flat bottom, over-ground	Vertical cylindrical with flat bottom, over-ground
Type of fluid to be handled	48 - 48 % Sodium Hydroxide	48 - 48 % Sodium Hydroxide	48 - 48 % Sodium Hydroxide
Effective Capacity of each Tank	Adequate to hold the quantity of alkali required for thirty(30) days of operation.	Adequate to hold the quantity of alkali required for single regeneration of one(1) no. MB Unit with 20% overall margin.	Adequate to hold the quantity of alkali required for neutralization of excess acid in waste effluent due to single regeneration of a Condensate Polisher Mixed Bed with 20% overall margin.
MOC	Shell –SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70. Dished Ends- SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70. Inside lined with Natural Rubber [4.5 mm thick in (3) layers].	SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70. Inside lined with Natural Rubber [4.5 mm thick in (3) layers].	SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70. Inside lined with Natural Rubber [4.5 mm thick in (3) layers].

8.00.00 DILUTION WATER HEATER	
Number required	One (1) no. common for 1 x 800 MW Unit
Type	Vertical cylindrical with dished ends.
Type of fluid to be handled	DM Water
Effective capacity	Suitable to meet the requirements for alkali injection and alkali displacement in course of single regeneration of a Condensate Polisher Mixed Bed, plus 20% margin.
MOC	
Dished Ends	SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
Shell	Shell –SA 515 Gr. 60 or 70 / SA 516 Gr. 60 or 70.
Inside Protection	Natural Rubber (suitable for temperature 70°C-8 mm thick in (6) layers
9.00.00 PUMPS	

	Acid Transfer Pumps	Alkali Transfer Pumps	DM Water Regeneration/ Resin Transfer Pump	Neutralized Waste Disposal Pump
Number required	Two (2) nos. for 1 x 800MW Unit- One (1) no. in operation and other as standby	Two (2) nos. for 1 x 800 MW Unit- One (1) no. in operation and other as standby	Two (2) nos. for 1 x 800 MW Unit- One (1) no. in operation and other as standby	[Two (2) nos. for 1 x 800 MW Unit- One (1) no. in operation and other as standby
Description (applicable for each pump)				
Type	Horizontal Centrifugal	Horizontal Centrifugal	Horizontal Centrifugal	Vertical Centrifugal
Rated capacity, Cu.m/hr.	10	10	To be selected by the Bidder as necessary to meet the system requirements	100 minimum (To be increased by the Bidder if necessary to transfer the waste of single regeneration of the resins of a Condensate Polisher Mixed Bed within four (4) hours)
Head to be developed	10 mlc	10 mlc	To be specified by the Bidder.	To be specified by the Bidder.
Material of Construction				
Casing	Polypropylene	Stainless Steel	Stainless Steel	Stainless Steel

		type 304	type 316	type 316
Impeller	Polypropylene	Stainless Steel type 304	Stainless Steel type 316	Stainless Steel type 316
Shaft	Hardened Carbon Steel - EN 8	Stainless Steel type 410	Stainless Steel type 410	Stainless Steel type 410

10. HYDROCHLORIC ACID DOSING PUMPS	
Number	Two (2) [one (1) no. to be under operation and one (1) no. will be as common standby].
Description for each Pump	
Type of Pump	Positive displacement and hydraulic diaphragm type with stroke adjustment.
Location	Indoor.
Fluid to be handled	Commercial (30-33%) Hydrochloric Acid
Service	To dose Acid solution to the Cation Regeneration Vessel
Duty	Continuous and suitable for parallel operation
Suction Condition	Flooded
Rated Capacity, m ³ /hr	The Capacity of each pump shall be suitable to cater the requirement of One Regeneration of MB plus 20% margin.
Tentative head to be developed at rated capacity, MLC	To be specified by the Supplier to meet the system requirements
Design Standard	As per Tender Specification
Design Temperature, °C	60
Range of Operation (%)	0 – 100
Pump Speed, (RPM)	1500 preferred
Material of construction	
a) All wetted parts	PP
b) Diaphragm	PTFE
Type of drive	Electrical Motor
Criteria for selection of drive motor	Minimum 15 % margin over BKW at rated duty point shall be taken and standard motor with next higher KW as available shall be selected. This shall in no way be less than the maximum power required by the Pump.
Rated speed (RPM)	1500 (Sync.) maximum.
Voltage, Phase & Frequency (± % Variation)	415 V (+10%), 3 Phase, 50 HZ (+3 to -5%).
Type of coupling between Pump & Motor	Flexible Spacer.
Noise level (for complete set of Pump & Motor)	Not more than 85 db (At a distance of 1.0 m from the outer surface of Motor).
Painting for complete set of Pump & Motor	
a) Primer	As per the requirements of Painting Specification.
b) Finish paint	As per the requirements of Painting Specification.
c) Shade	As approved by Purchaser.
Tests and Inspection	

Material Test required for	Casing, Impeller, Shaft and Shaft Sleeve.
Hydro-test	As per IS-1520 and IS-5120.
Dynamic Balancing Test	To be provided
Performance Test	Required as per Tender Specification
Instruments along with alarms, interlocks and accessories	To be provided as per the requirements of the Tender Specification and Drawings, enclosed with it.
Start and stop facility provided both at local and remote	To be provided in conjunction with Auto Start Facility.
Trip interlock	To be provided.
Accessories to be provided	
a) Pulsation Dampener	To be provided.
b) Pressure Relief Valve	To be provided.

11. ALKALI DOSING PUMPS	
Number	Two (2) [one (1) no. to be under operation and one (1) no. will be as common standby].
Description for each Pump	
Type of Pump	Positive displacement and hydraulic diaphragm type with stroke adjustment.
Location	Indoor.
Fluid to be handled	Commercial (40-48%) Sodium Hydroxide
Service	To dose Alkali solution to the Anion Regeneration Vessel
Duty	Continuous and suitable for parallel operation
Suction Condition	Flooded
Rated Capacity, m ³ /hr	The Capacity of each pump shall be suitable to cater the requirement of One Regeneration of MB plus 20% margin.
Tentative head to be developed at rated capacity, MLC	To be specified by the Supplier to meet the system requirements
Design Standard	As per Tender Specification
Design Temperature, °C	60
Range of Operation (%)	0 – 100
Pump Speed, (RPM)	1500 preferred
Material of construction	
c) All wetted parts	SS-316.
d) Diaphragm	PTFE
Type of drive	Electrical Motor
Criteria for selection of drive motor	Minimum 15 % margin over BkW at rated duty point shall be taken and standard motor with next higher KW as available shall be selected. This shall in no way be less than the maximum power required by the Pump.
Rated speed (RPM)	1500 (Sync.) maximum.
Voltage, Phase & Frequency (± % Variation)	415 V (+10%), 3 Phase, 50 HZ (+3 to -5%).
Type of coupling between Pump & Motor	Flexible Spacer.
Noise level (for complete set of Pump & Motor)	Not more than 85 db (At a distance of 1.0 m from the outer surface of Motor).
Painting for complete set of Pump & Motor	
a) Primer	As per the requirements of Painting Specification.
b) Finish paint	As per the requirements of Painting Specification.
c) Shade	As approved by Purchaser.
Tests and Inspection	
Material Test required for	Casing, Impeller, Shaft and Shaft Sleeve.
Hydro-test	As per IS-1520 and IS-5120.
Dynamic Balancing Test	To be provided
Performance Test	Required as per Tender Specification
Instruments along with alarms, interlocks and accessories	To be provided as per the requirements of the Tender Specification and Drawings, enclosed with it.
Start and stop facility provided both at local and remote	To be provided in conjunction with Auto Start Facility.
Trip interlock	To be provided.
DEVELOPMENT CONSULTANTS (e-PCT-TS-K-02-2014-15 -V-II-C-Sec-VI-CPU.doc)	V.II-C/S-VI: 33
Accessories to be provided	
a) Pulsation Dampener	To be provided.
b) Pressure Relief Valve	To be provided.

13. ACTIVATED CARBON FILTER FOR ALKALI SERVICE	
Number	One (1) no.
Description for each unit	
Type	Vertical cylindrical with dished ends.
Location	Indoor.
Effective Capacity in m ³ /hr	Not less than 10
Time Period for each Service Cycle between two consecutive regenerations, in hrs	24.
Design surface flow rate in m ³ /m ² /hr	Not more than 15.
Design Temperature in °C	60.
Design Pressure in kg/cm ² (g).	Design pressure should be the maximum expected pressure to which the vessel may be subjected plus 5% extra margin. Maximum expected pressure for a vessel placed in the discharge line of a pump shall be based on the shut-off head of the pump plus static head at pump suction, if any.
Design Inlet Alkali Quality	As per the stipulations of Tender Specification.
Design Treated Alkali Quality	As per the stipulations of Tender Specification.
Design Code	As per the requirements of Tender Specification.
Code for Tests and Inspections	As per the requirements of Tender Specification.
Filter Media	
a) Type	Activated Carbon.
b) Characteristics of Activated Carbon	Grade : Suitable Grade. Bulk Density : Not less than 400 kg/m ³ . Particle Density : 1.3-1.4 gm/cc. wetted in water Effective size, mm : 0.8-0.9 mm. Uniformity Coefficient : 1.5-1.6. Mean particle dia : 1.2-1.4 mm. Total surface area : Not less than 850 m ² /gm. Iodine no. : Minimum 850. Carbon content : Not less than 90%. Moisture content : 5% (max). Ash content : 8% (max).
c) Bed depth in mm	Activated Carbon - minimum 1200 and Support Gravel - minimum 300.
d) Percentage freeboard	75 % minimum.
Details of Regeneration of Filter Media	
a) Backwash	Backwash by reversible flow of filtered water.
b) Backwash Velocity	To be specified by the Tenderer.
Material of construction	
a) Shell	Carbon steel as per IS 2062 or ASTM A 515 Gr.60/70 or better.

b) Dished ends	Carbon steel as per IS 2002 or ASTM A 515 Gr.60/70 or better.
Protection	
a) Internal	
• Material	As per Painting Sub- section.
• Thickness	As per the requirements of Tender Specification.
b) External	
• Primer	As per Painting Sub- section.
• Finish paint	As per Painting Sub- section.
• Shade	As approved by Purchaser.
Design code	ASME SEC-VIII Div-I
Hydrostatic Test Pressure	1.5 thmes of Design Pressure.
Influent Distributor Material	SS-316
Manhole	Two (2) nos. minimum each of Davit type and 500 mm dia.
Sight windows	One (1) no. in Backwash Space.
Hand hole	One (1) no. of 150 mm dia. for removal of Activated Carbon.
Instruments, alarm and Interlock	To be provided as per the Tender Specification and Tender P&ID.

14. RINSE RECIRCULATION PUMPS	
Number required	Two (2) nos. for 1 x 800MW Unit-One (1) no. in operation and other as standby
Description (applicable for each pump)	
Type	Horizontal Centrifugal
Rated capacity, Cu.m/hr.	To be selected by the Bidder as necessary to meet the system requirements
Head to be developed	To be specified by the Bidder.
Material of Construction	
Casing	Stainless Steel type 316
Impeller	Stainless Steel type 316
Shaft	Stainless Steel type 410

15. BLOWERS		
	Air Blowers for Service Vessels	Air Blowers for Regeneration Vessels
Numbers required	Two (2) nos. for 800 MW Unit -One in operation and other as stand-by.	Two (2) nos. for 1 x 800 MW Unit-One in operation and other as stand-by.
Location	Indoor	Outdoor
Type	Rotary, Twin Lobe, oil free, positive displacement	Rotary, Twin Lobe, oil free, positive displacement
Material of Construction	Casing – Cast Iron Lobe – Cast Iron Shaft – Carbon steel to EN 8	Casing – Cast Iron Lobe – Cast Iron Shaft – Carbon steel to EN 8



TITLE:

TECHNICAL SPECIFICATION FOR
CONDENSATE POLISHING UNIT
1X800 MW TSGENCO KOTHAGUEDEM TPS
STAGE -VII, PALONCHA

SPEC NO: PE-TS-410-155A-A001

VOLUME: II-B

SECTION: C1

REV NO: 00

DATE:

**LEAD SPECIFICATION FOR
PROJECT**

CONTENT

LEAD SPECIFICATION

SECTIONS	DESCRIPTION
SECTION-I	: INTENT OF SPECIFICATION
SECTION-II	: PROJECT SYNOPSIS AND GENERAL INFORMATION
SECTION-III	: SCOPE OF SUPPLY & SERVICES
SECTION-IV	: GENERAL TECHNICAL REQUIREMENTS
SECTION-V	: PROJECT MANAGEMENT & SITE SERVICES
SECTION-VI	: ENGINEERING SERVICES
SECTION-VII	: QUALITY ASSURANCE REQUIREMENTS
SECTION-VIII	: REQUIREMENT OF SPARES, TOOLS & TACKLE, LUBRICANTS/OIL/CONSUMABLES
SECTION-IX	: SALIENT DESIGN DATA
SECTION-X	: PAINTING

INTENT OF SPECIFICATION

INTENT OF SPECIFICATION

1.00.00 This specification is intended to cover supply and installation of complete Plant Equipment & accessories along with all facilities as detailed hereinafter for 1 x 800 MW Kothagudem Thermal Power Station (KTPS), Stage-VII, Unit-12 for Telangana State Power Generation Corporation Ltd. (TSGENCO) at Kothagudem, Telangana.

The scope shall include design, engineering, manufacture, inspection and testing at manufacturer's works, packing and shipment, transit insurance and delivery at site. In addition, the Bidder's scope shall also include all necessary civil/structural/ architectural works, erection/installation including unloading storage and handling at site, site testing, commissioning, trial run, performance and guarantee tests and other services including supply co-ordination, engineering and project management related to the equipment/systems comprising 1 x 800 MW Unit, as specified hereinafter and in accordance with the requirements, conditions, appendices, drawings etc. stated in Volume-I and Volumes II-B to X which shall be considered as a part of this volume as completely as if bound herewith.

The specification consists of Volumes : I to X, the detailed index of which has been furnished elsewhere. This specification shall be read and construed in conjunction with the drawings and annexures to determine the scope of work. The quantities shown on drawings and annexures are indicative. Any variation arising during detailed engineering stage will be taken into account by the Contractor without any extra cost and time to the Owner.

The Bidder shall be responsible for providing all material, equipment and services, specified or otherwise which are required to meet the intent of this specification, ensuring high degree of reliability and ease of operation and maintenance. The equipment and system/sub-systems shall conform to all aspects of high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation, in a manner acceptable to the Owner and shall also be in line with the current practice for reliable and efficient functioning of the plant.

Owner shall interpret the meaning of the specification, drawings, requirement of operation, maintenance, redundancy etc., and shall have a right to reject or accept any work or material which in his assessments is not technically complete to meet the requirements of this specification and/or applicable National and International Standards mentioned elsewhere in this specification.

Bidder is required to carefully examine and understand the specifications and seek clarifications, if required, to ensure that he has understood the specifications as intended by the Owner. In the absence of any specific clarifications made by the Owner during bidding stage, the interpretation of

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Owner shall be final. The Bidder's offer should not carry any sections like clarifications, interpretations and/or assumptions. All such points are required to be clarified during bidding stage.

In the event of conflict between requirements of any two clauses of this specification/documents or requirements of different codes/standards, specified, the more stringent requirement as per the interpretation of the Owner shall apply.

The Bidder may also make alternate offer, provided such offers are superior in his opinion, in which case, adequate technical information and justifications, operating feed back data etc. shall be enclosed with the offer, to enable the Owner to assess the superiority and reliability of the alternative offered without the need to seek any further clarification or explanation. In case of each alternative offer, its implications on the performance, guaranteed efficiency, heat rate auxiliary power consumptions and definite advantages the Owner can positively derive shall all be clearly brought out along with commercial implications, if any for the Owner to make an overall assessment. In any case, the base offer shall necessarily be in line with this specification. Under no circumstances shall the specified equipment/plant be brought out as an alternative offer.

In case all the above requirements are not complied with, the offer may be considered as incomplete and liable to be treated as non-responsive.

- 2.00.00 Whenever a material or article is specified or described by the name of a particular brand, manufacturer or vendor, the specific items mentioned shall be understood as establishing type, function and quality desired.
- 3.00.00 In case there is any difference of content/information between "Hard Copy" and "Soft Copy" of this specification document, the statement/information as printed in hard copy shall prevail.

PROJECT SYNOPSIS AND GENERAL INFORMATION

CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	INTRODUCTION
2.00.00	APPROACH TO SITE
3.00.00	LAND
4.00.00	SOURCE OF COAL
5.00.00	SOURCE OF WATER
6.00.00	ASH DISPOSAL AREA
7.00.00	SALIENT DESIGN DATA

PROJECT SYNOPSIS AND GENERAL INFORMATION

1.00.00 INTRODUCTION

The proposed 1x800 MW Kothagudem Thermal Power Station (KTPS), Stage-VII, Unit-12 would be set up by Telangana State Power Corporation Ltd. (TSGENCO) at Kothagudem, Telangana. The proposed Power Plant will be installed adjacent to the existing D colony of Kothagudem Thermal Power Station, at Kothagudem.

The Bidder shall acquaint himself by a visit to the site, if felt necessary, with the conditions prevailing at site before submission of the bid. The information given here in under is for general guidance and shall not be contractually binding on the Owner. All relevant site data /information as may be necessary shall have to be obtained /collected by the Bidder.

2.00.00 APPROACH TO SITE

Site is located in the existing D Colony of Kothagudem Thermal Power Station, which is at a distance 30 km from temple town of Bhadrachalam and 300 km from Hyderabad by road. The Nearest railway station is Bhadrachalam Road (Known as Kothagudem) at a distance of 12 km. Kothagudem- Bhadrachalam National Highway branches off to the power station site near village Paloncha.

3.00.00 LAND

Land is primarily required for the main plant & auxiliaries (BTG) and balance of plant (BOP) like ash handling, coal storage, cooling tower, switchyard etc., which is available within the existing plant boundary.

The existing colony is to be dismantled, and the land of about 137 acres will be used for the main plant building, water facilities, switchyard, coal handling etc. The raw water reservoir will be located adjacent to the existing raw water reservoirs.

230 acres of land required for Ash Dyke will be procured. Land is available for staff colony, which is to be constructed by the EPC contractor.

4.00.00 SOURCE OF COAL

100% Imported and Blended coal (50% imported + 50% indigenous) will be used. Indigenous coal shall be sourced from Suliyari coal mines, Madhya Pradesh.

5.00.00 SOURCE OF WATER

Source of water (total quantity of water is 2192 m³/hr) is Godavari River near Burgampahad & water will be pumped through existing GRP pipe line (of length approx. 26 km).

6.00.00 ASH DISPOSAL AREA

Ash shall be dumped in the ash dump area which will be about 9 km from plant. The ash dyke area of 230 acres is adequate for 1x800 MW unit as per MOEF norms.

7.00.00 SALIENT DESIGN DATA

7.01.00 Meteorological data of site is given below:-

Elevation above MSL	:	89 m
Monthly highest temperature	:	44.9 °C
Monthly lowest temperature.	:	12.9 °C
Rainfall		
	Average.:	1031 mm
	Max. :	100 mm/ hr
Mean Wind speed	:	5.8 kmph
Relative Humidity		
	Max :	82%
	Min :	35%
Seismic Zone	:	Zone-III as per IS- 1893 (Part-IV)

[Climatological data of Khammam is attached for reference].

SCOPE OF SUPPLY AND SERVICES

CONTENT

- A. SUPPLY OF EQUIPMENT AND SYSTEMS
- B. SERVICES TO BE RENDERED BY THE BIDDER
- C. EXCLUSIONS
- D. TERMINAL POINTS
- E. FACILITIES TO BE PROVIDED BY THE OWNER

SCOPE OF SUPPLY AND SERVICES

A. SUPPLY OF EQUIPMENT AND SYSTEMS

The Works as detailed hereinafter of this Project for 1x800 MW Kothagudem Thermal Power Station (KTPS), Stage-VII, Unit-12 shall be contracted on a Single Package turnkey basis for complete plant, equipment and systems.

The plant shall be designed to operate as a base load station. However, continuous operation under two shift and cyclic modes during certain periods is also envisaged. The design would cover adequate provision for quick start-up and loading of the units to full load at a fast rate. The main plant and its auxiliaries with their controls would be designed to permit operation of the units on house load without there being any necessity to shut down the units in the event of sudden loss of total load due to tripping of transmission lines or any other grid disturbances. The design of the plant equipments and control system would permit participation of the plant in automatic load frequency control.

- 1.00.00 One (1) no. super-critical once through dry bottom, balanced draft, outdoor type pulverized coal fired with oil as start-up and stabilising fuel steam generating unit, complete with all major auxiliary plant and equipment consisting of, but not limited to, the following :
- a) Furnace/ evaporator complete with spiral/ vertical rifle/ ribbed tubes, headers, steam generating tubes, risers, furnace bottom hoppers etc. for once through boiler.
 - b) Economiser, Superheater, Reheater, Separator other Pressure Parts, Soot Blowing System etc. including circulation pumps (for low load and start up).
 - c) Integral pipework, valves and specialties along with supporting system.
 - d) Draft plant including tri-sector type air-preheaters, ducting and accessories upto chimney inlet flange.
 - e) Fuel (Coal) preparation and firing systems including start-up/ stabilisation system with fuel oil and mill rejects handling & disposal system.
 - f) Integral instrumentation, safety interlocks and controls for steam generator.
 - g) Galleries, platforms and structural steelwork.
 - h) Electrostatic precipitators.

i) Chemical Dosing System

j) Thermal Insulation.

For detailed scope, refer to Volume: IIB of this specification.

2.00.00 Fuel Oil System

Heavy Fuel Oil (HFO) and Light Diesel Oil (LDO)/ High Speed Diesel (HSD) Oil unloading, storage, pressurizing and heating System as detailed in Volume: IIB of this specification.

3.00.00 Multi-cylinder (three cylinders) tandem compound, one single flow HP, one single flow IP, two double flow LP cylinders, single/double reheat, regenerative, condensing type turbine-generator sets complete with all related auxiliaries matching super critical boiler parameters and consisting of, but not limited to, the following major sub-systems:

a) Steam turbine proper along with auxiliary systems e.g. gland sealing, turbine lube oil and control oil system for lubrication protection-governing, water spray, steam washing systems etc. as applicable.

b) Stop and control valves on Main Steam (MS) and Hot Reheat (HR) inlet with strainers, quick closing non-return valves on extraction lines and Cold Reheat (CR) outlet, H.P.& L.P. Bypass valves etc. together with hydraulic actuation system, reheater isolating device, blanking pieces etc. as necessary for protection during steam blowing.

c) All integral piping for turbine steam, drain and vent systems including flash boxes, oil, air and water systems.

d) Condensate Polishing System.

e) Generator coupled to steam turbines and complete with auxiliary systems e.g. excitation, seal oil, hydrogen cooling, stator cooling, carbon-di-oxide purging systems etc. as necessary.

f) Integral instrumentation, safety interlocks and controls for the turbo-generator.

g) Thermal Insulation and Noise Insulation.

For detailed Scope, refer to Volume : II-C of this specification.

4.00.00 Water cooled, two nos. single pass with cooling water (CW) side of condenser in series, horizontal surface condensers complete with integral accessories, CW line pressure balanced expansion joints, butterfly valves, water box handling devices, air evacuation, on load tube cleaning system etc. as specified in Volume: IIC of this specification.

5.00.00 All power cycle pumps and drives as required including Boiler Feed Pumps, Condensate Extraction Pumps, Heater Drain Pumps (if applicable); the

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- pumps are to be complete with accessories for sealing and lubrication, flexible/hydraulic couplings, gear box, integral instrumentation, handling devices, etc. and Auxiliary steam turbine and ancillaries for Boiler feed pump device as specified in Volume: IIC of this specification.
- 6.00.00 Low pressure and high pressure feed heaters and deaerator complete with integral instrumentation and valves, supports, platforms, rails, handling devices etc. as specified in Volume: IIC of this specification.
- 7.00.00 Turbine oil purification system and central turbine oil storage and transfer system as specified in Volume: IIC of this specification.
- 8.00.00 Complete piping, valves and specialties as indicated hereunder, but not limited to, the following:
- a) Power cycle piping consisting of main steam, hot reheat, cold reheat, extractions, auxiliary steam, air evacuation, cascade drains, condensate, feed water, cycle make-up, drains to waste and atmospheric vents etc. Blanking devices for emergency stop and reheat stop valves and other items as required for steam blowing operation along with steam blowing piping and quick opening valve as specified in Volume: IID of this specification.
 - b) Large diameter piping for condenser and auxiliaries Cooling Water Systems as detailed in Volume III-E of this specification.
 - c) Low pressure piping for various water (cooling, service, drinking, plant make-up etc.) air (instrument, service air etc.), steam (other than that covered in item [a] above) and other services as detailed in Volume III-E of this specification.
- 9.00.00 Steel storage tanks/ vessels such as, condensate storage tank, potable water tank to be constructed under this specification, waste drain and other tanks not specifically mentioned but required for completion of various systems supplied under this specification. Refer Volume III-E of this specification for detailed scope.
- 10.00.00 Thermal insulation including cladding material as required for conservation of heat and for personnel protection, as specified in Volume: II-D of this specification.
- 11.00.00 Complete Control and Instrumentation (C&I) systems in turnkey basis. Any item not specifically mentioned in this specification but required for completion of the total C&I system shall be included. The major C&I systems shall comprise of but not be limited to Distributed Digital Control and Management Information System (DDCMIS), SG and TG integral control and instrumentation systems, Plant Auxiliaries and Off site Plants Controls and monitoring systems, Performance Analysis Diagnostics and Optimisation (PADO) system, Master Clock system (MCS), Rotating Machine Condition Monitoring System (RMCMS) , Close Circuit Television (CCTV) System for plant surveillance, Furnace and Flame viewing System, PA and EPABX systems, Computerised Maintenance & Inventory Management System (CMIMS), Ambient Air Quality Monitoring System (AAQMS), Steam and

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Water Analysis System (SWAS), Continuous Emissions Monitoring System (CEMS), Microprocessor based Alarm Annunciation System, HART management system, Power supply, C&I Laboratory, Erection Hardware Field instruments and sensors, Performance and Guarantee test instruments, Primary flow elements, Pneumatic, motorized and hydraulically operated valves and dampers, cables, Panel, desks and cabinets, Racks, Maintenance, calibration, commissioning, site testing instruments, Special tools and tackle, Spares and Consumables etc.

Volume VI of this specification shall be referred for further details of C&I requirements.

12.00.00 Complete cooling water system consisting of, but not limited to, the following major equipment :

- a) Cooling Tower
- b) Condenser Circulating Water (CW) pumps, drives and accessories.
- c) Auxiliary Cooling Water (ACW) pumps, drives and accessories.
- d) Closed circuit DM cooling water pumps, drives and accessories.
- e) Heat exchangers for closed circuit DM cooling water systems.
- f) Cycle make-up pumps, Condensate Transfer Pumps and Condensate Storage Tank.

For detailed scope, refer to Volume: III-A and VII-D of this specification.

13.00.00 Complete Instrument Air and Service Air System consisting of but not limited to the following:

- a) 3x50% Instrument Air Compressor
- b) 3x50% Service Air Compressor
- c) 3x50% Refrigerant type Air Dryer
- d) 6 Nos. Air Receiver

For detailed scope, refer to Volume III-E of this specification.

14.00.00 Ventilation and Air-conditioning system including all equipment, piping, false ceiling, insulation, ducting etc. as required for all buildings and facilities.

14.01.00 The Air-conditioning system shall cover the following areas as a minimum :

- a) TG Building Room

Unit Control Room, Control Equipment Rooms, Shift Charge Engineer's Rooms, Computer Room, Uninterrupted Power Supply (UPS) Rooms, Automatic Voltage Regulator (AVR) Rooms if any, Steam and Water Analyzer

(SWAS) Panel Rooms (dry panel), Excitation Room, Relay Panel Room and other office areas like Telephone Exchange Room, Conference Hall, Library, Laboratory Rooms etc. if any on the operating floor.

- b) Service Building
 - i. Maintenance Office areas, conference rooms, lecture rooms and any other areas needs Air Conditioning.
 - ii. AC plant control room (in Central AC plant equipment room proposed to be located in ground floor of Service Building)
- c) ESP Control Room.
- d) VFD Control Room (if applicable).
- e) Ash Handling Plant Control Room.
- f) DM plant control room, office and Laboratory area.
- g) Switchyard Control Room.
- h) Chemical Laboratory Building.
- i) Coal Handling Plant control room.
- j) Any other Local Control Rooms / Cubicles of different Auxiliary Buildings housing Programmable Logic Controllers (PLC) Panels and other Input / Output (I/O) modules.
- k) Rooms having the equipment required controlled temperature by nature for their operating feature.
- l) Any other area requiring Air conditioning as per manufacturer's recommendation.

All the buildings described above shall preferably be provided with separate air conditioning systems because they may be far apart from each other.

14.02.00 The Ventilation system shall cover the following areas as a minimum :

14.02.01 Evaporative Cooling System with Air Washer Units (AWU) shall be adopted for the ventilation of the following areas of Power House Building :

- i) TG Hall
- ii) MCC, Switchgear rooms and cable spreader rooms
- iii) Battery Charger Rooms

- 14.02.02 Mechanical Dry Ventilation System with either Supply or Exhaust Fans shall be provided for the following areas of the Power House Building:
- i) Battery Rooms
 - ii) Elevator Machine Rooms
 - iii) Toilets
- 14.02.03 Mechanical Dry Ventilation System with Exhaust Fans shall be provided for the following areas of Mill Bay:
- i) Coal Conveyor Tripper floor
- 14.02.04 Similarly evaporative cooling system with Unitary Air Filtration Units (UAF) shall be provided for the ventilation system for the MCC / Switchgear Rooms and other non-AC areas of the following areas :
- i) Non-AC areas of ESP Control Building
 - ii) Ash Handling Electrical / Control Building.
 - iii) CHP Control Building
- 14.02.05 Dry Ventilation System with either Supply or Exhaust Fans shall also be provided for the following Auxiliary Buildings:
- i) DG and Compressor House
 - ii) Ash slurry pump House
 - iii) HFO & LDO forwarding Pump House
 - iv) CW Treatment Building
 - v) DM Plant Building
 - vi) DM, Service and Potable Water Pump House
 - vii) Non-AC areas of Chemical House
 - viii) CPU Regeneration Building
 - ix) Switch-yard Control Building
 - x) CW Pump House
 - xi) AHP Compressor Building
 - xii) Non-AC areas of Service Building
 - xiii) Silo Utility-cum-HCSD Pump House
 - xiv) Vacuum Pump House
 - xv) Ash Water Pump House
 - xvi) Clarified Water Pump House
 - xvii) Centrifuge Building
 - xviii) Store Building

However, for detailed scope, refer to Volume III-D of this specification.

15.00.00 Fire Protection System for all plant, equipment and facilities under this specification comprising of, but not limited to, the following :

- a) Hydrant Protection System.
- b) Spray Water System.
- c) Smoke/Fire Detection System.
- d) Inert Gas Flooding System
- e) Fixed foam Protection System
- g) Portable Fire Extinguishers
- h) Fire Tender

For detailed scope, refer to Volume III-E of this specification.

16.00.00 Sump Pumps complete with drives and accessories for drainage of pits from all buildings/facilities, inclusive of, but not limited to the following areas:

- a) Power House and Boiler Area.
- b) Fuel Oil (F.O) Unloading, Forwarding and Pressurizing Pump House.
- c) Transformer Area.
- d) Coal handling plant.
- e) Other Auxiliary Buildings.

For detailed scope, refer Volume III-F of this specification.

17.00.00 Miscellaneous Cranes complete with drives, electrical and all other accessories for the following buildings, as a minimum.

- a) Turbine Hall
- b) Mill building
- c) CW Pump House.
- d) Store Building
- e) ESP Control-cum-Fly Ash Equipment Bldg.
- f) Air Compressor Building

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g) Clarified Water Pump House

h) Fire Water Pump House

i) Coal handling plant

For detailed scope, refer Volume III-F of this specification.

18.00.00 Miscellaneous hoists & Lifting devices complete with drives and accessories for all buildings and facilities, not covered by item 17.00.00 above as also required for handling during operation & maintenance of any equipment weighing above 500 Kg supplied under this specification but not covered by any of the cranes mentioned under item 17.00.00. For detailed scope refer Volume III-F of this specification.

19.00.00 Elevators complete with drives, electricals, control and instrumentation and all other accessories, inclusive of, but not limited to the following facilities.

a) Stack Elevator.

b) Boiler Elevator.

c) Power House Building Elevator.

d) Service Building Elevator

e) Elevators in coal handling plant

For detailed scope refer Volume III-F of this specification.

20.00.00 Not used.

21.00.00 Plant Water System

Raw Water System, Clarified Water System, Potable Water System, Service Water System consisting of all equipment, facilities and auxiliaries but not limited to the following :

a) Rerouting of existing raw water 1200 NB GRP pipe with MS pipe inside plant boundary of approximate length 2 km is under TSGENCO scope. However, the supply of Raw water pumps are under the bidder's scope.

b) Raw Water Reservoir and pump house

c) Intake Valve Chamber modification and extension

d) Coal Handling Plant Dust Suppression system

e) Ash Handling Plant Supply Pumps

f) Service Water Pumps.

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- g) Plant Water Transportation Pumps.
- h) Potable Water Storage Tank
- i) Service Water Storage Tank

For detailed scope refer Volume III-B of this specification.

22.00.00 Water Treatment System

All equipment/system consisting of, but not limited to the following :

- a) River Water Pre-Treatment System
- b) Demineralisation System.
- b) Side Stream Filtration System.
- c) CW Chemical Treatment.
- d) CW Chlorination System.

For detailed scope refer Volume III-C of this specification.

23.00.00 Waste Water Treatment System

- a) Complete Waste Water Treatment System with all equipment and auxiliaries as detailed in Volume III-C.

Bidder to note that the plant will be a Zero Discharge Plant.

- b) Centralised Sewage Treatment System

24.00.00 Coal Handling Plant

Complete Coal Handling Plant including all equipment and auxiliaries as detailed in Volume IV-A..

25.00.00 Ash Handling Plant

Complete Ash Handling Plant including all equipment and systems as detailed in Volume IV-A..

26.00.00 Complete Mill Reject System

27.00.00 H₂, CO₂ and N₂ Gas Cylinders as detailed in Volume III-E.

28.00.00 Complete electrical equipment and accessories as specified under "Electrical Equipment & Accessories – "Volume V-A and Volume V-B" of this bid document.

29.00.00 Complete civil, structural, architectural & building service works, underground and overground, including all design, preparation of design and construction

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drawing for power house, miscellaneous plant buildings & other indoor/outdoor facilities as included in this package including supply of materials, labour, tools & machinery as required. The services shall include but not be limited to the following:

- a) Foundation for all the equipment supplied under this package including installation of anchor bolts, sleeves and other embedded fixtures. Foundation of Turbine generators, TDBFPs located on operating floor, MDBFP located on mezzanine floor, ID fans, FD fans, PA Fans and Coal Mills shall be conventional machine foundations.
- b) Fabrication & erection of all types of steel work as required for buildings, platforms, stairs, ladders, hangers & supports, pipe and cable rack structures, conveyor galleries and trestles, equipment mounting structures, switchyard gantries and towers etc.
- c) Installation of grounding & lightning protection mat for all equipment & building including risers, sub-grids, down conductors, shielding masts etc. as necessary.
- d) Soil investigation of area under this package, Land grading over existing grades as necessary for installation of equipment/structures including provision for retaining walls where required, excavation, backfilling, disposal of excess soil, concrete paving, boulder soling of various areas as specified.
- e) Brickwork, plastering, flooring and floor finish, doors, rolling/ sliding shutters, windows/louvers, internal partitions, glazing, false ceiling, false flooring, external cladding, roof protection, painting, sanitary & plumbing works etc. as specified and necessary for all the buildings constructed under this package.
- f) Permanent & construction roads around power house and other buildings, as well as arterial roads, culverts and area drainage as specified elsewhere in this specification.

Apart from the power house building & mill building the following miscellaneous plant buildings/structures will be required to be constructed under this specification package:

- g) C.W. Pump house with electrical annex including cooling tower, water conveying concrete duct from cooling towers, forebay, etc.
- h) ESP Control-cum-Fly Ash Equipment Building.
- j) Mill Reject System Compressor House, Mill reject Silo
- k) Condensate Transfer RCC Pump House
- l) Pipe and Cable Racks, Trenches & Culverts.
- m) Transformer foundation with fire barrier wall, pits, rails etc.
- n) Fire water storage tanks & fire water pump house including

equipment, foundation & pipe supports with their foundation.

- o) Fire Station Building
- p) Ash Silo , ash dyke and pump-houses and sumps required for ash handling plant
- q) Coal Handling Plant
- r) Chimney
- s) Service building and all other non-plant building and utilities mentioned elsewhere in this specification

The above list is not exhaustive and any building required to be constructed, as incidental to this contract shall be deemed to be included under the scope of the present specification.

For further details refer Volume VII-A & Volume VII-B of this specification.

Set of spares for all plants and equipment for all systems, as recommended by the respective manufacturer/bidder for regular reliable operation of minimum two (2) years. Bidder is to develop recommended list of spare parts with prices by items and this shall be furnished separately in the prescribed format. Sufficient description and drawings are to be provided to permit analysis and evaluation of spares recommended.

Set of tools and tackle, fixtures etc. in new condition, as required for regular operation and maintenance of the plant and equipment offered. Adequate means shall be provided for lifting and handling of each item of plant and equipment including slings etc. Price for such tools & tackle, fixtures etc. shall be furnished separately in the prescribed format.

B. SERVICES TO BE RENDERED BY THE BIDDER

The services to be rendered by the Bidder shall include but not be limited to the following :

- 1.00.00 Dismantling of all existing structures/buildings in colony (excluding the temple) needs to be done by the EPC contractor, and the disposal of the debris is to be made at a distance of about 5 km from the plant site, location of which will be identified by the TSGENCO site engineer.
- 2.00.00 Construction of residential colony including recreation club, hospital building, indoor stadium, shopping complex, STP in residential colony, rain water harvesting structures, potable water treatment plant in colony, Bank building including ATM building
- 3.00.00 Services for complete engineering, co-ordination and project management as detailed in Section-IV of this specification volume. Necessary site survey, measurement, collection of data/detail about existing installations wherever

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- applicable for interfacing with existing plant.
- 4.00.00 Services for shop tests and quality assurance, etc. as detailed elsewhere in this specification.
- 5.00.00 Services for construction, fabrication, equipment erection, testing as well as trial run & commissioning of various equipment and accessories under the contract. The details of such services are indicated in Section-VI of this specification volume. Bidder shall arrange tower crane for erection and construction work, wherever necessary. Moreover, all erection tools and tackle necessary for all the equipment as well as for generator stator handling and erection shall be arranged by the bidder.
- 6.00.00 Supply of all mandatory, erection/commissioning and recommended spares, special tools & tackle including required after-sales services during and after the warranty period.
- 7.00.00 Supply of all consumables required for the works as per provision of respective clauses specified in conditions of contract.
- 8.00.00 Furnishing of all document, drawings, design basis reports, optimization, study reports, instruction manuals, etc. including "As built" drawings, as called for in the specification both in requisite no. of hard copies and in soft form (CD).
- 9.00.00 Operation and Maintenance training.
- 10.00.00 Obtaining approval from statutory bodies in India. However, Owner shall provide assistance to do so.
- 11.00.00 Equipment shop painting.
- 12.00.00 Any other service, although not specifically called for but required for a turn-key contract of the size and nature indicated in this specification.
- 13.00.00 For details of services under clause B, subsequent sections of this Lead specification may be referred.

C. EXCLUSIONS

Raw water intake system, other than modification of the GRP pipe with MS pipe inside plant boundary.

D. TERMINAL POINTS

The terminal points of the complete package to be supplied shall be as follows. For all terminal points scope of this contract shall include making the joint including supply of mating flanges, gaskets, bolts, nuts etc and including any isolation valve. Terminal Points mean Engineering, Procurement and Erection in entirety.

- 1.00.00 Railway line terminal point

For railway line terminal point, refer to RITES report attached.

2.00.00 Plant Water System

Inlet of existing intake valve chamber. However, intake GRP pipe needs to be rerouted/modified by MS pipe as detailed in Volume III-B of this specification.

3.00.00 **Electrical**

400kV Switchyard line take-off gantry (including droppers for line side equipment) for power evacuation through new switchyard/transmission lines.

E. FACILITIES TO BE PROVIDED BY THE OWNER

1.00.00 Land, free of charge as available for the construction of plant.

2.00.00 Construction water shall be provided free of cost at one point.

3.00.00 Employer will arrange power source free of cost at 11 kV level at one point. Street lighting and distribution system to be done by EPC contractor. High mast lighting is to be provided. Adequate lighting from safety point of view is to be provided in the construction area.

4.00.00 Potable/drinking water to be provided at one point.

GENERAL TECHNICAL REQUIREMENTS

CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	CODES AND STANDARDS
2.00.00	RESPONSIBILITY FOR DESIGN
3.00.00	NAME PLATES (RATING PLATES)
4.00.00	SAFETY AND SECURITY
5.00.00	GUARDS
6.00.00	LOCATION AND LAYOUT REQUIREMENTS
7.00.00	OPERATION, MAINTENANCE AND AVAILABILITY CONSIDERATIONS
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10.00.00	LUBRICANTS & CONTROL FLUIDS
11.00.00	OPERATION AND MAINTENANCE
12.00.00	PLANT LIFE AND MODE OF OPERATION
13.00.00	PACKAGING & MARKING
14.00.00	PROTECTION
15.00.00	ENVIRONMENT PROTECTION AND NOISE LEVEL REQUIREMENT
16.00.00	INSPECTION AND TESTING
17.00.00	TRAINING OF OWNER'S PERSONNEL
18.00.00	DEVIATIONS
	ATTACHMENTS
ANNEXURE-I	LIST OF STANDARDS FOR REFERENCE
ANNEXURE-II	CRITERIA FOR LAYOUT

GENERAL TECHNICAL REQUIREMENTS**1.00.00 CODES AND STANDARDS**

1.01.00 Except where otherwise specified, the Plant shall comply with the appropriate Indian Standard or an agreed internationally accepted Standard Specification as listed in the annexure to this Section and mentioned in detailed specifications, each incorporating the latest revisions at the time of tendering. Where no internationally accepted standard is applicable, the Bidder shall give all particulars and details as necessary; to enable the Owner to identify all of the Plant in the same detail as would be possible had there been a Standard Specification.

1.02.00 Where the Bidder proposes alternative codes or standards he shall include in his tender one copy (in English) of each Standard Specification to which materials offered shall comply. In such case, the adopted alternative standard shall be equivalent or superior to the standards mentioned in the specification.

1.03.00 The plant will be designed in compliance with applicable National and International Codes and Standards such as ASME, ASTM, DIN, BS, IEC, IEEE, IS, etc. Wherever specified or required the Plant shall conform to various statutory regulations such as Indian Boiler Regulations, Indian Explosives Act, Indian Factories Act, Indian Electricity Act, Environmental Regulations, etc. Wherever required, approval for the plant supplied under the specification from statutory authorities shall be the responsibility of the Contractor.

1.04.00 In the event of any conflict between the codes and standards referred above, and the requirements of this specification, the requirements, which are more stringent, shall govern.

1.05.00 In case of any change of code, standards and regulations between the date of purchase order and the date the Contractor proceeds with manufacturing the Owner shall have the option to incorporate the changed requirements. It shall be the responsibility of the Contractor to advise Owner of the resulting effect.

1.06.00 Successful Bidder to furnish two (2) sets of latest of national/inter-national codes and standards to owner.

2.00.00 RESPONSIBILITY FOR DESIGN

2.01.00 The Contractor shall assume full responsibility for the design of the whole and every portion of the Plant, whether or not the design work was undertaken specifically in relation to the Contract and whether or not the Contractor was directly involved in the design work.

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- 2.02.00 Notwithstanding the Owner's wish to receive the benefits of new, advanced and improved technologies, a prime requirement is that all the systems and components proposed shall have been already adequately developed and shall have demonstrated good reliability under similar, or more arduous conditions elsewhere, at least for continuous 2 years in two different power station.
- 2.03.00 The successful bidder shall have to carry out surge analysis, BFP transient analysis and other transient condition studies as may be necessary and as required by the Owner as per proven engineering practice.
- 2.04.00 The Bid shall include a detailed discussion on the development status of, and the reasons for any changes made in proposed systems or components for the Plant, as compared with similar items previously supplied in other installations cited by the bidder as reference plants.
- 2.05.00 The Bidder may also make alternate offers, provided such offers are superior in his opinion in which case adequate technical information, operating feed back, etc. are to be enclosed with the offer, to enable the Owner to assess the superiority and reliability of the alternatives offered. In case of each alternative offer, its implications on the performance, guaranteed efficiency, auxiliary power consumptions, etc. shall be clearly brought out to the Owner to make an overall assessment. In any case, the base offer shall necessarily be in line with the specifications i.e. Base offer shall be as per the technical specifications and the same will be considered for techno-commercial evaluation.
- 3.00.00 **NAME PLATES (RATING PLATES)**
- 3.01.00 Instruction plates, name plates or labels shall be permanently attached to each main and auxiliary item of plant in a conspicuous position. These plates shall be engraved with the identifying name, type and manufacturers serial number, together with the loading conditions under which the item of plant has been designed to operate.
- 3.02.00 Items such as valves, etc. which are subject to hand operation, shall be provided with nameplates so constructed as to remain clearly legible throughout the life of the plant giving due consideration to the difficult climatic conditions to be encountered. Nameplates shall be securely mounted where they will not be obscured in service by insulation, cladding, actuators or other equipment. Direction of flow is also to be engraved.
- 3.03.00 All trade nameplates and labels shall be in English language. All measurements shall be in M.K.S. Units.
- 3.04.00 The size and location of nameplates shall be subject to Approval of the Engineer.
- 4.00.00 **SAFETY AND SECURITY**
- 4.01.00 The design shall incorporate every reasonable precaution and provision for the safety of all personnel and for the safety and security of all persons and

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- property. The design shall comply with all appropriate statutory regulations relating to safety. All structures and equipment shall be designed and constructed to withstand every foreseeable static and dynamic loading condition, including loading under earthquake conditions, with an adequate margin of safety.
- 4.02.00 Ready and safe access with clear head room shall be provided to all parts of the plant for operation, inspection, cleaning and maintenance.
- 4.03.00 Escape routes and clear ways shall be provided to allow speedy evacuation of the plant in the event of fire or explosion, and the plant layout shall allow for ease of access to all parts of the Works by rescue and fire fighting teams. The plant layout shall be designed to localise and minimise the effects of any fire or explosion. The recommendations of NFPA, OSHA, and TAC etc. as necessary shall be followed in all respects.
- 4.04.00 The use of corrosive, explosive, toxic or otherwise hazardous materials shall be kept to a minimum during construction and the design of the plant shall minimise the requirement for such materials during operation and maintenance. Where such materials must be used, all necessary precautions shall be taken in the design, manufacture and layout of equipment to minimise the resulting hazard, and all equipment necessary for the protection and first-aid treatment of personnel in the event of accidents shall be provided. Particular attention is drawn to avoid the use of materials containing asbestos in any form.
- 5.00.00 **GUARDS**
- 5.01.00 Effective guards and fences must be provided to prevent injury to operators through accident or malpractice.
- 5.02.00 Mesh guards which allow visual inspection of equipment with the guard in place are generally preferable. The guards shall be constructed of mesh attached to a rigid framework of mild steel rod, tube, or angle and the whole galvanised to prevent loss of strength by rusting or corrosion. The guards shall be designed to facilitate removal and replacement during maintenance.
- 5.03.00 All drive belts, couplings, gears, sharp metallic edges and chains must be safely guarded. Any lubricating nipple requiring attention during normal running must be positioned where they can be reached without moving the guards.
- 5.04.00 Guards for couplings and rotating shafts shall be in accordance with BS 5304-1975 or similar approved standard. All rotating shafts and parts of shafts must be covered.
- 5.05.00 Suitable fencing shall be provided to enclose all openings or doorways used for the hoisting and lowering of machinery etc. This fencing must be securely fixed but quickly detachable when required. A secure hand hold must be provided on each side of the opening or doorway.

6.00.00 **LOCATION AND LAYOUT REQUIREMENTS**

The majority of plant and equipment (excluding steam generator and some other auxiliaries) shall all be of indoor installation. A broad list of buildings housing such equipment is given elsewhere in this specification. Layout should facilitate access for operation-maintenance and inspection of any one or more equipment/components at a time without disturbing the operation or installation of rest of the plant. Further, Bidder should comply with the criteria given under the various equipment and system specifications as well as those stipulated in Annexure-II attached to this section.

Enclosed General Layout and other tender layout drawings show the location of major installations and auxiliary buildings. The Bidder shall try to retain these locations as far as practicable. The layout of equipment within the power house as shown in the tender drawings is indicative. The Bidder may, subject to Owner's approval alter the same to suit the space requirement of the equipment offered.

Bidder may give as an alternative his own preferred layout clearly indicating the advantages and other implications, if any. Such alternative will not be considered for evaluating the bid, but may be considered with the successful Bidder if Owner/Engineer finds the proposal more attractive in terms of techno-economic consideration.

While developing the layout of buildings the following criteria shall be given effect :

- a) The minimum width of clear access corridors around equipment shall be 1.2 meter.
- b) Each building shall have an identified vacant space for equipment unloading and maintenance and preferably a separate bay altogether in buildings housing heavy equipment. Provision for handling equipment by monorail hoist and/or overhead crane shall be made as specified.
- c) The minimum clear height available between two consecutive floor slabs shall not be less than five (5) meters. A clear head room of 2.5m shall be maintained between the floor and any overhead piping/ cables or other obstruction. Adequate provision for natural ventilation and illumination shall be made as per good engineering practices.
- d) There shall be at least two (2) nos. main access doors, one on either side of each building, of which one shall be minimum 3 meters wide with rolling shutters for equipment entry. For multistoried buildings, at least two (2) nos. regular staircases diagonally opposite to each other shall be provided connecting all the floors and roof. These minimum requirements shall be augmented as required depending on the floor area, statutory requirements and TAC recommendations.
- e) All buildings shall have provision for toilet and associated effluent discharge system together with facility for drinking water. The criteria for ventilation, fire protection and illumination of building spaces specified

elsewhere in this specification shall be complied with.

- f) All rail/road crossings for pipe/cable racks shall be done with minimum 8 meters headroom from top of rail/road to bottom of rack. Similarly top cover over underground pipes/cables shall be minimum one (1) meter. For other detail refer to Annexure-II.
- g) Cubicle for operating personnel shall be located at safe place near the equipment.
- h) Interplant cable routing will be on overhead cable trays on pipe cum cable trestle or on cable trestle except where approved by purchaser/consultant. In exceptional case, small stretch of outdoor run of interplant cable routing may be taken through cable trench only with the Employer's prior approval.
- i) Concept of various mechanical and electrical equipment location and building dimensions (including column-row spacing) as shown in Plot Plan/Floor Plan drawing are to be adhered to. Any departure from this suggestive layout is primarily not recommended.

7.00.00 OPERATION, MAINTENANCE & AVAILABILITY CONSIDERATIONS

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

7.02.00 Ample space for ease of operation and maintenance including equipment removal, tube bundle/cartridge/rotor pulling etc. shall be provided. All valves, gates, dampers and other devices shall be located and oriented in such a way that they are accessible from operating floor levels. Where this cannot be adhered to, platforms and walkways with access ladders shall be provided to facilitate operation and maintenance.

7.03.0 Motorised lifting devices, i.e. hoists, chain pulleys, jacks, etc. shall be provided for handling and carrying out maintenance of any equipment and/or part having weight in excess of 3000 Kg. Suitable beams, hooks etc. for this purpose shall be provided in the buildings.

No lifting arrangement is necessary for part having weight less than 500 Kg. Hoist shall be well protected by environment. Suitable painting and coating covering hoist at outdoor shall be provided.

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

7.04.00 All similar parts of the equipment shall be made to gauge and shall be interchangeable with and shall be made of same material and workmanship as the corresponding parts of the equipment. Where feasible common

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components shall be employed in different pieces of equipment in order to optimize the spares inventory and utilization.

8.00.00 MATERIALS

8.01.00 In selecting materials of construction of equipment, the Contractor shall pay particular attention to the atmospheric conditions existing at the Site and the nature of material/fluid handled. Wherever deviations are taken in respect of materials specified, the reasons shall be spelt out clearly in the proposal.

All materials shall be new, and shall be of the quality most suited to the proposed application.

8.02.00 In as far as is possible; materials shall be in accordance with Indian or international standard specifications and shall be used in accordance with Indian or international codes of practice. Where such standards or codes of practice are not available sufficient information shall be provided to allow the Owner to assess the suitability of the material for the particular application.

All materials used shall have performed lengthy satisfactory service in similar or more arduous conditions to those proposed by the Contractor.

8.03.00 All parts which could deteriorate or corrode under the influence of the atmospheric, meteorological or soil conditions at the Site, or under the influence of the working conditions shall be suitably and effectively protected so that such deterioration or corrosion is a minimum over the life of the plant.

9.00.00 LUBRICATION

9.01.00 Provision shall be made for suitable efficient lubrication where necessary to ensure smooth operation free from undue wear.

9.02.00 Non ferrous capillary tubing shall be used throughout.

9.03.00 Gear boxes and oil baths shall be provided with filling and drain plugs, both of adequate size. An approved means of oil indication including level switches and temperature indication shall be provided.

9.04.00 All high speed gears shall be oil bath lubricated. Low speed gears shall be lubricated by means of soft grease. Removable and accessible drip pans shall be provided to collect lubricant which may drop from operating parts.

9.05.00 All lubrication points shall be conveniently situated for maintenance purposes. It must be possible to carry out lubrication from a gangway or landing and without the removal of guarding or having to insert the hand into it. Where accessibility to a bearing for oiling purposes would be difficult a method of remote lubrication shall be fitted.

9.06.00 The Contractor shall supply grease gun equipment suitable to service each type of nipple fitted.

- 10.00.00 **LUBRICANTS AND CONTROL FLUIDS**
- 10.01.00 The Contractor shall provide a detailed and comprehensive specification for all lubricating oils, greases and control fluids required for the entire plant. A sufficient supply of these shall be provided by the Contractor for initial commissioning, first fill and till COD of the unit.
- 10.02.00 The Contractor shall supply a detailed schedule giving the lubricant testing, cleaning and replacement procedures. All equipment and facilities necessary for the testing, cleaning and changing of lubricants and control fluids shall be provided. The Contractor shall endeavor to reduce the varieties and grades of required lubricants and control fluids to a minimum, matching them where possible to those already in use in the generating station in order to simplify procurement and minimise storage requirements. All lubricants and control fluids shall be of internationally recognised standards and shall be easily obtainable from a large number of Indian suppliers. Bidder shall also indicate the equivalent Indian Standard for the above for easy procurement in future.
- 10.03.00 No lubricant or control fluid shall have toxic or other harmful effects on personnel or on the environment.
- 11.00.00 **OPERATION AND MAINTENANCE**
- 11.01.00 The plant shall be designed and constructed so that operation and maintenance manpower requirements are minimised.
- The design and layout shall facilitate inspection, cleaning, maintenance and repair. The importance of continuity of operation is second only to that of safety.
- 11.02.00 Spare parts for equipment shall be interchangeable with the original components and, so far as possible, be of common design and manufacture.
- 11.03.00 All similar standard components/parts of similar standard equipment provided shall be interchangeable with one another. Further identical equipments shall be provided for similar duties so that the same are interchangeable with one another in totality and component wise.
- 11.04.00 All heavy parts (500 Kg and above) must be provided with a convenient arrangement for slinging and handling during erection and overhaul. Any item of plant normally stripped or lifted during periods of maintenance and weighing one tonne or above, shall be clearly marked with its weight.
- 11.05.00 On completion of commissioning, a complete set of tools for the maintenance of the entire plant shall be provided by the Contractor. This shall include all necessary spanners, special wrenches, extraction equipment and any special tools reasonably required by the Engineer. Tools used during erection and commissioning shall not be accepted except with the specific approval of the Engineer.
- 11.06.00 All equipment and major valves should be provided with adequate maintenance approach and facility.

12.00.00 **PLANT LIFE AND MODE OF OPERATION**

The complete plant including all the equipment and systems individually and collectively shall be designed for continuous operation for an economic service life of thirty (30) years under the prevailing site conditions and for the type of duty intended.

The critical components of the Steam Generator, Turbine-Generator and Auxiliary equipment, the life of which is limited by time and temperature dependent mechanisms such as thermal stress, creep and low cycle fatigue, are to be designed considering expected (hot, warm and cold) start-up, shut-down and cyclic load variations.

The allowable stresses shall be reduced so that life expectancy to minimum 2,00,000 hours of operation can be achieved. The Bidder shall discuss this aspect in his technical proposal.

The unit would be operated on base load with cyclic load variation. The load variation is expected to be as per schedule depending on power demand.

The expected start-ups should be considered as minimum
 (Based on HPT metal temperature)

Cold start-up (>72 hrs. shutdown)	:	6 per year
Warm start-up (between 10 to 72 hrs. of shutdown)	:	40 per year
Hot start-up (less than 10 hrs. shutdown)	:	160 per year

13.00.00 **PACKAGING & MARKING**

All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. While packing all the materials, the limitations from the point of view of availability of railway wagon sizes in India should be taken account of. The details of various wagons normally available with Indian Railways for transportation of heavy equipment shall be considered by the Bidder. The Contractor shall be responsible for all loss or damage during transportation, handling and storage due to improper packing.

As per the information available, the dimensions of OD consignment for transportation of the equipment by rail (if any equipment to be handled through rail transportation) are as below :

a)	Width of the Package (from centre-line of rails - 1.6 metres on both sides)	:	3.2 Meters
b)	Height of the package from rail top	:	4.47 Meters

The above indicates the dimensions which can be normally transported on the

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wagons without infringement of the "moving gauge". This is however not indicative of the consignment which can be carried out with infringement of "moving gauge" duly authorised and approved by the Indian Railways. There may be difference between the "moving gauge" and the "fixed structure gauge" and consignments infringing the "moving gauge" can be moved after investigation regarding possible infringement with the fixed structures. As the critical fixed structures in each route are different, consignments infringing moving dimensions have to be individually investigated to select a route and also determine the restrictions under which such movement is to be carried out. Such routes selected or other mode of transport envisaged is to be clearly brought out in the proposal wherever transport of over dimensional equipment is involved.

Bidder to consider unloading of material delivered through rail transportation, at near by railway station/ site unloading siding. The subsequent transportation up to project work place shall be considered by road only. All unloading and handling equipment both at railway station siding and at project site shall be arranged by the Bidder. Necessary arrangement to be organized with the railway authority for such purpose shall also be under the scope of services of the Bidder. Bidder may consider entire material delivered up to site through rail transportation only.

The identification marking indicating the name and address of the consignee shall be clearly marked in indelible ink on two opposite sides and top of each of the packages. In addition the Contractor shall include in the marking gross and net weight, outer dimension and cubic measurement. Each package shall be accompanied by a packing note (in weather proof paper) quoting specifically the name of the Contractor, the number and date of contract and names of the office placing the contract, nomenclature of contents and Bill of Material.

For imported equipment and material, suitable port facilities may be used in which case material may be transported from the port by tractor-trailer. Bidder may consider this aspect.

14.00.00 PROTECTION

Equipment having antifriction or sleeve bearings shall be protected by weather-tight enclosures. Coated surfaces shall be protected against impact, abrasion, discoloration and other damages. Surfaces that are damaged shall be repainted.

Electrical equipment, controls and insulations shall be protected against moisture and water damages. All external gasket surfaces and flange faces, couplings, rotating equipment shafts, bearings and like items shall be thoroughly cleaned and coated with rust preventive compound as specified above and protected with suitable wood, metal or other substantial type covering to ensure their full protection. All exposed threaded parts shall be greased and protected with metallic or other substantial type protectors.

All piping, tubing and conduit connections on equipment and other equipment openings shall be closed with rough usage covers or plugs. Female threaded openings shall be closed with rough usage covers or forged steel plugs. The closures shall be taped to seal the interior of the equipment. Open ends of

pipings, tubing and conduit shall be sealed and taped.

Returnable containers and special shipping devices shall be returned by the manufacturer's field representative at the Contractor's expense.

15.00.00 **ENVIRONMENT PROTECTION AND NOISE LEVEL REQUIREMENT**

15.01.00 **Environment Protection**

The plant shall be designed for installation and operation in harmony with the surrounding environment and all measures of pollution control shall be ensured by the Bidder to restrict pollution from the liquid effluent and stack emission within the limits as given below with due consideration of Environment (Protection) Rules 1986 as amended till date.

In case the Ministry of Environment & Forest stipulate any other conditions not specified hereunder while clearing the project shall be complied with the plant by the contractor.

15.01.01 For Liquid Effluent

- a) Provision laid down in schedule-I for Thermal Power Plants and also in Schedule-VI. General Standards for discharge of Environmental pollutants Part-A : Effects of Environmental (protection) Rules 1986, as amended till date.
- b) Any specific requirement of State Pollution Authorities over and above the above stipulation.

15.01.02 For Air Emission

- a) Suspended Particulate Matter i.e. dust burden at chimney outlet - Maximum 50 mg/Nm³ (with worst coal and one field out at TMCR).
- b) NO_x - 365 ppm Max. or 750 mg/Nm³ (Equivalent NO₂).
- c) SO₂ - Concentration based standard 2000 mg/Nm³. Load based standard 0.2 metric tonne /MWe/day (for first 500 MW and 0.1 metric tonne/MWe/day for rest of the capacity above 500 MW)

In absence of Indian Standard for emission from power plants as on date, for certain gaseous effluents, the internationally accepted World Bank Standard is to be followed. Indian Standard for emission of power plants are under formulation. Should this standard is published before finalisation of the contract, the bidder has to comply the more stringent of the above norm or the new Indian Standard.

The bidder shall include in his scope all necessary equipment and measuring instruments to comply with above requirements. Location and accessibility of the instruments shall be properly coordinated.

15.02.00 Noise Level Requirement

The plant will be designed, constructed and provided with suitable acoustic measures to ensure the noise level criteria as per the following stipulations.

- a) Maximum noise level shall not exceed 85 dB (A) when measured at 1.0M away from the noise emission source.
- b) Maximum noise level from its source within the premises shall not exceed 70 dB (A) as per Environment (Protection) Rules 1986, Schedule-III, 'Ambient Air Quality Standards' in respect of noise.
- c) Any statutory changes in stipulations regarding noise limitation that may occur in future according to State Pollution Control Board or Central pollution Control Board or Ministry of Environment & Forest regulation during tenure of the contract, the contractor shall comply with the requirement.

An exception will be made for the plant at startup operations and other big pressure reducing devices operating during emergency periods and for the safety valves.

16.00.00 INSPECTION AND TESTING**16.01.00 Inspection and Tests during Manufacture**

- 16.01.01 The method and techniques to be used by the Contractor for the control of quality during manufacture of all plant and equipment shall be agreed with the Owner prior to the Award of Contract.
- 16.01.02 The Owner's general requirements with respect to quality control and the required shop tests are set out elsewhere in this specification.
- 16.01.03 Before any item of plant or equipment leaves its place of manufacture the Owner shall be given the option of witnessing inspections and tests for compliance with the specification and related standards.
- 16.01.04 Advance notice shall be given to the Owner as agreed in the Contract, prior to the stage of manufacture being reached, and the piece of plant must be held at this stage until the Owner has inspected the piece, or has advised in writing that inspection is waived. If having consulted the Owner and given reasonable notice in writing of the date on which the piece of plant will be available for inspection, the Owner does not attend the Contractor may proceed with manufacture having forwarded to the Owner duly certified copies of his own inspection and test results.

The Contractor shall forthwith forward to the engineer duly certified copies of the Test Certificates in six copies (one to the Purchaser and five to the Consulting Engineer) for approval. Distribution of six (6) copies of Test Certificates for approval will be two(2) copies to owner and four(4) copies to consultant. These four(4) copies will be further distributed by consultant after approval to owner, site and bidder. One copy will be retained with the

consultant for record purpose.

Further, nine (9) copies of Shop Test Certificates shall be bound with Instruction Manuals referred to elsewhere. Distribution of nine (9) copies of Shop Test Certificates for approval will be Two (2) copies to owner, Three (3) copies to site, Two (2) copies to consultant, Two (2) copies to owner's library / record.

- 16.01.05 Under no circumstances any repair or welding of castings be carried out without the consent of the Owner's Engineer. Proof of the effectiveness of each repair by radiographic and/or other non-destructive testing technique, shall be provided to the Engineer along with Defect Map.
- 16.01.06 All the individual and assembled rotating parts shall be statically and dynamically balanced in the works.
- Where accurate alignment is necessary for component parts of machinery normally assembled on site, the Contractor shall allow for trial assembly prior to despatch from place of manufacture.
- 16.01.07 All materials used for the manufacture of equipment covered under this specification shall be of tested quality. Relevant test certificates shall be made available to the Purchaser. The certificates shall include tests for mechanical properties and chemical analysis of representative material or any other test as required by approved QAP/ Material specification.
- 16.01.08 All pressure parts connected to pumping main shall be subjected to hydraulic testing at a pressure of 150% of shut-off head for a period not less than one hour. Other parts shall be tested for one and half times the maximum operating pressure or as required by design code of that part, for a period not less than one hour.
- 16.01.09 All necessary non-destructive examinations shall be performed to meet the applicable code requirements.
- 16.01.10 All welding procedures adopted for performing welding work shall be qualified in accordance with the requirements of Section-IX of ASME code or IBR as applicable. All welded joints for pressure parts shall be tested by liquid penetrant examination according to the method outlined in ASME Boiler and Pressure Vessel code. Radiography, magnetic particle examination magniflux and ultrasonic testing shall be employed wherever necessary/recommended by the applicable code. At least 10% of all major butt welding joints shall be radiographed.
- 16.01.11 Statutory payments in respect of IBR approvals including inspection for design and manufacturer of equipment shall be made by the Bidder. All payment for erection and testing at site (i.e. under IBR jurisdiction) shall also be made by the Bidder. In such case Contractor's scope shall also be extended to preparation of all necessary documents, co-ordination and follow-up with IBR authorities for above approval.
- 16.02.00 **Performance Tests at Site**

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- 16.02.01 The full requirements for testing the system shall be agreed between the Owner and the Bidder prior to Award of Contract. The completely erected System shall be tested by the Contractor on site under normal operating conditions. The Contractor shall also ensure the correct performance of the System under abnormal conditions, i.e. the correct working of the various emergency and safety devices, interlocks, etc.
- 16.02.02 The Bidder shall provide complete details of his normal procedures for testing, for the quality of erection and for the performance of the erected plant. These tests shall include site pressure test on all erected pipe work to demonstrate the quality of the piping and the adequacy of joints made at site.
- 16.02.03 The Contractor shall furnish the quality procedures to be adopted for assuring quality from the receipt of material at site, during storage, erection, pre-commissioning to tests on completion and commissioning of the complete system/equipment.
- 16.03.00 For details of specific tests required on individual equipment refer to respective section of this specification.

17.00.00 TRAINING OF OWNER'S PERSONNEL

The Contractor shall extend all possible assistance and co-operation to the Purchaser regarding the transfer of technology and developing expertise in the area of engineering operation and maintenance of the Plant.

Number of man-days of training as mentioned below shall be included in his Tender.

17.01.00 Training at Contractor's Premises

The Contractor shall conduct training of sixty (60) engineers of the Owner on engineering, operation and maintenance of the Plant at the Contractor's or Associates or Sub-contractor's premises where adequate training facilities are available during the design and manufacturing stage of the Contractor.

The total man-months for training of engineers shall be maximum sixty (60), having following indicative break-up :

Discipline	No. of Engineers	No. of Man-month
Operation	20 heads	20
Maintenance Boiler, Turbine, Mechanical	20 heads	20
Electrical Maintenance	8 heads	4
Control & Instrumentation	8 heads	4
Maintenance Planning	4 heads	2
	-----	-----

60 heads
-----60

However, the details of the training programme will be discussed and finalised with the successful Bidder.

The training may also be arranged by the Contractor in any Plant where the equipment manufactured by the Contractor or his Associates is under installation, operation or testing to enable the trainees to become familiar with the equipment being furnished by the Contractor. All expenses inherently related to the training shall be borne by the Contractor and shall include but not limited to travel expenses (international and inland fares), lodging and per diem charges as well as medical insurance, instructors fee, programme and miscellaneous cost to be incurred during the training.

The training programme shall be adequate for the trainees to acquire the necessary expertise and competence in the area of engineering, operation and maintenance and as trainers for in-house technology transfer programme of the Purchaser.

The Contractor shall be responsible for the development of the Training Module and Programme Schedule which shall be submitted to the Purchaser for approval.

The components of the training modules shall include but not be limited to the training procedures/methodology, instructional materials such as audio visual materials, CDs and slides and manuals for each trainee.

Three (3) sets of the materials included in the training modules shall be handed over to the Purchaser upon completion of the training. An evaluation shall be jointly undertaken by the Contractor and the Purchaser's representative on the adequacy, appropriateness and relevance of the training and the programme effectiveness after the training. The training material shall be in English language only.

The content of the training programme shall include but not be limited to:

1. Coal fired thermal plant principles in management and practice for operators, technicians and maintenance personnel.
2. Plant operation and systems training for operators including simulator training as applicable.
3. Maintenance training programme covering electrical, mechanical and instrumentation and control.

Said training programme shall be submitted to the Purchaser for approval.

The timing of the training should be such that the participants will be conversant with sufficient know-how to participate in the pre-commissioning and commissioning tests of the Plant.

The Contractor shall provide qualified English speaking instructors and training

coordinator(s) during the tenure of the training programme.

17.02.00 Operation and Maintenance Training at Site

The Contractor shall provide a comprehensive training programme related to design application, plant management, operation and maintenance, including trouble shooting, of the Contractor's supplied system and equipment at the Site starting from Start of Commissioning and thereafter up to the Final Acceptance of the first Unit.

The following instructors shall be at the Site continuously during the training :

- a) One (1) for Steam Generator and Auxiliaries ;
- b) One (1) for Turbine Generator and Auxiliaries ;
- c) One (1) for Electrical Works ;
- d) One (1) for Instrumentation and Control (Boiler and Auxiliaries) ;
- e) One (1) for Instrumentation and Control (Turbine and Auxiliaries).

17.03.00 On-the-Job Training

During the period of pre-commissioning, commissioning and trial operation, the Purchaser shall provide operation and maintenance personnel to assist the Contractor in the operation and maintenance of his supply and work under the direction of the Contractor for the purpose of on-the-job training.

The Purchaser shall have the right to send to the Site his employees later intended to operate and maintain the equipment supplied under this Contract. The Contractor shall, without additional cost, use his site staff to instruct these employees on the operation and maintenance of the equipment. All instructions shall be in the English language.

17.04.00 For detail C&I training refer to Volume-VI, Section-9.

18.00.00 DEVIATIONS

The Bidder is required to submit with his proposal in the relevant schedules a detail list of any and all deviations taken by him clearly without any ambiguity. In the absence of such a list it will be understood and agreed that the Bidder's proposal is based on strict conformance to this specification and no post-contract negotiations would be allowed in this regard.

Unless otherwise specifically indicated in the deviation list, it will be construed and agreed that details indicated in documents & drawings furnished by the Bidder along with the offer is in-line with the specification requirement.

ANNEXURE-I**LIST OF STANDARDS FOR REFERENCE**

- a) International Standards Organisation (ISO).
- b) International Electro-technical Commission (IEC).
- c) American Society of Mechanical Engineers (ASME).
- d) American National Standards Institute (ANSI).
- e) American Society for Testing and Materials (ASTM).
- f) American Institute of Steel Construction (AISC).
- g) American Welding Society (AWS).
- h) Architecture Institute of Japan (AIJ).
- i) National Fire Protection Association (NFPA).
- j) National Electrical Manufacturer's Association (NEMA).
- k) Japanese Electro-technical Committee (JEC).
- l) Institute of Electrical and Electronics Engineers (IEEE).
- m) Federal Occupational Safety and Health Regulations (OSHA).
- n) Instrument Society of America (ISA).
- o) National Electric Code (NEC).
- p) Heat Exchanger Institute (HEI).
- q) Tubular Exchanger Manufacturer's Association (TEMA).
- r) Hydraulic Institute (HIS).
- s) International Electro-Technical Commission (IEC) Publications.
- t) Power Test Code for Steam Turbines (PTC).
- u) Applicable German Standards (DIN).
- v) Applicable British Standards (BS).
- w) Applicable Japanese Standards (JIS).

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- x) Electric Power Research Institute (EPRI).
 - y) Standards of Manufacturer's Standardization Society (MSS).
 - z) Bureau of Indian Standards Institution (BIS).
 - aa) Indian Electricity Rules.
 - bb) Indian Boiler Regulations (IBR).
 - cc) Indian Explosives Act.
 - dd) Indian Factories Act.
 - ee) Tariff Advisory Committee (TAC) rules.
 - ff) Emission regulation of Central Pollution Control Board (CPCB).
 - gg) Pollution Control regulations of Dept. of Environment, Govt. of India
 - hh) Central Board of Irrigation and Power (CBIP) Publications.
 - ii) The Air Prevention and Control of Pollution Act.
 - jj) The Environmental Protection Act
 - kk) The Public Liability Insurance Act.
 - ll) The Forest Conservation Act
 - mm) The Wildlife protection Act.
 - nn) The EIA Notification, 1994.
 - oo) IS: 14665-Specification for Electric Traction Lift
 - pp) Any other statutory Codes/Standards/Regulations

ANNEXURE-II**CRITERIA FOR LAYOUT****PLOT PLAN LAYOUT REQUIREMENTS**

ITEM	SPECIFICATION REQUIREMENT
A. Site conditions to be considered	
1. Prevalent wind direction	See wind-rose in plot plan. Also refer Metrological Data.
B. Layout Requirements	
1. Maximum permissible slope in	
a) Rail track	1 in 400
b) Road	1 in 30
c) Sides of unpaved embankment	1 in 2
2. Required road width	
a) Main roads	Refer VII-A, B, C.
b) Auxiliary interconnections	Refer VII-A, B, C.
c) Road to the power house unloading bay :	
• Only for entry to the unloading bay	Yes
• To pass through the unloading bay	No
3. Required minimum horizontal distance between the nearest points of	
a) Plant boundary and the boundary of residential area	(Local municipality/factory rule)
b) Electrical transformer and any other building/facility	As per the Tariff Advisory Committee/ LPA Rules
c) Fire water supply installation and any building/facility subject to fire risk.	As per the Tariff Advisory Committee/ LPA Rules
d) Inflammable liquid (fuel oil, etc.) storage & handling installation and their fencing and other buildings/facilities.	Rules of the Indian Explosive (Indian Explosives Act) and Indian Petroleum Code

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ITEM	SPECIFICATION REQUIREMENT
4.	Required minimum vertical clearance
a)	Under pipes/cable racks at road crossings 8.0 Metres
b)	Soil coverage over underground pipes 1.0 Metre (minimum)
5.	Railway Wagon clearance Rules of the Indian Railways
6.	Minimum Clearance between any road edge and building/structure/ any fixed installation. 3 Metres
7.	Required level, above the local developed grade level, of
a)	top of all roads 150 mm above FGL
b)	all outdoor paved areas 100 mm above FGL
c)	Temporary storage areas, workshops, offices, residence etc. required at the time of erection work. Yes
d)	Green belt around power plant area As per environmental guidelines of MOEF, Govt. of India.

BUILDING/ EQUIPMENT LAYOUT REQUIREMENTS

A.	Minimum clear space required at all working and walking areas for operating & maintenance personnel
1.	Horizontal, in all directions
a)	Adjacent to any electrical equipment, electrical cables, running (rotating/reciprocating) equipment, safety valve or vent/drain pipe outlet, pipe/ equipment of surface temperature exceeding 60°C. 1200 mm
b)	Adjacent to any other plant facilities (including walls/structures) 1000 mm
2.	Vertical (head-room clearance)
a)	Under any pipe/equipment surface of temperature exceeding 60°C and any electrical cables or other electrical items. 2.5 Metre
b)	Under any other plant facilities (including structures, pipes etc.) 2.5 Metre

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ITEM	SPECIFICATION REQUIREMENT
3. For all areas where any equipment (including trucks, trolleys and other material handling equipment) will move or maneuver.	Minimum 500 mm clear in all direction from the outer edges of the equipment
4. Minimum clear hand space required for	
a) The application of thermal insulation	100 mm
b) Welding work	150 mm
c) Bolt tightening	150 mm
B. Floors, platforms, staircase, ladders, walls, doors & windows	
1. Statutory Requirement	As per the regulations of Tariff Advisory Committee, Indian National Building Code, Indian Factories Act, Local Municipal Rules, etc.
2. Operation & Maintenance Requirement	
a) Adequate floor space shall be kept to permit dismantling, temporary storing and in-situ maintenance of plant & equipment parts, satisfying the clear space requirements stated above. A separate unloading bay for such purpose is required.	Yes
b) Floors or fixed/portable platforms with stairs/ ladders shall be provided for easy approach to any plant item, including valves, instruments, etc. to be operated, observed and/or to be frequently (more than once a month) maintained.	Yes
3. Plinth level of all buildings, above the finished grade level	500 mm
4. Minimum access opening required (with rolling shutter) for transportation, wherever entry of truck for material handling is envisaged	3.5M wide x 4M high or, more depending upon the equipment size to be handled.

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ITEM	SPECIFICATION REQUIREMENT	
C.	Other Maintenance Requirement	
1.	Generator stator handling In case the Generator stator cannot be handled by the turbine house crane, all provisions for its overhauling, including the arrangement to slide the stator on the turbine house floor, the foundation work for stator jacking /lowering assembly, dismantling of building end walls/structures etc. shall be kept.	Yes
2.	Maintenance of the internals/impellers of all important equipment, like boiler feed pumps, feed water heaters, Surface Condenser, fans of the boiler draft plant, Intake and circulating water pumps, cooling water pumps, coal mills, compressors, blowers, heat exchangers, fuel oil pumps, filters etc.	Shall be possible without disconnecting or dismantling any piping/ducting.
3.	Overhauling and handling of the casings for the above items	Shall be possible without disturbing/dismantling any piping/ducting not directly connected to them.
4.	Crane Approach Wherever required the unobstructed approach of the crane hook/other hoisting equipment hook to various plant & equipment shall be possible.	Yes
D.	Central Control Room All electronic equipment other than those directly associated with control, operation or presentation of displays shall be mounted external to the control room in air conditioned control equipment room. The bidder shall describe in his bid the proposed layout philosophy of the Central Control Room and Control Equipment Room and the arrangement of equipment best suited for the system offered by him and as per good ergonomically consideration. However, as a guide line, following features are given :	Yes
a)	False ceiling and false flooring shall be provided.	
b)	Uniform height, colouring schemes for cabinets etc. shall be available.	

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ITEM	SPECIFICATION REQUIREMENT
c) The total area of floor space covered by Control Consoles/Panels in the Control Room shall not exceed 15% of floor area.	
d) No opening shall be provided from Boiler side.	
e) Two double leaf doors, suitably located for entering the Control room shall be provided with opening towards the turbine floor.	
f) Cable entry for the panels/consoles shall be from bottom and suitable openings shall be provided.	
g) The Control Room lighting shall be designed to provide a glare free uniform illumination. The level of illumination shall be minimum 400 LUX.	
h) Necessary Air Conditioning shall be provided for Central Control room, Control Equipment Room and SWAS room etc.	
i) Basic amenities like toilet, Tiffin rooms, wash basins, rest rooms etc. shall be provided near the Control Room.	
E. Toilet and drinking water facility	Required in all buildings and on all floors wherever operating personnel are to be deployed.

PROJECT MANAGEMENT AND SITE SERVICES

CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	PROJECT MANAGEMENT SERVICES
2.00.00	SITE SERVICES
3.00.00	PROJECT INFORMATION AND MANAGEMENT SYSTEM, INCLUDING DOCUMENT MANAGEMENT SERVER (DMS)

PROJECT MANAGEMENT AND SITE SERVICES**1.00.00 PROJECT MANAGEMENT SERVICES****1.01.00 Responsibility**

The Bidder shall identify a separate and independent project management team headed by a Project Manager for the execution of this project. Responsibilities of this project Management team shall cover the areas listed below :

- a) Planning and Monitoring
- b) Engineering Management
- c) Contracts Management
- d) Project Safety Management
- e) Quality Assurance, Inspection & Expediting
- f) Construction Management
- g) Spares Management
- h) Erection & Commissioning Management

Detailed responsibilities in the above areas are discussed below :

1.02.00 Organisation**1.02.01 Headquarters**

The headquarters of the project management team shall be headed by a senior level executive designated as the Project Manager who shall be responsible to Owner for the execution of the project. He should have adequate financial power and authority to give decision.

Separately, designated leaders shall be identified for each of the areas mentioned under 1.01.00, who, in turn, will report to the Project Manager for all matters relative to this contract.

1.02.02 Central Co-ordination Cell

The central coordination cell shall have sufficient technical personnel to coordinate technical matters and to quickly resolve day to day queries or

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references made by Owner and his Consultants without having the need to refer to his headquarters each time.

1.02.03 Site Organisation

The site should have a competent construction manager for all site operations with adequate financial power and sufficient level of authority to take site decisions. The organisation chart for site should indicate the various levels of experts to be posted for supervision in the various fields in civil construction, erection, commissioning etc.

1.02.04 Organisation Chart

The Bidder shall furnish a detailed organisation chart for the project management team, clearly identifying the key personnel in each of the areas mentioned at 1.01.00 above. The expected number of executives at different levels shall also be indicated, separately for headquarters, central coordination cell and site organisation.

1.03.00 **Implementation Schedule**

The schedule for the completion of the Project would be as follows :

Period in Months from Zero date (Taken as advance payment date of EPC Package)

a)	Boiler Hydro-test	By Bidder
b)	Boiler light up	By Bidder
e)	Commercial operation	50

To achieve these targets, the Contractor shall furnish to the Owner, various schedules as defined below:

1.03.01 Engineering Schedules

These schedules shall cover various design submissions indicating different engineering activities to be performed. Such schedules shall be furnished by the Bidder for each and every plant/systems/ equipment item covered in the scope of this specification.

1.03.02 Manufacturing Schedule

The Contractor shall submit to the Engineer his manufacturing and delivery schedules for all equipment within thirty (30) days from the date of issue of the Letter of Intent (LOI). Such schedules shall be in line with the detailed network for all phases of the work of the Contractor. Such schedules shall be reviewed, updated and submitted to the Engineer, once in every two months thereafter, by the Contractor. Schedules shall also include the materials and equipment purchased from outside suppliers.

1.03.03 Erection Schedules

In order to achieve the overall completion schedule, the Contractor shall provide the Owner all the information covering erection sequence, testing and commissioning activities. These schedules may be based on the recommended erection procedures and will be subject to discussions/agreements with the Owner subsequent to the award of contract.

1.03.04 The successful Bidder shall have to provide all the above schedules (i.e. 1.03.01, 1.03.02 & 1.03.03) in a tabular form in addition to that in the form of L2 & L3 networks and these shall necessarily include information not limited to the earliest and latest dates for various activities/submissions and also any related constraints. However, the Bidder shall include in his proposal a Level-1 (L-1) network showing the major activities and various milestones to achieve the above mentioned completion schedule.

1.03.05 The Contractor shall provide the Owner the original disc/software for all such schedules alongwith requisite no. of copies (as required by the Owner) within an agreed time schedule. This time schedule will be agreed between Owner/Bidder at the time of award of contract. The Contractor's project management software shall be compatible with that of the Owner and the input data shall be furnished to the Owner in a manner compatible with Owner's project management software, SAP.

1.04.00 **Detailed Responsibilities**

1.04.01 Planning & Monitoring

a) Planning

The Bidder shall prepare a Master Network Schedule in the form of PERT network.

The network shall be prepared on a Work Breakdown Structure for the project which sub-divides the project into a set of manageable systems/sub-systems. The master network will identify milestones of key events for each system/package in the areas of engineering, procurement, manufacture and despatch and erection and commissioning. The master network shall represent the Level-I plan and will form the basis for development of detailed second and third tier execution plans. The master network shall conform to the overall schedule prescribed by Owner.

The master network should be submitted along with the bid which would be mutually discussed and finalised before the Award of Contract. This master network would clearly indicate the responsibility of the Bidder and project management team. This master network would form a part of the contract. The master network shall also identify a complete list of inputs to be furnished by the Owner which may be required for proper interfacing and tie-up. Scheduled dates for providing such inputs shall also be indicated, which will be mutually discussed and finalised.

b) Monitoring & Progress Reporting

The progress reports would be emanated every month, one from the head office of the Contractor and another from the site office. The progress report emanating from the head office should necessarily include the following sections:

- i) Report on key milestones.
- ii) Management summary indicating critical areas with details of actions initiated and effect of any on the project.
- iii) Action needing attention of the Owner/Consultant.
- iv) Detailed package-wise status of engineering submissions, quality plan submissions and approval, procurement manufacture and despatch.

The monthly report generated from the site office should necessarily include:

- i) Report on key milestones.
- ii) Management summary indicating critical areas with details of actions initiated and effect if any on the project.
- iii) Action needing attention of the Owner/Consultant.
- iv) This report would also cover the areas pertaining to the receipt of the equipment at the port, port clearance, transport, receipt at site, erection and commissioning.

In addition to the above, as the project execution progresses, the Contractor shall also be responsible for generating more frequent reports in the form of fax/e-mail information on progress in critical areas so that actions can be expedited. The exact format of the progress report shall be finalised after award of Contract.

1.04.02 Engineering Management

Based on the master network for the project (L-1) the Contractor will prepare an exhaustive list of engineering activities for the equipment/systems covered in his scope and a detailed programme of accomplishing the same within the time frame specified in the master network. This schedule will form the Level-2 (L-2) network for engineering activities.

Based on (L-2) network, the Contractor shall further develop the Level-3 (L-3) network for engineering activities which will indicate schedule for data availability, drawing release date and document submission dates.

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Detailed (L-2) and (L-3) networks would be submitted sequentially by the Contractor within two months from the date of issue of Letter of Intent and finalised within one (1) month thereafter.

All such networks shall be provided in MS PROJECT software as well as in other format / software suitable to Owner.

The engineering management team should also co-ordinate all interface engineering activity between the Contractor and the equipment sub-vendors so as to ensure the correctness and completeness of related engineering documentation before the same is submitted to the Owner.

TSGENCO is implementing SAP ERP. Hence the bidder apart from submission of the hard copies shall upload all the documents, drawings etc. in soft format in the relevant C- folder environment (web based) and comply with the additional requirements, if any.

1.04.03 Contracts Management

Based on the master network, the Contractor shall submit L-2 programmes of manufacture and despatch. In addition, the master network shall also include periods considered for site activities viz. erection, commissioning etc. These L-2 programmes would be submitted in 2 months time from the date of award of contract and finalised within one (1) month thereafter. The Contractor will also submit site mobilisation plan. This programme would be submitted at the time of finalisation of award of contract and agreed immediately thereafter so that immediate development of the various activities at site could take place.

The Contractor should also submit L-3 programmes for the manufacturing, despatch of the various items. These networks shall also show the customer hold points (CHP) which have to be cleared by Owner or their authorised representative(s) before further manufacture can take place. These L-3 programmes for the manufacture and despatch would clearly identify responsibilities of the Contractor, sub-Contractor and Owner. These networks shall be submitted within one (1) month of the date of finalisation of the various sub-contracts by the Contractor.

In case all the manufacture is being done by the Contractor then the L-2 programmes would be themselves amplified to cover details of the manufacture, inspection, clearance by Owner and despatch.

The Contractor shall also submit the programme for procurement of boughtout items, detailed shipping schedule and cash flow statement for Owner's approval.

1.04.04 Quality Assurance, Inspection and Expediting

The Contractor shall submit the list of manufacturers/sub-vendors from whom the equipment are expected to be procured and the quality assurance plans thereof for the manufacture shall be approved by the QA group of Owner before the manufacture is commenced. The list of major suppliers would be submitted along with the bid and this shall be mutually discussed and approval will be given by the Owner during contract negotiation meeting prior

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to placement of Letter of Intent. This approved list will be binding to the bidder. In the said list, Owner reserves the right to include reputed/reliable vendors of his own choice. Regarding the various other sub-vendors, the list would be submitted within six (6) months of the award of the contract that shall be scrutinized by the Owner to accord approval. In such list Owner reserves the right to include vendors of his own choice. No further vendor approval will be given after twelve (12) months. On the quality plans, the customer hold points will also be identified based on which Owner would give clearance for the manufacture to proceed further.

Quality assurance/Inspection group of Owner or its representative would issue a material despatch clearance certificate (MDCC) after the inspection clearance which will enable the Contractor to despatch the equipment and claim the payment. In the despatch programme, the Contractor shall indicate a schedule of estimated programme, tonnages specifically identifying various oversize dimensioned consignments (ODC). Further the Contractor will also be required to ensure at all stages of shipment that packing of all shipments despatched are suitable for ocean freight to India, handling at the port of entry, inland transportation and preservation at site upto erection. All despatch details & item lists shall be made available to both Owner & site immediately after shipping.

The Contractor shall also expedite all despatches from their own works/works of their sub-vendors, so as to match with the various activities mentioned at 1.04.03 above.

1.04.05 Construction Management

Based on the L-1 Master Network Programme, within two (2) months of the issue of Letter of Intent, the Contractor shall submit a programme of construction/ erection/ commissioning, either in continuation with the manufacture and despatch or separately for the implementation. These programmes would be amplified showing when the civil drawings shall be released by him and construction of civil works shall be completed by him to facilitate start of erection and subsequent activities and shall form the basis for site execution and detailed monitoring. The three monthly rolling programme with the first month's programme being tentative based on the site conditions would be prepared based on these L-3 programmes. The Contractor shall also be involved along with the Owner to tie up detailed resource mobilisation plan over the period of time of the contract matching with the performance targets.

The L-3 programme would be jointly finalised by the site in charge of the Contractor with the Owner's project coordinator as well as the site planning representative. The erection programme will also identify the sequential erectable tonnages that are required for various equipment which should be taken care of in the despatch programmes.

Erection and commissioning of the equipment shall also be done under the supervision of experts from the respective equipment/ system supplier.

1.04.06 Spares Management

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Alongwith the proposal for the plant and equipment, the Contractor shall also submit proposals/schedule for the following:

- a) Mandatory spares
- b) Recommended spares

While the award for mandatory spares will be finalised at the time of the award of contract, recommended spares will be finalised thereafter.

1.05.00 Project Progress Review Meetings

Keeping in mind the overall responsibility of the Contractor it is intended that periodic progress reviews on the entire activities of execution of the project will be held initially at least once in two (2) months at Hyderabad/site/ at the discretion of the Owner.. During peak period it may be held once in a month. These meetings will be attended by reasonably higher officials of the Contractor and their leading sub- contractors and will be used as a forum for discussing all areas where progress needs to be speeded up. Actions will be placed on the concerned agencies and decisions will be taken to expedite/speed up the progress. Minutes of such meetings will be issued reflecting the major discussions and decisions taken and circulated to all concerned for reference and action. The Contractor shall be further responsible for ensuring that suitable steps are taken to meet various targets decided upon such meetings.

In addition to the above, and to streamline the construction and erection at site, a suitable frequency and forum of periodic meetings between the Contractor and the Owner will be decided upon as part of erection coordination procedure. Site co-ordination meeting may be held on weekly basis.

1.06.00 Owner's Consultant

The Owner would appoint a consultant to assist him in some of the areas mentioned at 1.01.00 above. The details of interaction and procedures for coordination between Owner / Owner's Consultant and Contractor/ Contractor's project management team shall be finalised during contract negotiations.

1.07.00 Commissioning Management

1.07.01 For commissioning of the various equipment/system covered under the scope of contract, Owner will form an organisation structure which may consist of the following committees. The Contractor shall nominate his representative on one or more of the committee as decided by the Owner:

- a) Steering Committee
- b) Commissioning Panel.
- c) Working Parties
- d) Testing Teams.

1.07.02 Commissioning documents shall be prepared by the Contractor in the

following manner and submitted for Owner's approval :

a) Field Quality Plan

This document shall be prepared for the various equipment/ systems under commissioning and shall have the following objectives to fulfill and shall be submitted for Owner's approval at least six (6) months before their actual commissioning :

- i) Establish design data against which Plant Performance will be compared.
- ii) Set-out the testing objectives and proposals.
- iii) Define the documentation required.

b) Testing/Commissioning Schedule

These shall be prepared for the various equipment/systems under consideration and shall contain sections like detailed testing method, programme, safety, individual responsibility and results.

c) Standard Check Lists

Standard check lists are intended for use at the completion of erection to ensure correct erection, testing and to a limited extent operation for repetitive items.

1.07.03 Test Reports

After the completion of commissioning activity of equipment/ systems, the Contractor shall prepare the test reports which shall include all the relevant information related to various commissioning checks, tests carried out, any deviations/commissions noticed with respect to the intended design requirements, sequence of various commissioning activities as actually adopted vis-a-vis as recommended in the procedures, programme schedules achieved and any other such information as required. These test reports shall be submitted in requisite number of copies to the Owner and this should be duly signed jointly by the Owner/Consultant and the Contractor/Equipment supplier, who are involved during the commissioning activities.

2.00.00 **SITE SERVICES**

These services shall be rendered by the Bidder as part of the overall project management service. The services shall broadly include but not be limited to the following :

2.01.00 Arranging material despatch from the shop by rail/road and/or sea as applicable.

2.02.00 Monitoring movement of materials & follow-up as necessary with Railways, road transport, port clearance etc. from the time of despatch F.O.R. works/ F.O.B. port of shipment by Contractor till receipt of the same at site.

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- 2.03.00 Unloading of materials at Railway Station/Railway Siding inside project area/ Road Transportation, transportation to site store, assessment of lost/damaged items in transit and arranging insurance claims and replacement of lost/damaged items. The Contractor shall submit to the Engineer a report detailing all the receipts during the week as well as storing, preservation of material at site.
- 2.04.00 Issuing materials from site store/open yard from time to time for erection as per the construction programme. The Contractor shall be the custodian of all the materials issued till the plant is officially taken over by the Owner after complete erection and successful trial run & commissioning.
- 2.05.00 Transportation of materials to their respective places of erection and erection of the complete plant & equipment as supplied under this specification.
- 2.06.00 Trial run and commissioning of individual equipment/sub-systems and the plant as a whole to the satisfaction of the Owner, including supply of temporary equipment & services for chemical cleaning, steam blowing as well as performance guarantee tests.

Apart from Boiler, proper chemical cleaning shall be carried out in following pipe lines/equipment before commissioning

- a) Deaerator
- b) Boiler feed suction, recirculation leak-off lines
- c) Boiler Feed discharge line by passing heaters
- d) Attemperation lines
- e) Condensate suction & discharge piping upto deaerator by passing the feed water heaters.
- f) Fuel oil lines.

Provision for preservation of individual equipment after trial run and commissioning e.g. Nitrogen blanketing etc. as necessary shall also be in the scope of the Bidder.

Safe disposal of effluent after chemical cleaning shall be done by the contractor.

- 2.07.00 Supply and application of the final paints and first fill lubricants on all the equipment to be erected under this specification. Supply of chemicals, lub oils and other consumables upto COD.
- 2.08.00 For the purpose of erection and commissioning the Contractor's scope of work shall include but not be limited to the following :
- 2.08.01 Deployment of all skilled and unskilled manpower required for erection, supervision of erection, watch & ward, commissioning and other services to

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be rendered under this specification.

- 2.08.02 Deployment of all erection tools & tackle, construction machinery, transportation vehicles and all other implements in adequate number and size, appropriate for the erection work to be handled under the scope of this specification.
- 2.08.03 Supply of all consumables, e.g. welding electrodes, cleaning agents, diesel oil, grease, lubricant etc. as well as materials required for temporary supports, scaffolding etc. as necessary for such erection work except those listed under exclusion elsewhere in this specification.
- 2.08.04 Construction of all civil/structural/architectural works, including construction of foundation for all equipment supplied as required, grouting of equipment on foundation after alignment, and all other incidental civil activities as detailed elsewhere.
- 2.08.05 All structural steel fabrication and erection work as detailed elsewhere in the specification.
- 2.08.06 Providing support services for the Contractor's erection staff e.g. construction of site offices, temporary stores, residential accommodation and transport to work site for erection personnel, insurance cover, watch & ward for security and safety of the materials under the Contractor's custody etc. as required.
- 2.08.07 Maintaining proper documentation of all the site activities undertaken by the Contractor as per the proforma mutually agreed with the Owner; submitting monthly progress reports as also any such document as and when desired by the Owner; taking approval of all statutory authorities e.g. Boiler Inspector, Factory Inspector, Inspector of Explosives, Electrical Inspector etc. for respective portions of work under the jurisdiction of such statutes or laws.
- 2.08.08 The Contractor shall provide 'Industrial Relations' unit and 'Medical' unit to take care of his erection staff and the Owner shall have no obligation in the regard.
- 2.08.09 The successful Bidder shall arrange for Tower cranes of adequate capacity for speedy erection activities.

2.09.00 Site Organisation

The Contractor shall maintain a site organisation of adequate strength in respect of manpower, construction machinery and other implements at all times for smooth execution of the contract. This organisation shall be reinforced from time to time, as required, to make up for slippages from the schedule without any commercial implication to the Owner. The site organisation shall be headed by a competent construction manager having sufficient authority to take decisions at site.

On award of contract, the Contractor shall submit to the Owner a site organisation chart indicating the various levels of experts to be deployed on the job. The Owner reserves the right to reject or approve the list of personnel

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proposed by the Contractor. The persons, whose bio-data have been approved by the Owner, will have to be posted at site and deviations in this regard will not generally be permitted.

The Contractor shall also submit to the Owner for approval a list of construction equipment, erection tools, tackle etc. prior to commencement of site activities. These tools & tackle shall not be removed from site without written permission of the Owner.

2.10.00 General Guidelines for Field Activities

2.10.01 The Contractor shall execute the works in a professional manner so as to achieve the target schedule without any sacrifice on quality and maintaining highest standards of safety and cleanliness.

2.10.02 The Contractor shall co-operate with the Owner and other Contractors working in site and arrange to perform his work in a manner so as to minimise interference with other Contractors' works. The Owner's engineer shall be notified promptly of any defect in other Contractor's works that could affect the Contractor's work. If rescheduling of Contractor's work is requested by the Owner's engineer in the interest of overall site activities, the same shall be complied with by the Contractor. In all cases of controversy, the decision of the Owner shall be final and binding on the Contractor without any commercial implication.

2.10.03 The Engineer shall hold weekly meetings of all the Contractors working at Site at a time and a place to be designated by the Engineer. The Contractor shall attend such meetings and take notes of discussions during the meeting and the decisions of the Engineer and shall strictly adhere to those decisions in performing his Work. In addition to the above weekly meeting, Engineer may call for other meetings either with individual contractors or with selected number of contractors and in such a case the Contractor, if called will also attend such meetings.

2.10.04 Time is the essence of the Contract and the Contractor shall be responsible for performance of his Work in accordance with the specified construction schedule. If at any time the Contractor is falling behind the schedule, he shall take necessary action to make good of such delays by increasing his work force or by working overtime or otherwise accelerate the progress of the work to comply with the schedule and shall communicate such action in writing to the Engineer, satisfying that his action will compensate for the delay. The Contractor shall not be allowed any extra compensation for such action.

2.10.05 The Engineer shall however not be responsible for provision of additional labour and or materials or supply or any other services to the Contractor except for the co-ordination work between various Contractors as set out earlier.

2.10.06 The works under execution shall be open to inspection & supervision by the Owner's engineer at all times. The Contractor shall give reasonable notice to the Owner before covering up or otherwise placing beyond the reach of inspection any work in order that same may be verified, if so desired by the Owner.

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- 2.10.07 Every effort shall be made to maintain the highest quality of workmanship by stringent supervision and inspection at every stage of execution. Manufacturer's instruction manual and guidelines on sequence of erection and precautions shall be strictly followed. Should any error or ambiguity be discovered in such documents, the same shall be brought to the notice of the Owner's engineer. Manufacturer's interpretation in such cases shall be binding on the Contractor.
- 2.10.08 The Contractor shall comply with all the rules and regulations of the local authorities, all statutory laws including Minimum Wages, Workmen Compensation etc. All registration and statutory inspection fees, if any, in respect of the work executed by the Contractor shall be to his account.
- 2.10.09 All the works such as cleaning, checking, leveling, blue matching, aligning, assembling, temporary erection for alignment, opening, dismantling of certain equipments for checking and cleaning, surface preparation, edge preparation, fabrication of tubes and pipes as per general engineering practice at site, cutting grinding, straightening, chamfering, filling, chipping, drilling, reaming, scrapping, shaping, fitting-up bolting/welding, etc., as may be applicable in such erection and are necessary to complete the work satisfactorily, are to be treated as incidental and the same shall be carried out by the Contractor as part of the work.
- 2.10.10 In case of any class of work for which there is no such specification as laid down in the contract such as, blue matching, welding of stainless steel parts, etc., the work shall be carried out in accordance with the instructions and requirements of the Engineer and as per the Standards.
- 2.10.11 It may sometimes be necessary to remove some of the erected structural members to facilitate erection of bigger/pre-assembled equipment. In such cases, the removal and re-erection of such members, which are essential, and if so agreed by the Engineer, will have to be done by the Contractor.
- 2.10.12 Attachment welding of necessary instrumentation tapping points, thermocouple pads, root valves, condensing vessels, flow nozzles and control valves etc., both for regular measurement and performance testing to be provided on equipment, its auxiliaries or pipelines covered within the scope of this tender, will also be the responsibility of the Contractor and the same will be done as per the instructions of Engineer. The erection and welding of all above items will be the Contractor's responsibility, even if :
- a) Product groups under which these items are re-leased are not covered in the scope of this tender.
 - b) Items are supplied by an agency other than the Contractor.
- 2.10.13 Preservation of all materials/equipment under custody of the Contractor during storage, pre-assembly & erection, commissioning etc., shall be the responsibility of the Contractor. All necessary preservatives and consumables like paints, etc., shall be arranged by the Contractor. Necessary touch up painting, periodic application of preservatives/paints on pressure parts/other equipment even after erection until completion of work shall be carried out by

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- the Contractor. The Contractor shall fabricate piping, install lub oil systems and carry out the acid cleaning of fabricated piping. The Contractor shall also service the lub. oil system, carryout the hydraulic test of oil coolers, etc.
- 2.10.14 It is responsibility of the Contractor to do the alignment etc. if necessary, repeatedly to satisfy Engineer, with all the necessary tools & tackle, manpower, etc. The alignment will be complete only when jointly certified so, by the Contractor's Engineer & Owner. Also the Contractor should ensure that the alignment is not disturbed afterwards.
- 2.10.15 Additional platforms for approaching different equipment as per site requirement, which may not be indicated in drawings, shall be fabricated and erected by the Contractor. The materials required for these works shall be supplied by the Contractor and he will have to fabricate them to suit the requirement.
- 2.10.16 Equipment and material which are wrongly installed shall be removed and reinstalled to comply with the design requirement at the Contractor's expense, to the satisfaction of the Owner/ Consultant.
- 2.10.17 Before erection of any equipment on a foundation, the Contractor shall check and undertake if necessary rectification of foundation bolts, reaming of holes, drilling of dowels, matching of bolts and nuts, making new dowel pin, etc.
- 2.10.18 Assistance for calibrating/testing the power cylinders, valves, gauges, instruments, etc., and setting of actuators coming under various groups shall be provided by Contractor.
- 2.10.19 It shall be the responsibility of the Contractor to provide ladders on columns for initial works till such time stairways are completed. For this, the ladder should not be welded on the column and should be prefabricated clamping type. No temporary welding on any structural member is permitted except under special circumstances with the approval of Owner.
- 2.10.20 Structural materials required for the supporting/operating platforms required for the valves at various levels for the same operation of valves will be arranged by the Contractor.
- 2.10.21 For civil, structural and architectural works, volume VII-A, VII-B, VII-C may be referred. For Instrumentation and Electrical works Vol. VI, V-A and V-B may be referred.
- 2.11.00 **Safety**
- Safety and overall cleanliness of work site shall be given top priority.
- 2.11.01 The Contractor shall ensure the safety of all workmen, materials and equipment either belonging to him or to others working at site. He shall observe safety rules & codes applied by the Owner at site without exception.
- 2.11.02 The Contractor shall notify the Owner of his intention to bring to site any equipment or material which may create hazard. The Owner shall have the right to prescribe the conditions under which such equipment or material may be

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- handled and the Contractor shall adhere to such instructions. The Owner may prohibit the use of any construction machinery, which according to him is unsafe. No claim for compensation due to such prohibition will be entertained by the Owner.
- 2.11.03 Storage of petroleum products & explosives for construction work shall be as per rules and regulation laid down in Petroleum Act, Explosive Act and Petroleum and Carbide of Calcium Manual. Approvals as necessary from Chief Inspector of Explosives or other statutory authorities shall be the responsibility of the Contractor.
- 2.11.04 The Contractor shall be responsible for safe storage of his and his sub-contractor's radioactive sources.
- 2.11.05 All requisite tests & inspection of handling equipment, lifting tools & tackle shall be done by the Contractor and certified copies shall be supplied to the Owner. Defective equipment shall be removed from service. Any equipment shall not be loaded in excess of its recommended safe working load.
- 2.11.06 All combustible waste and rubbish shall be collected and removed from the worksite at least once each day. Use of undercoated canvas paper, corrugated paper, fabricated carton, plastic or other flammable materials shall be restricted to the minimum and promptly removed.
- 2.11.07 The Contractor shall provide adequate number of fire protection equipment of the required types for his stores, office, temporary structures, labour colony etc. Personnel trained for fire-fighting shall be made available by the Contractor at site during the entire period of the Contract.
- 2.11.08 All electrical appliances used in the work shall be in good working condition and shall be properly earthed. No maintenance work shall be carried out on live equipment. The Contractor shall maintain adequate number of qualified electricians to maintain his temporary electrical installation.
- 2.11.09 All workmen of the Contractor working in construction site shall wear safety helmets, safety boots and safety belts. The Contractor shall take appropriate insurance cover against accidents for his workmen as well as third party.
- 2.11.10 All the worksites shall be provided with adequate lighting facilities e.g. flood lighting, hand lamps, area lighting etc. by the Contractor for proper working environment during night times.
- 2.11.11 All safety precautions shall be taken for welding and cutting operations as per IS-818.
- 2.11.12 All safety precautions shall be taken for foundation and other excavation marks as per IS-3764.
- 2.12.00 **Taking Delivery & Storage**
- 2.12.01 The Contractor shall arrange issue of all equipment and materials to be erected under the contract from the stores/open yard at site by signing on standard indent forms. After completion of work, detailed auditing of the

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- materials so issued shall be submitted to the Owner.
- 2.12.02 The Contractor shall arrange for proper and safe storage of materials till the same are taken over by the Owner as per terms of the contract. Manufacturer's instructions for preservation shall be strictly followed.
- 2.12.03 All empty containers, packing materials, gunny bags, transport frames and also surplus and unused materials reconciliation prior to completion of contract shall be the property of the Owner and returned to the Owner by the Contractor.
- 2.13.00 **Site Welding & Heat Treatment**
- 2.13.01 Welding shall be done in accordance with IS-813, IS-816, IS-9595 & other relevant IS/International standards and as per instructions of Contractor. Only those welders, who are qualified as per IS-817 for ordinary welds and as per IBR/ASME Section-IX for high pressure welds, shall be employed in the job.
- 2.13.02 All welders shall be tested and approved by Engineer before they are actually engaged on the work even though they may possess the requisite certificates. The Owner reserves the right to reject any welder without assigning any reason. The welder identification code as approved by the Engineer shall be stamped by the welder on each joint done by them. The Contractor will be responsible for the periodic renewal, re-testing of the welders as demanded by Owner.
- 2.13.03 The Engineer is entitled to stop Contractor's any welder from his work if his work is unsatisfactory for any technical reason or there is a high percentage of the rejection of joints welded by him, which in the opinion of Engineer will adversely affect the quality of welding even though the welder has earlier passed the tests. The welders having passed the tests do not relieve the Contractor from his contractual obligations, to check the performance of the welders.
- 2.13.04 All charges for testing of welders including destructive and non- destructive tests if conducted by Owner or by the inspection authority at site shall have to be borne by the Contractor. The necessary test materials and consumables will have to be arranged by the Contractor and all testing facility made available, as required.
- 2.13.05 All welded joints shall be subject to acceptance by Engineer. Inspection of welds shall be in accordance with IS-822 or equivalent code.
- 2.13.06 Preheating/post heating and stress relieving after welding are part of fabrication and erection work and shall be performed by the Contractor in accordance with the instruction of Engineer. Contractor shall arrange to supply heating equipment with automatic recording devices. Also the Contractor shall have to arrange for the labour, heating elements, thermocouples, compensating cables, insulation materials like mineral wools, asbestos cloth, ceramic beads, asbestos rope, etc. required for the heat-treatment and stress relieving works. During pre- heat/stress relieving operations, the temperature shall be measured at one or more points as required by attaching thermocouples and recorded on a continuous printing

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- type recorder. All the record graphs for the heat treatment works carried out shall be got signed by the Engineer prior to the commencement of each cycle and handed over to Engineer on completion. The graphs will be the property of Owner. The Contractor has to provide thermo-chalks temperature recorders, thermocouple attachments, units, graph sheets, etc. required for the job and maintain them in good condition.
- 2.13.07 All electrodes shall be baked and dried in the electric/electrode drying oven to the required temperature and for the period specified by the Engineer before they are used in erection work. The electrodes used shall be as per IS-814, IS-815, IS-1442, IS-7280 and other codes as applicable, and shall be of approved reputed manufacture. The electrodes shall meet the requirement of the pipe material. No electrode manufactured more than 12 months ago and the type covered under certificate issued after conducting tests more than 6 months ago shall be used. All electrodes shall be preserved at works and at site as per manufacturer's recommendations.
- 2.13.08 Oxy-acetylene flame or Exothermic chemical heating for stress relieving is not permitted. Heating shall be by means, of electric induction coil or electric resistance coil.
- 2.13.09 It may become necessary to adopt inter layer radiography/MPT/UT depending upon the site/technical requirement necessitating interruptions in continuation of the work and making necessary arrangement for carrying out the above work.
- 2.13.10 Gas tungsten arc welding process (TIG) shall be adopted for all root pass welds except for structural works until 4.75 mm thickness is deposited. Subsequent welding after root pass can be carried out by manual metal arc welding with coated electrodes. For pipes of thickness less than 6 mm the entire welding has to be carried out by TIG welding.
- Fillet weld shall be made by shielded metal arc process as per applicable codes.
- However, the Engineer will have the option of changing the method of welding as per site requirement. The method adopted for manual arc welding shall be weaving technique and the width of weaving shall not exceed 1.5 times of the dia. of the electrode.
- In case of deviation from welding process and electrodes, the Contractor shall take approval of the Owner prior to adoption of same.
- 2.13.11 The root pass for butt joints shall be such as to achieve full penetration with complete fusion of root edges.
- 2.13.12 Each pass shall be cleared and freed of slag before the next pass is deposited.
- 2.13.13 On completion of each run, craters, weld irregularities, slag etc. shall be removed by grinding or chipping.
- 2.13.14 Each layer of welding shall have an even and smooth appearance.

- 2.13.15 Welding sequence shall be adjusted in such a way that distortion due to welding shrinkage is minimised. Further any movement, shock or vibration during welding shall be avoided to prevent weld cracks.
- 2.13.16 Proper protection of welders and the work shall be taken during periods of rain. No welding shall be carried out when surface to be welded are wet from any cause.
- 2.13.17 Following will be stages of inspection during welding :
- a) Two pieces to be joined shall be individually checked for the weld edge preparation and profile dimensionally and to the template. Dye penetrant check shall be carried out on edge prepared surfaces at random. The percentage will depend upon on criticality as specified by Engineer.
 - b) Joint fit up will be a stage of inspection. Misalignment after fit up may vary from 0.3 mm to 1.6 mm depending on outside diameter and thickness.
 - c) All joints shall be offered for visual inspection after root run. Subsequent welding should be made only after the approval of root run.
- 2.13.18 All welded joints shall be painted with anti-corrosive paint immediately on completion of radiography and stress-relieving.
- 2.14.00 For further details on procedures of work at site on civil, architectural, electrical and instrumentation & control services, refer Volume : V, VI & VII of this specification.
- 3.00.00 **PROJECT INFORMATION AND MANAGEMENT SYSTEM, INCLUDING DCOUMENT MANAGMENT SERVER (DMS)**
- 3.01.00 Contractor shall submit as part of its Work Scope detailed documentation as outlined in this section and / or required by the Technical Requirements. The content and format of the documentation to be submitted are subject to Owner's approval.
- 3.02.00 Contractor shall utilise a computer based system for control and management of project documentation. The system must be capable of producing customized reports and information on demand. This control system should have been successfully applied to similar projects and be familiar to the project control personnel selected. Contractor's detailed project documentation plan shall identify all documentation requirements for the project, the party responsible for production of the document, the basic content of the document and the required timing for issue. This plan shall include, but not be limited to the details of all Drawings to be produced, plant specification / definition documentation, equipment orders and manuals. The documentation identified shall be entered into the computer based control system The database thus created shall be capable of being sorted and

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ordered on a variety of selected parameters such as document type, subject description, responsible party, start date and finish date, to enable review and update to be conducted only on those documents which are relevant.

3.03.00 Regular documentation control progress reports shall be prepared by the Contractor to record the status of documentation. In the event either Party or Engineer expresses concern with the content of such progress reports, the accuracy of progress reports, status of documentation production and other such matters, the concern will be identified to the Project Manager. Within five days of notification of this concern, the Project Manager will attend a meeting with relevant Owner Representatives and provide details of specific actions to be initiated to satisfactorily overcome the difficulties identified. It will be the Project Manger,s responsibility to initiate whatever action is necessary to ensure that the production of documentation is completely in accordance with Project Information Management System (PIMS).

3.04.00 Within 90 days after Effective Date of Contract, the Contractor shall establish an integrated PIMS which will support the needs of Project and management, detail design and engineering, procurement, construction and operation, and maintenance.

PIMS shall utilise software which links various software and database programs to form a composite system. The typical scope of PIMS shall include, but not be limited to, the following:

- (a) Power plant systems and equipment data, from which Project specific flow diagrams, data sheets and other integrated data are derived. The Power plant systems and equipment data, from which Project specific flow diagrams, data sheets and other integrated data are derived. This data shall include, but not be limited to, the following:
 - (i) System descriptions and design requirements and design criteria
 - (ii) Equipment and material technical specifications for all engineering disciplines
- (b) Detail engineering data to create flow diagrams, plant arrangements, piping configurations, equipment layout and design, electrical and instrumentation systems, structures, and other systems. The software tool used shall be capable of manipulation and storage of plant layout and design information. The 3D model of the plant shall also contain details of the various components like pipe, structural steel work, etc., and relevant information shall be available on-line from relevant data base. Software shall be multi-user, multi-access nature allowing the designers of Contractor and major Sub-Contractors, if required, to work in interactive real time environment and software shall be capable of interference checking. The software shall allow access to different types of information held in the database. It shall estimate the type and quantity of materials required to build the plant and it shall be possible for such data to be taken off the system at any time.

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- (c) Construction data to monitor and manage site activities, including material control, scheduling and progress, quality control, start-up and testing, operation, maintenance, training, and all other site functions.

 - (d) Plant design and construction records to provide data for safe and efficient maintenance and operation. Records to include may be maintenance schedule, man power tracking, tools, spare parts, and test equipment inventory, equipment list, drawing, control, technical specifications, and equipment instruction manuals.
- 3.05.00 The PIMS shall be installed in a distributed processing array system and operated through personal computer work stations at the Contractor's site office. A complete integrated system shall be implemented. This system shall be utilised by Contractor during the Project execution.

ENGINEERING SERVICES

CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	GENERAL
2.00.00	DESIGN COORDINATION MEETING
3.00.00	CO-OPERATION WITH OTHER CONTRACTORS AND CONSULTING ENGINEERS
4.00.00	GUIDELINES FOR ENGINEERING SERVICES
5.00.00	OPERATING MANUALS AND MAINTENANCE INSTRUCTIONS
6.00.00	PLANT HANDBOOK
7.00.00	CONTRACT STAGE DOCUMENT SUBMISSION AND APPROVAL PROCEDURE
8.00.00	TENDER STAGE DOCUMENT SUBMISSION

ATTACHMENTS

ANNEXURE-1	DISTRIBUTION SCHEDULE
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ENGINEERING SERVICES

1.00.00 GENERAL

1.01.00 As part of the overall project management activity, the Contractor shall be responsible for proper engineering and co-ordination of activities during various phases of execution of the contract. The Contractor shall identify a person, designated as Project Manager, with whom the Owner, the Consulting Engineer or the Review Consultant shall interact on matters related to engineering as well as execution of the contract. The Project Manager shall be the single-point contact person on behalf of the Contractor and shall be responsible for all engineering co-ordination. The Owner/Consultant/Review Consultant shall interact with the Project Manager only on all matters of co-ordination between the Owner and the Contractor or on matters involving the Contractor, his manufacturing units and sub-vendors. For the purpose of expediting the Owner or his representative may sometimes interact with the manufacturing units or sub-vendors of the contractors. However such interaction will not, under any circumstance, dilute the responsibility of the Contractor to provide a fully engineered and co-ordinated package under this contract.

1.02.00 On finalization of the contract, a procedure for exchange of engineering information will be mutually agreed and finalized between the Owner and the Contractor.

2.00.00 DESIGN COORDINATION MEETING

The Contractor and his sub-vendors will be called upon to attend design co-ordination meetings with the Engineer, other Contractors and the Consultants of the Owner during the period of execution of contract. The Contractor including his sub-vendors shall attend such meetings at their own cost at Owner's or Consultant's office in Kolkata or at mutually agreed venue as and when required and fully cooperate with such persons and agencies involved during those discussions.

3.00.00 CO-OPERATION WITH OTHER CONTRACTORS AND CONSULTING ENGINEERS

The Contractor shall agree to cooperate with the Owner's other Contractors and Consulting Engineers and freely exchange with them such technical information as is necessary to obtain the most efficient and economical design and to avoid unnecessary duplication of efforts. The Engineer shall be provided with copies of all correspondences addressed by the Contractor to other Sub- contractors and Consulting Engineers in respect of such exchange of technical information.

- 4.00.00 GUIDELINES FOR ENGINEERING SERVICES**
- 4.01.00 Prior to commencement of the engineering work as part of design submissions, all aspects of design viz., criteria for selection and sizing of all equipment and systems, design margins etc. including that for structural steel and civil work shall be outlined and these shall form the basis for the detailed engineering work.
- 4.02.00 Engineering work shall be performed on modern and proven concepts and internationally accepted good engineering practices but fully compatible with the Indian environments. Owner shall have the right to review and approve the engineering work by themselves and/or through consultant and ask for any clarifications and changes/modifications to the work performed by Contractor.
- 4.03.00 At any stage during the performance of assignment, the Contractor may be required to make certain changes/modification/improvements in design/drawing/other documents which are applicable to 800 MW Unit, which in the opinion of the Owner could result in better improved design, layout, operability, plant availability, maintainability, reliability or economy of the plant and its systems/sub-systems in view of revised and more accurate information/data available at a later date(s) or feedback(s) received during execution / operation of similar units. Such changes / modifications/improvements required could be identified by Owner and/or consultant and mutually discussed. Owner requires the Bidder to incorporate such action in the subject assignment appropriately without any additional cost liability and time implication to the Owner and same shall be within the responsibilities and scope of the Contractor.
- 4.04.00 During the course of review of detailed engineering stages, it may be essential in the opinion of Owner to obtain certain classified data for review purposes only. In case Owner so desires, the Bidder shall submit such data to Owner.
- 4.05.00 During the course of review of detailed engineering, it may be essential in Owner's opinion to obtain data and information on similar equipment and plants engineered by the Bidder. In case Owner so desires the Bidder shall submit such data and information to the Owner.
- 4.06.00 It is not the intent to give details of every single task covered in the total engineering work to be carried out by Contractor, however, all engineering work required for the satisfactory completion of the plant/systems as specified shall be carried out by the Contractor. Broadly, the following are the minimum requirements in respect of scope of major items of work:
- 4.06.01 Preparation, updating and finalisation of scheme drawings, control and interlock diagrams, detailed and fully dimensioned layout drawings (plant layout and equipment layout detailed plan, elevation and cross-sectional drawings at different elevations / floor levels) covering all mechanical, electrical, C&I, civil and structural items, equipment, systems and facilities. Drawings and Schedules prepared by the Contractor from time to time, as detailed designs are developed, shall be submitted for Owner's / Consultant's

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- approval before the work is taken up. Revisions, corrections, additions to drawings and schedules shall not be considered to change the scope of work.
- 4.06.02 Preparation of detailed technical specifications including data sheets, tender drawings and bill of material for all bought out items, as also finalisation of corresponding sub-contractors.
- 4.06.03 Review of sub-contractor's data, drawings, design calculations, schedules, bill of materials, instruction manuals etc. for all equipment, before forwarding them to Owner/Consultant for approval.
- 4.06.04 Preparation of civil construction drawings for all equipment showing foundation details and full details regarding equipment loads, floor openings, details of embedments etc. required for preparation of civil construction drawings and also as referred at relevant sections of Scope, Terminal Points & Exclusions. These documents shall be preceded by appropriate design calculations, static and dynamic analysis as necessary.
- 4.06.05 Preparation and finalisation of process piping and instrumentation diagrams and schematics, complete in all respects for all systems/packages of the power plant.
- 4.06.06 Preparation of consolidated schedules and bills of materials, including line numbers, tag numbers, source of supply, service conditions, specifications, materials, types and connections details, quantities for items of the plant including dampers, steam traps, strainers, instrumentations, ducting.
- 4.06.07 Sizing of all piping and equipment as per the stipulated design criteria; carrying out of flexibility analysis/dynamic analysis as necessary; hangers & support engineering.
- 4.06.08 Final revision of all documents including preparation and compilation of Instruction Manuals for installation, commissioning, operation and maintenance for all equipment and systems. Refer clause 5.00.00 for the specific requirement in this regard.
- 4.06.09 Certification and submission of final as-built drawings for all areas.
- 4.06.10 Preparation and compilation of all drawings, schedules and instructions which may be required at site, whether separately mentioned or not.
- 4.06.11 All erection and assembly drawings which may be required at site.
- 4.06.12 For all bought out item packages, the Contractor shall provide complete material / component list along with detail specification, drawings, component part no. etc. during detail engineering stage prior to final approval. Such approved drawing/document shall be made available at site in adequate number prior to commencement of work. Moreover, such document/drawing shall be provided in soft form (CD)
- 4.06.13 Preparation of necessary documentation, design calculations etc. required for submission to statutory authorities like IBR, Chief Electric Inspector, Factory Inspector etc.

5.00.00 **OPERATING MANUALS AND MAINTENANCE INSTRUCTIONS**

5.01.00 The Contractor shall provide at least six (6) months before the time of commissioning and before taking over of the plant and equipment, all necessary maintenance manuals and operating instructions. The instruction manual shall be submitted in the form of one (1) soft copy in CD and 15 hard copies as per distribution schedule (Annexure-1).

5.02.00 The information provided, which shall be contained in loose leaf stiff backed covers, shall include :

- a) A complete inventory of all main items of plant, with identification details.
- b) Service manuals for all plant and equipment giving full descriptions of the main items and auxiliary items such as power packs, hydraulic equipment, actuators, lubricating pumps, etc.
- c) A separate electrical manual covering items such as switchgear, cabling, instrumentation, controls, cabling layouts and wiring diagrams.
- d) A schedule of recommendations for routine maintenance of all electrical and mechanical equipment, recommended inspection point, information on detection, cause and rectifications of troubles & faults.
- e) A lubrication schedule with all necessary drawings diagrams to identify the lubrication points.
- f) Manufacturer's literature.

5.03.00 The instruction manual shall be subject to the approval of Owner.

6.00.00 **PLANT HANDBOOK**

The Contractor shall submit to the Engineer, a preliminary plant handbook preferably in A-4 size sheets which shall contain the design and performance data of various plant, equipment and systems covering the complete project including single line flow diagrams, within twenty four (24) months from the date of his acceptance of the Letter of Intent. The final plant handbook complete in all respects shall be submitted by the Contractor six (6) months before start-up and commissioning activities. The plant handbook shall be submitted as per distribution schedule.

7.00.00 **CONTRACT STAGE DOCUMENT SUBMISSION AND APPROVAL PROCEDURE**

7.01.00 Within fifteen (15) days to one month of issue of Letter of Intent (LOI) by the Owner, the Contractor shall furnish a schedule of drawings and design

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document to be submitted by him to the Owner/Engineer indicating dates against each document.

The documents shall be divided into two categories : a) for approval and b) for information/further engineering and co-ordination by the Owner.

In preparing this schedule, the Contractor shall allow two (2) weeks from date of receipt for review and comments by the Owner/Engineer for each submission of a document.

This document submission schedule shall require approval by the Owner/Engineer.

7.02.00 All contract documents shall be marked, without fail, with the name of the Owner, the Project, the specification title and number and the unit designation.

All dimensions shall be in metric units.

All notes, markings etc. shall be in English.

7.03.00 Documents/Drawings, submitted during tender stage, shall be revalidated or revised as required and submitted as certified contract document for approval / information of the Owner/Engineer.

7.04.00 Unless specified otherwise, the following categories of documents/drawings would require approval of the Owner/Engineer:

- a) List of sub-vendors (from Owner only)
- b) System scheme and instrumentation diagrams
- c) Design basis justifying selection of equipment & process parameters where not specified in the Contract
- d) Equipment data sheets and general arrangement drawings
- e) Materials of construction
- f) Layout drawings.
- g) Operation logic diagrams.
- h) Typical control circuit.
- i) Drawings of Instrumentation and control.

7.05.00 Unless specified otherwise, the following categories of documents/ drawings would be treated for information/further engineering by the Owner/Engineer. The Contractor shall, however, incorporate all additional information and clarifications in these documents / drawings as and when desired by the Owner/Engineer.

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- a) Equipment foundation drawings.
- b) Equipment cross-section drawings, product literature etc. which are of proprietary nature.
- c) Predicted performance curves of equipment.
- d) Various bills of quantity, schedules etc.
- e) Piping fabrication drawings, isometrics etc.
- f) Panel wiring diagrams.
- g) Instruction/Operation manuals.
- h) Service manuals and trouble shooting guide for C & I system including field instruments.
- i) Cable schedule and interconnection chart.
- j) Drive/feederwise control scheme showing all external interfaces.

In essence, the Contractor is solely responsible for corrections and adequacy of design & engineering for documents under this category.

7.06.00 Upon review, the Owner/Engineer shall put his remarks and one of the following action stamps on the drawing/document:

- a) A - Drawing submitted as approved, proceed with fabrication
- b) B - Drawing approved subject to comments noted, proceed with fabrication, considering our comments. Correct as necessary and resubmit for record.
- c) C - See attached memo.
- d) D - Correct your original drawing incorporating our comments and resubmit for approval.
- e) E - Information furnished is noted.
- f) F - Prints not enclosed

For action stamps in category (c) & (d), documents must be resubmitted for review by the Owner/Engineer. For action stamp in category (b), further review by Owner/Engineer would not be necessary provided the Contractor agrees & incorporates the comments made on the document.

Except for action stamp under category (c) & (d), the Contractor can proceed with manufacturing and other sequential activities for those areas of a drawing/document which do not have any review comment by the Owner/Engineer.

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The Owner/Engineer may accord approval in category (c) or (d) in more than one submission of a document till he is satisfied that the intent of the specification has been fully complied with. The Contractor shall be responsible for delay in such cases and no extension of time shall ordinarily be allowed on such grounds. Approval of contract documents by the Owner/Engineer shall not relieve the Contractor of his responsibility for any errors and fulfillment of contract requirements.

The Contractor's work shall be in strict accordance with the finally approved drawings and no deviation shall be permitted without written approval of the Owner/Engineer.

7.07.00 Except key plan/general yard plan, any layout drawing requiring scrutiny shall not be drawn to a scale less than 1:50.

7.08.00 For review by the Consulting Engineer, the Contractor shall furnish soft copies of drawings & documents and three (3) prints of each drawing/document. Two (2) prints of such submission shall also be sent to the Owner. After review, comment/approval will be sent to the Contractor. Upon action under category (a) or (e), the Contractor shall directly distribute the documents to the various offices of the Owner and other agencies in number of copies as specified in the contract document. Such distribution copies shall be marked with the reference and date of the letter by which the Owner/Engineer has accorded his final approval. Penal action shall be taken against the Contractor for any unauthorised revision in the drawings so distributed from the drawings approved by the Owner/Engineer. The contractor shall furnish three (3) CDs of all as built/final drawings for Owner/Consultant site.

7.09.00 In case of contradiction between the stipulations above and those stated elsewhere in the specification, the stipulations herein shall prevail.

7.10.00 For details of documentation for Civil, Structural and Architectural works, VII-A, VII-B and VII-C may be referred.

8.00.00 TENDER STAGE DOCUMENT SUBMISSION

8.01.00 The Bidder shall submit along with his bid all documents/drawings as requested in respective specifications. The documents shall include but not be limited to the following :

- a) All Bid proposal sheets duly filled up.
- b) Detailed experience list and financial resources of the prime bidder his collaborators/associates in this bid as well as the sub-vendors proposed.
- c) Scheme drawings indicating scope of supply and service as offered by the Bidder indicating clearly exclusions, if any.
- d) List of terminal points of the package offered together with quality and quantity of various input (i.e. water, air, electricity etc.) as required from the Owner at such interfaces.

- e) Equipment GA, Layout, Design Calculations, interlock and other write-up, catalogues/literature etc. as required for clear understanding of the bid submitted.
- f) L-1 network indicating target dates for intermediate milestones and final commissioning of equipment supplied; This network shall be supplemented by a detailed write-up on proposal procedure of project implementation, deployment schedule for Key personnel with their bio-data, schedule of construction machinery etc.
- g) List of suppliers for all bought out items.

ANNEXURE-1

DISTRIBUTION SCHEDULE

S. No	Description	TSGENCO										M/S DCPL, KOLKATA			Equipment Vendor	Remarks
		Director Projects	Director Technical	CE/Civil Thermal Projects Hyd.	CE/ TPC-I, Hyd	CE/ O&M/ KTPS	SE/ Civil KTPS	SE/E&M / KTPS	DE Constr. KTPS	Kolkata	HYD	KTPS				
A	Letter Of Intent or Contract Documents	1	1	1	S	1	2	2	1	1	1	1	1	1	2	
B	Vendor Drawings															
1.	Preliminary	1	1	1	2	1	1	2	2	12	1	-	-	S		
2.	Return preliminary with comments	-	-	1	2	1	1	1	1	S	1	-	-	1		
3.	Final and any revision thereof															
	a. Civil	1	1	6+1T	1	1	1	6+1T	1	2+1T	1	1	1	S		
	b. E&M	1	1	1	6+1T	1	1	1	6+1T	2+1T	1	1	1	S		
C.	Design Drawings															
1.	Preliminary															
	a. Civil	1	1	2	1	1	1	2	1	4	1	1	1	S		
	b. E&M	1	1	1	2	1	1	1	2	4	1	1	1	S		
2.	Released for construction															
	a. Civil	1	1	2	1	1	1	6	1	1	1	2	2	S		
	b. E&M	1	1	1	1	2	1	1	6	1	1	2	2	S		
3.	Return marked 'As built'															
	a. Civil	-	-	1	-	-	1	1	-	1	1	S	1	1		
	b. E&M	-	-	-	1	-	-	-	1	1	1	S	1	1		
4.	As built drawings															
	a. Civil	-	-	1+1T	-	2+1T	5+1T	-	-	1+1T	1	1	1	S		
	b. E&M	-	-	1	2+1T	2+1T	-	5+1T	1+1T	1+1T	1	1	1	S		

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S. No	Description	TSGENCO										M/S DCPL, KOLKATA			Equipment Vendor	Remarks
		Director Projects	Director Technical	CE/Civil Thermal Projects Hyd.	CE/ TPC-I, Hyd	CE/ O&M/ KTPS	SE/ Civil KTPS	SE/E&M / KTPS	DE Constr. KTPS	Kolkata	HYD	KTPS				
D	Progress Report Monthly															
1.	Equipment vendor	1	1	1	2	1	1	2	1	1	1	1	1	1	S	
2.	M/s DCPL, Kolkata	1	1	2	2	1	1	2	1	1	1	1	1	1	Nil	
E	Test & Inspection Reports															
1.	Equipment manufacturer															
a.	Civil	1	1	1	2	1	1	1	1	1	1	1	1	1	S	
b.	E&M	1	1	-	2	1	1	1	-	1	1	1	1	1	S	
2.	M/s DCPL, Kolkata	1	1	-	2	1	1	1	-	1	1	1	1	-	-	
F	Instruction Manuals/Data Books															
1.	Equipment manufacturer															
a.	Civil	1	1	1+1T	1	1	1	1	6+1T	1	1	1	2+1T	1	S	
b.	E&M	1	1	-	3+1T	1	1	1	-	6+1T	2	3+1T	1	1	S	
2.	M/s DCPL, Kolkata	1	1	-	10+1T	1	1	1	-	15+1T	-	S	1	1	Nil	
G	M/s DCPL, Kolkata Criteria	1	1	1	8+1T	1	1	1	1	2	1	1	1	1	S	
H	Design Calculations	1	1	1	8+1T	1	1	1	1	2	1	1	1	1	S	
I	Final consulting Engineering Report	1	1	1	10	1	1	1	1	2	1	1	S	1	Nil	

S – Source, T – Transparency & Soft Copy on CD,

TSGENCO : Telangana State Power Generation Corporation Limited
 Director, Projects, Hyd : Director/ Projects, TSGENCO, Vidut Soudha, Hyderabad – 500 082

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Director, Technical, Hyd	:	Director/ Technical, TSGENCO, Vidyut Soudha, Hyderabad – 500 082
CE/ Civil, Hyd	:	Chief Engineer/Civil, Thermal Projects, TSGENCO, Vidyut Soudha, Hyderabad – 500 082
CE/ TPC-I, Hyd	:	Chief Engineer/TPC, TSGENCO, Vidyut Soudha, Hyderabad – 500 082
CE/ O&M/ KTPS	:	Chief Engineer(O&M), KTPS, Kothagudem, Telangana
SE/Civil, KTPS	:	Superintending Engineer (Civil), KTPS, Kothagudem, Telangana
SE/E&M, KTPS	:	Superintending Engineer (E&M), KTPS, Kothagudem, Telangana
DE/Constr./ KTPS	:	Divisional Engineer/Construction, KTPS, Kothagudem, Telangana
M/s DCPL, Kolkata	:	M/s DCPL, Kolkata.
M/s DCPL, Hyd	:	M/s DCPL, Hyderabad.
M/s DCPL, KTPS	:	M/s DCPL, KTPS, Kothagudem, Telangana

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QUALITY ASSURANCE REQUIREMENTS

CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	QUALITY ASSURANCE PROGRAMME
2.00.00	GENERAL REQUIREMENTS QUALITY ASSURANCE
3.00.00	QUALITY ASSURANCE DOCUMENTS
4.00.00	INSPECTION, TESTING & INSPECTION CERTIFICATES

ATTACHMENTS

ANNEXURE-I	FORMAT OF QUALITY ASSURANCE PROGRAMME
ANNEXURE-II	FIELD WELDING SCHEDULE

QUALITY ASSURANCE REQUIREMENTS

1.00.00 QUALITY ASSURANCE PROGRAMME

1.01.00 To ensure that the equipment and services under the scope of Contract whether manufactured or performed within the Contractor's works or at his Sub-contractor's premises or at the Owner's site or at any other place or work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points, as necessary. Such programmes shall be outlined by the Contractor and shall be finally accepted by the Owner/Authorised representative after discussions before the award of contract. A quality assurance programme of the Contractor shall generally cover the following :

- a) His organisation structure for the management and implementation of the proposed quality assurance programme.
- b) Documentation control system.
- c) Qualification data for Bidder's key personnel.
- d) The procedure for purchase of materials, parts, components and selection of Sub-contractor's services including vendor analysis, source inspection, incoming raw-material inspection, verification of materials purchased etc.
- e) System for shop manufacturing and site erection control including process controls and fabrication and assembly controls.
- f) Control of non-conforming items and system for corrective actions.
- g) Inspection and test procedure both for manufacture and all site related works.
- h) Control of calibration and testing of measuring and testing equipments.
- i) System for quality audit.
- j) System for indication and appraisal of inspection status.
- k) System for authorising release of manufactured product to the Owner.
- l) System for handling storage and delivery.
- m) System for maintenance of records.

- n) Furnishing of quality plans for manufacturing and field activities detailing out the specific quality control procedure adopted for controlling the quality characteristics relevant to each item of equipment/component as per format enclosed at Annexure-I to this section for Owners approval
- o) Internal standards, if referred in the quality plans shall generally be compatible with National / International standards and shall be mentioned in the quality plans. Alternatively bidder shall furnish extracts of the internal standards detailing out acceptance norm for the product / material.

2.00.00 GENERAL REQUIREMENTS - QUALITY ASSURANCE

2.01.00 All materials, components and equipment covered under this specification shall be procured, manufactured, erected, commissioned and tested at all the stages, as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the Contractor for some of the major items is given in the respective technical specification. This is however, not intended to form a comprehensive programme as it is the Contractor's responsibility to draw up and implement such programme duly approved by the Owner/Consultant. The detailed Quality Plans for manufacturing and field activities should be drawn up by the Bidder, separately in the format attached at Annexure-I and will be submitted to Owner/Authorised representative for approval. Schedule of finalisation of such quality plans will be finalised before award.

Contractor shall furnish list of Manufacturing Quality Plans of major equipments indicating proposed inspection categorisation indicating items that will be offered for Owner's inspection etc and the Field Quality Plans

2.02.00 Manufacturing Quality Plan for all the major equipment will detail out their respective important components, their in-process various tests/inspection & final inspection / tests, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Contractor's Quality Control organization. The relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing are to be comprehensibly documented by Contractor.

Manufacturing Quality Plan for all major equipments/ items will be approved by owner. In these approved quality plans, Owner / Authorised representative shall identify customer hold points (CHP), test / checks which shall be carried out in presence of the Owners Engineer or his authorised representative and beyond which the work shall not proceed without consent of Owner / Authorised representative in writing. Inspection/ Test reports are to be submitted to owner as specified in final approved Manufacturing Quality Plans.

2.03.00 Field Quality Plans / Procedures for all field activities shall be submitted to

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owner for review / approval. These Quality Plans / procedures will detail out, for all equipment, the quality practices and procedures etc. to be followed by the Contractor's site Quality Control organisation, during various stages of site activities from receipt of materials/ equipment at site.

- 2.04.00 The Bidder shall also furnish copies of the reference documents/plant standards/acceptance norms/tests and inspection procedure etc., as referred in Quality Plans along with Quality Plans. These Quality plans and reference documents/standards etc. will be subject to Owner's approval without which manufacture shall not proceed. These approved documents shall form a part of the contract. In these approved quality plans, Owner/Authorised representative shall identify customer hold points (CHP), test/checks which shall be carried out in presence of the Owners Engineer or his authorised representative and beyond which the work will not proceed without consent of Owner/Authorised representative in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and major deviations in the form of Non Conformity Report shall be referred to Owner/Authorised representative for approval and dispositioning.
- 2.05.00 No material shall be despatched from the manufacturer's works before the same is accepted subsequent to pre-despatch final inspection including verification of records of all previous tests/inspections by Owner's Engineer/ Authorised representative for "CHP" and "W" points marked in quality plans , and duly authorised for despatch by issuance of Material Despatch Clearance Certificate (MDCC). For items which is not under owner's inspection the contractor shall apply for despatch clearance (MDCC) from owner by submitting their internal inspection reports and quality records
- 2.06.00 All materials used or supplied shall be accompanied by valid and approved materials certificates and tests and inspection report. These certificates and reports shall indicate the sheet serial numbers or other such acceptable identification numbers of the material. The material certified shall also have the identification details stamped on it.
- 2.07.00 Castings and forgings used for construction shall be of tested quality. Details of results of chemical analysis, heat treatment record, mechanical property test results shall be furnished.
- 2.08.00 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section - IX (latest edition) or other International equivalent standard acceptable to the Owner.

All brazers, welders etc. employed on any part of the contract at Contractor's/ Sub-Contractor's works or at site shall be qualified as per ASME Section-IX (latest edition) or equivalent international standard approved by the Owner. Such qualification tests shall be conducted in presence of Owner / his authorised representative or owner approved Third Party Inspection Agency(TPIA). Previously qualified WPS & PQR shall be acceptable if witnessed by owner's approved TPIA.

For welding of pressure parts and high pressure piping coming under IBR purview, the requirements of IBR shall also be complied with.

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- 2.09.00 All non-destructive examination (NDT) shall be carried out in accordance with LIST OF STANDARDS FOR REFERENCE as given below in this section.
- The NDT operator shall be qualified as per SNT-TC-IA (of American Society of non- destructive examination). Results of NDT for the list major equipments / items identified for owner's inspection shall be properly recorded and submitted for review and approval. Other items not covered under owner's inspection, contractor shall review and approve the NDT results and such reports shall be submitted to owner in the final documentation of the items / equipments
- 2.10.00 All the sub-vendors proposed by the Contractor for procurement of major bought out items including castings, forgings, semi-finished and finished components/equipment list of which shall be drawn up by the Contractor and finalised with the Owner shall be subject to Owner's approval. Quality Plans of the successful vendors shall be discussed, finalised and approved by the Owner/Authorised representative and form part of the Purchase Order between the Contractor and the Vendor.
- 2.11.00 All the purchase specifications for the major bought-out items, list of which shall be drawn up by the Contractor and finalised with the Owner shall be furnished to the Owner for comments and subsequent approval before orders are placed.
- Owner reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the Contractor's or their sub-vendor's quality management and control activities. The Contractor shall provide all necessary assistance to enable the Owner carry out such audit and surveillance.
- Quality audit/approval of the results of tests and inspection will not prejudice the right of the Owner to reject equipment not giving the desired performance after erection and shall not in no way limit the liabilities and responsibilities of the Contractor in earning satisfactory performance of equipment as per specification.
- 2.12.00 Quality requirements for main equipment shall equally apply for spares and replacement items.
- 2.13.00 Repair/rectification procedures to be adopted to make any job acceptable shall be subject to the approval of the Owner.
- 2.14.00 For quality assurance of all civil works refer to the specifications for civil works.
- 3.00.00 **QUALITY ASSURANCE DOCUMENTS**
- 3.01.00 The Contractor shall be required to submit two (2) copies and two (2) sets of microfilms / CDs of the following Quality Assurance documents within three (3) weeks after despatch of the equipment:
- a) Material mill test reports on components as specified by the specification.

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- b) The inspection plan with verification, inspection plan check points, verification sketches, if used and methods used to verify that the inspection and testing points in the inspection plan were performed satisfactorily.
- c) Non-destructive examination results /reports including radiography interpretation reports.
- d) Factory tests results for testing required as per applicable codes and standards referred in the specification.
- e) Welder identification list listing welder's and welding operator's qualification procedure and welding identification symbols.
- f) Sketches and drawings used for indicating the method of traceability of the radiographs to the location on the equipment.
- g) Stress relief time temperature charts.
- h) Inspection reports duly signed by QA personnel of the Owner and Contractor for the agreed inspection hold points. During the course of inspection, the following will also be recorded :
 - i) When some important repair work is involved to make the job acceptable.
 - ii) The repair work remains part of the accepted product quality.
- i) Letter of conformity certifying that the requirement is in compliance with finalised specification requirements.

4.00.00 INSPECTION, TESTING AND INSPECTION CERTIFICATES

4.01.00 The Owner's Engineer, or his duly authorised representative and/or an outside inspection agency acting on behalf of the Owner shall have access inside the workshops, test labs, establishments at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor shall obtain for the Owner's Engineer and for his duly authorised representative permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.

4.02.00 The Contractor shall give the Owner's Engineer/ Authorized Inspector twenty one (21) days written notice for "CHP" / "W" points of any material being ready for testing by owner' engineer / Authorized inspector. Such tests shall be to the Contractor's account except for the expenses of the Inspector. The Engineer/ Inspector, unless the witnessing of the tests is virtually waived, will attend such tests within fifteen (15) days of the date on which the equipment is notified as being ready for test/inspection. If owner's Engineer / Authorised Inspector fail to attend the inspection, next mutually convenient date for test shall be agreed with Contractor. Contractor shall, in

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- no case proceed with the test without owner or his authorized inspectors, unless the witnessing is officially waived and advised Contactor to proceed with the test. Contactor shall forthwith forward duly certified completed test report and a product quality certificate in six (6) copies to owner upon completion of such test.
- 4.03.00 The Engineer or Inspector shall within fifteen (15) days from the date of Inspection as defined herein give notice in writing to the Contractor, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract / QAP or other approved quality documents. The Contractor shall give due consideration to such objections and shall either make modifications that may be necessary to meet the said objections or shall confirm in writing to the Engineer/Inspector giving reasons therein, that no modifications are necessary to comply with the contract / QAP or other approved quality documents.
- 4.04.00 When the factory tests have been completed at the Contractor's or sub-contractor's works, the Engineer/Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests excluding the test completion date subject to submission of all certified documents related to the test, If the tests are not witnessed by the Engineer/Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Contractor's test certificate by the Engineer/Inspector. Failure of the owner's Engineer/Inspector to issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests, or the issue of the certificates shall not bind the Owner to accept the equipment should it, on further tests after erection be found not to comply with the contract / QAP or other approved quality documents.
- 4.05.00 In all cases where the contract provides for tests whether at the premises or works of the Contractor or any sub-contractor, the Contractor, except where otherwise specified shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the owner's Engineer/Inspector or his authorised representatives to carry out effectively such tests on the equipment in accordance with the Contract / QAP or other approved quality documents. Contractor and shall give facilities to the owner's Engineer/ Inspector or to his authorised representative to accomplish testing.
- 4.06.00 To facilitate advance planning of inspection in addition to giving inspection notice as per Clause 4.02.00, the Contractor shall furnish quarterly inspection programme indicating proposed schedule dates of inspection at customer hold point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.

LIST OF STANDARDS FOR REFERENCE

- a) International Standards Organisation (ISO).
- b) International Electro-technical Commission (IEC).
- c) American Society of Mechanical Engineers(ASME)
- d) American National Standards Institute (ANSI).
- e) American Society for Testing and Materials (ASTM).
- f) American Institute of Steel Construction (AISC).
- g) American Welding Society (AWS).
- h) Architecture Institute of Japan (AIJ).
- i) National Fire Protection Association (NFPA).
- j) National Electrical Manufacturer's Association (NEMA).
- k) Japanese Electro-technical Committee (JEC).
- l) Institute of Electrical and Electronics Engineers (IEEE).
- m) Federal Occupational Safety and Health Regulations (OSHA).
- n) Instrument Society of America (ISA).
- o) National Electric Code (NEC).
- p) Heat Exchanger Institute (HEI).
- q) Tubular Exchanger Manufacturer's Association (TEMA).
- r) Hydraulic Institute (HIS).
- s) International Electro-Technical Commission Publications.
- t) Power Test Code for Steam Turbines (PTC).
- u) Applicable German Standards (DIN).
- v) Applicable British Standards (BS).
- w) Applicable Japanese Standards (JIS).
- x) Electric Power Research Institute (EPRI).
- y) Standards of Manufacturer's Standardization Society (MSS)

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- z) Bureau of Indian Standards Institution (BIS).
- aa) Indian Electricity Rules.
- bb) Indian Boiler Regulations (IBR).
- cc) Indian Explosives Act.
- dd) Indian Factories Act.
- ee) Tariff Advisory Committee (TAC) rules.
- ff) Emission regulation of Central Pollution Control Board (CPCB).
- gg) Pollution Control regulations of Dept. of Environment, Govt. of India
- hh) Central Board of Irrigation and Power (CBIP) Publications

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**ANNEXURE-I
FORMAT OF QUALITY ASSURANCE PROGRAMME**

VENDOR'S LOGO , NAME & ADDRESS	MANUFACTURING QUALITY ASSURANCE PLAN	DOC NO: XXXXX-CAL-QAP-M-0001			
ITEM : -		REV NO : 0 1 2 3 4			
		DATE :			
CLIENT :		LOCATION			
PROJECT :		REFERENCE PURCHASE ORDER NO. & DT :			
VENDOR :		REFERENCE APPROVED DATA SHEET :			
SUB VENDOR :		REFERENCE APPROVED DRAWING. NO. :			
ABBREVIATIONS :		GENERAL REMARKS			
QAP - QUALITY ASSURANCE PLAN, CR - CRITICAL, MA - MAJOR, MI - MINOR SPEC - SPECIFICATION, TC - TEST CERTIFICATES P - PERFORM W - WITNESS V - VERIFY CHP - CUSTOMER HOLD POINT		1 THE ITEMS WHICH ARE FALLING UNDER ANY STATUTORY AUTHORITY'S (LIKE I.B.R. ETC.) SCOPE SHALL BE SUBJECTED TO THAT STATUTORY AUTHORITY'S INSPECTION CLEARANCE.			
AGENCY :		1 - DCPL/PROJECT AUTHORITY 2 - SUPPLIER 3 - SUB-SUPPLIER 4 - MANUFACTURER 5 - THIRD PARTY INSPECTION AGENCY			
MATL - MATERIAL, APP - APPROVED, DWG - DRAWING, SUPL - SUPPLIER, PROC - PROCEDURE					
NOTES:		1. EXACT MATERIAL / PROCESS / INSPECTION / TESTS FOLLOWED BY THE MANUFACTURER SHALL BE SPECIFIED 2. EXACT REFERENCE DOCUMENT/ACCEPTANCE STANDARD SHALL BE SPECIFIED 3. IN CASE SPECIFIED ACCEPTANCE STANDARD / NORMS IS OTHER THAN NATIONAL / INTERNATIONAL STANDARDS . STANDARD / COPY OF THE ACCEPTANCE NORMS FOLLOWED BY THE MANUFACTURER SHALL BE SUBMITTED FOR REVIEW RECORD 4 FINAL INSPECTION DOSSIER SHALL BE PREPARED BY MANUFACTURER & SHALL BE ENDORSED BY INSPECTION AGENCY			
Prepared by		Checked by			
Revision DATE	R0	R1	R2	R0	R1 R2
		R2			
		R0	R1	R2	R0 R1 R2

DEVELOPMENT CONSULTANTS
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V.IIA/S-7 : 9

ANNEXURE-II

FIELD WELDING SCHEDULE

PROJECT : FWS NO :
 CONTRACTOR : REV NO. :
 PACKAGE : FIELD WELDING CODE :
 SYSTEM : PAGE NO. :

Sl No.	Drawing No. for Weld Locations & Identification mark	Description of parts to be welded	Material specification	Dimensions	Process of Welding	Type of Weld	Electrode Filler Specification	WPS No.	Minimum Pre-heat Temperature	Heat Treatment Temperature [Holding Time in secs]	NDT Method	NDT Specification Number	Acceptance Norm Ref.	Remarks
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The Field Welding Schedule should be submitted for :

- 0 Pressure Parts
- 0 Tanks/Vessels
- 0 Piping
- 0 Heavy/Important Structural Steel
- 0 Heat Exchangers
- 0 Bus Ducts

REQUIREMENTS OF SPARES, TOOLS & TACKLE, LUBRICANTS/OIL/CONSUMABLES

CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	TOOLS AND TACKLE
2.00.00	SPARES
	ATTACHMENT
ANNEXURE-I	MANDATORY SPARE LIST

**REQUIREMENTS OF SPARES, TOOLS & TACKLE,
LUBRICANTS/OIL/CONSUMABLES**

1.00.00 TOOLS & TACKLE

The Contractor shall supply with the equipment one complete set of special tools and tackle as required for the erection, assembly, dismantling & maintenance of the equipment. These special tools will also include special material handling equipment, jigs & fixtures for maintenance and calibration/readjustment, checking & measurement aids etc. A list of such tools & tackle shall be submitted by the Bidder along with the offer. Detailed description of each tools/tackle, its function along with the equipment/part for which it is meant for and the price of each tools/tackle shall also be indicated in the offer. These tools & tackle shall be separately packed and sent to site before the first unit commissioning. The Bidder shall also ensure that these tools are not used for erection purpose.

2.00.00 SPARES

2.01.00 General

The Bidder shall indicate and include in his scope of supply all the necessary start-up, commissioning and recommended spares in addition to mandatory spares as specified elsewhere in the specification. The Owner reserves the right to buy any or all mandatory and recommended spares. The Contractor shall also state for each item of spares both mandatory and recommended, the normal expected service life.

2.01.01 All spares supplied under this contract shall be strictly interchangeable with the parts for which they are intended to replace. 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 bags with dessicator packs as necessary.

2.01.02 Each spare part shall be clearly marked or labelled on the outside of the packing with the description. When more than one spare part is packed in a single case, a general description of the contents shall be shown on the outside and a detailed list enclosed. All cases, containers and other packages must be suitably marked and numbered for the purposes of identification.

2.01.03 All cases, containers or other packages are liable to be opened for examination as may be considered necessary by the Engineer.

2.01.04 All mandatory spares shall be delivered to site within one to three months prior to the scheduled date of the trial operation of the plant. However, they shall not be despatched before the despatch of the associated main equipment.

- 2.01.05 The Bidder shall also guarantee supply of spare parts, which will be made, based on manufacturer's drawings on special order from the Purchaser for 30 years after commissioning of the plant.
- 2.01.06 Warranty period for all kinds of spares shall be six thousand (6000) hours of operation, except normal wear or eighteen (18) months from the date of receipt at site, whichever is earlier. In case of failure or non-conformance to specifications, the Contractor shall replace them free of cost.
- 2.02.00 **Recommended Spares**
- 2.02.01 The Contractor shall provide a list of recommended spares giving unit prices and total prices for 2 years of normal operation of the plant for spares of indigenous origin, and for 5 years of normal operation for spares of non-indigenous origin. This list shall take into consideration the mandatory spares specified elsewhere in the specification and should be a separate list.
- 2.02.02 The price of recommended spares will not be used for the evaluation of bids. The price of these spares shall remain valid for a period as specified elsewhere in the specification from the date of Award of the Contract. Where the recommended spares are the same as mandatory spares, the prices shall be the same. The prices of any recommended spares, which are not common with mandatory spares, shall be subject to review by the Owner, and shall be finalised after mutual discussion.
- 2.03.00 **Start-up Commissioning Spares**
- 2.03.01 Start-up commissioning spares are those spares which may be required during the start-up and commissioning of the equipment/system. All spares used until the plant is handed over to the Owner shall come under this category. Said spares, properly marked, shall be supplied together with the main equipment and shall be used by the Contractor, if needed, during erection & commissioning stage. All such spares which remain unused till issuance of Taking Over Certificate by the Owner, along with an equipment-wise quantitative consumption report shall be returned to the Owner during time of handover. The list of commissioning spares to be brought by the Contractor to ensure smooth commissioning of the plant shall be subject to the Engineer's approval.
- 2.03.02 The Contractor shall submit a complete BBU list inclusive of recommended, mandatory, initial start-up and commissioning spares. Costs of the above spares, which are consumed before the handing-over of the plant, shall be deemed to have been included in the lump sum proposal price of the package, and the Contractor shall have no claim on this account to the Owner.
- 2.04.00 **Mandatory Spare Parts**
- 2.04.01 The Owner considers some of the spares are essential for running the equipment irrespective of whether they are included in the list of recommended spares by the Bidder as mentioned above.

Since the components involved can not be foreseen at the bidding stage, only

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broad requirements of the Owner in this respect are outlined hereinafter. The bidder shall include his proposal, on the basis of this guideline, an item-wise list of all components and the quantity, unit prices & total price thereof, offered as mandatory spares for each and every equipment. This list shall be separate from the list of recommended spares and shall be used for bid evaluation purposes. Any clarification in this respect may be obtained by the Bidder at the pre-bidding stage.

2.04.02 The mandatory spares should be supplied to the Owner at least one month before the trial run. The despatch programme is subject to approval of the Owner/Consultant after award of contract.

2.04.03.1 Criteria for selection of Quantity of Mandatory Spares :

For Mandatory Spares refer Annexure-V

2.04.04 Purchaser will have the option to procure any or all of the mandatory spares at his discretion.

**TECHNICAL SPECIFICATION
FOR
PRESSURE AND STORAGE VESSELS**

**TECHNICAL SPECIFICATION
FOR
PRESSURE AND STORAGE VESSELS**

C O N T E N T S

CLAUSE NO.	DESCRIPTION	PAGE NO.
1.00.00	INTENT OF SPECIFICATION	1 OF 9
2.00.00	CODES AND STANDARDS	1 OF 9
3.00.00	GENERAL DESIGN FEATURES	2 OF 9
4.00.00	MATERIAL OF CONSTRUCTION	3 OF 9
5.00.00	FABRICATION	4 OF 9
6.00.00	APPURTENANCES	5 OF 9
7.00.00	ERECTION	7 OF 9
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9.00.00	TESTS & INSPECTION	9 OF 9

**TECHNICAL SPECIFICATION
FOR
PRESSURE AND STORAGE VESSELS**

1.00.00 INTENT OF SPECIFICATION

This specification covers the design, manufacture, shop testing, shop testing, construction, fabrication, erection, testing, inspection & commissioning of pressure and storage vessels at works & site.

2.00.00 CODES AND STANDARDS

The design, manufacture, shop testing, site fabrication and erection, testing and commissioning of the pressure vessels and atmospheric storage tanks vessels shall conform to the latest revisions of the following standards, in addition to other standards addressed elsewhere in the Bid Specification subject to any modification and requirement, as specified elsewhere:

a)	ASME Section VIII	Rules for Construction of Pressure Vessels
b)	ASTM Standards	Standards published by American Society for Testing and Materials
c)	BS EN 12285-2	Workshop fabricated steel tanks. Horizontal cylindrical single skin and double skin tanks for the aboveground storage of flammable and non-flammable water polluting liquids
d)	IS-803	Code of Practice for Design Fabrication and Erection of Vertical Mild Steel Cylindrical Welded Oil Storage Tanks
e)	IS-816	Code of Practice for Use of Metal Arc Welding for General Construction in Mild Steel
f)	IS-817	Code of Practice for Training and Testing of Metal Arc Welders
g)	IS-822	Code of Procedure for Inspection of Welds
h)	IS-1363 Part 1 to Part 3	Hexagon Head Bolts, Screws and Nuts of Product Grade C
i)	IS-1367 Part 1 to Part 16	Technical Supply Conditions for Threaded Steel Fasteners
j)	IS-2002	Steel Plates for Pressure Vessels for Intermediate

		and High Temperature Service including Boilers
k)	IS-2062	Hot Rolled Medium and High Tensile Structural Steel
l)	IS-2825	Code for Unfired Pressure Vessels
m)	IS-3133	Manhole and Inspection Openings for Chemical Equipment - General Requirements
n)	IS-4049 Part 1 & Part 2	Formed Ends for Tanks and Pressure Vessels
o)	IS-4682 Part 1 to Part 10	Code of Practice for Lining of Vessels and Equipment for Chemical Processes
p)	IS-4864 to IS-4870	Shell Flanges for Vessels and Equipment

3. 00.00 GENERAL DESIGN FEATURES

3. 01.00 Design of all pressure vessels shall conform to IS 2825 or ASME Section VIII Division-I or equivalent code / standard (subject to approval by Purchaser).

3. 02.00 Design of all vertical cylindrical atmospheric storage tanks containing water, acid, alkali and other chemicals shall conform to IS-803.

Supporting frame where required for design of Demineralized Water Storage Tanks shall be in accordance with IS-800. The tank shall be "Non-pressure" fixed roof type with atmospheric vents.

3. 03.00 Design of all horizontal cylindrical atmospheric storage tank containing decationized water, acid, alkali and other chemicals shall conform to BS EN 12285-2.

3. 04.00 Design temperature of all pressure vessels and atmospheric 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.

3. 05.00 Design pressure shall be the maximum expected pressure to which the vessels may be subjected to plus 5% additional 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 pumps suction, if any.

3. 06.00 In case, tank is subjected to vacuum under any situation, the same shall be duly considered as one of the criteria for design of the tank.

3. 07.00 Each pressure vessel / atmospheric storage tank without inside rubber lining shall have a corrosion allowance of minimum 2.0 mm.

3. 08.00 Mill tolerance as per applicable code (minimum 0.3 mm) shall be duly considered for each shell as well as dished end.

3. 09.00 Thinning allowance of 2.0 mm (minimum) shall be considered for each dished end.

3. 10.00 Effective liquid volume for an atmospheric storage tanks tank shall be considered as the liquid volume in between the design highest operating level / design highest level switch set point and design lowest operating level / design lowest level switch set point.
3. 11.00 A liquid volume (corresponding to a minimum of 100 mm shell / liquid height in between design lowest operating level / design lowest level switch set point and top of side mounted outlet nozzle / bottom of tank) below the required effective liquid volume shall be considered & provided for satisfactory functioning of concerned level switch.
3. 12.00 Each atmospheric tank shall have sufficient free board (minimum 300 mm unless specified otherwise) above the design highest level / design highest level switch set point.
3. 13.00 The invert of overflow nozzle shall be kept at least 50 mm or 5 % of total height whichever is higher above the design highest level / design highest level switch set point for each of the atmospheric tanks, except for the Demineralized Water Storage Tanks.
3. 14.00 For Demineralized Water Storage Tanks, the invert of overflow nozzle shall be kept at least 500 mm or 5 % of total shell height whichever is higher above the design highest level / design highest level switch set point.
3. 15.00 A minimum 100 mm shell height shall be provided above the top of overflow nozzle of each atmospheric storage tank.
3. 16.00 Wall thickness of each of atmospheric tanks shall not be less than 6 mm. If higher thickness for any atmospheric storage tank is specified elsewhere in this Specification, the same shall be provided.
3. 17.00 Vessels coming under preview of IBR shall be designed accordingly.
4. 00.00 **MATERIAL OF CONSTRUCTION**
4. 01.00 The pressure vessels shall be designed as Class 3 vessels (as per IS-2825) and fabricated of steel as per IS-2062 / IS-2002 Grade 3 or SA-515 / 516 Grade 60 / 70 In case, the vessels are designed as Class 1 or Class 2 vessels (as per IS-2825), the material of construction shall conform to IS-2002 Grade 3.
4. 02.00 Atmospheric storage tanks shall be fabricated of mild steel as per IS-2062.
4. 03.00 The material of construction for various connections, for all the lined or unlined vessels/tanks shall be same as that of interconnecting piping material suitably lined wherever required. The pipe flanges, manhole/manhole covers, reinforcement pads etc. shall be fabricated out of the same material as that one used for the vessel / tank. However, screwed fittings for instrumentation, sample connection, drain connection of size 25 mm NB and less shall be of stainless steel construction (SS-316).

5. 00.00 FABRICATION

5. 01.00 All pressure vessels and storage tanks except the large tanks like Demineralised Water Storage Tanks should preferably be fabricated and tested completely at manufacturer's works to ensure better workmanship.
5. 02.00 The plates to be used for fabrication shall preferably have a minimum width of 1500 mm.
5. 03.00 Ends of pressure vessels shall be of dished design and constructed of forging, pressing or spinning as per IS-4049.
5. 04.00 Interior surfaces of all atmospheric storage tanks shall be clear of stiffeners and other structural supports. Tanks shall be reinforced and stiffened externally as required.
5. 05.00 Plates to be used for fabrication of atmospheric vertical storage tanks shall be accurately formed in bending rolls to the diameters called for and cold rolled through plate bending machine by several number of passes to true curvature and joined by welding.
5. 06.00 The atmospheric vertical storage tanks shall have flat bottom.
5. 07.00 Ends of atmospheric horizontal storage tanks shall be of dished design and constructed of forging, pressing or spinning as per IS-4049. Conical or Flat Ends shall not be accepted.
5. 08.00 All welding shall be as per IS-816 or equivalent code (subject to approval by Purchaser). The qualification of the welders should be as specified in IS-817 and welding electrodes shall be as per relevant Codes / Standards.
5. 09.00 Bidder shall state clearly in his proposal the make and type of welding rods necessary for fabrication / construction work.
5. 10.00 Welding sequence shall be adopted in such a way so as to minimize the distortion due to welding shrinkage. The Bidder shall indicate in drawing, the sequence of welding proposed which should meet prior approval of the Purchaser. Welding shall not be carried out when the surface of the parts to be welded are wet from any cause and during periods of rain and high winds unless the welder and work are properly shielded.
5. 11.00 All seams shall be so positioned that they do not pass through connections of vessel / tank. The connections shall be flushed with inner surface of vessel / tank and welded continuous on both sides of the vessel / tank. Sharp inside edges shall be rounded to a minimum 3 mm radius. Inside seam weld shall be ground smooth, suitable for applicable of corrosion resistant coating / lining.
5. 12.00 All the joints (circumferential / longitudinal) shall be double butt welded with full penetration or single butt welded without backing strip. For joints involving small thickness 6 mm or less, back chipping to metal followed by DP test and re-welding shall be done to have full penetration.
5. 13.00 All internal baffles, wear plates, pipes etc. shall be continuously welded on both sides at all contact points with full fillet welds which shall be free of voids, gaps,

- craters, high spots, sharp edges, and undercutting. Sharp edges shall be ground to a 3 mm minimum radius.
5. 14.00 All welds on inner surface of vessel / tank shall be free of voids, gaps, craters, pits, high spots, sharp edges, abrupt ridges and valleys or undercut edges. High spots, irregularities and sharp edges shall be removed by grinding.
5. 15.00 Weld splatter shall be removed.
5. 16.00 Inspection of all welds shall be carried out in accordance with IS-822 'Code of Practice for Inspection of Welds.'
6. 00.00 **APPURTENANCES**
6. 01.00 Internals for pressure vessels and atmospheric storage tanks shall be provided as detailed out elsewhere in the specification and as further required.
6. 02.00 All the pressure vessels and atmospheric storage tanks shall be provided with drain connections along with drain valves of suitable size.
6. 03.00 All the pressure vessels and atmospheric storage tanks shall be provided with the vent connections. The design shall be as to offer adequate area for venting. Venting area shall be such that over pressure/vacuum is not created during maximum filling / withdrawal rate. The maximum withdrawal rate for the Demineralized Water Storage Tanks shall be intimated later at detail engineering stage to the Bidder.
6. 04.00 Various instrumentation and the fittings required for the pressure vessels and atmospheric storage tanks shall be provided as elaborated elsewhere in the specification.
6. 05.00 **Manholes / Hand Holes**
- 6.05.01 Manholes shall be provided for all pressure vessels and atmospheric storage tanks to provide easy access into the same. The diameter shall be minimum 500 mm and each manhole will be provided with cover plate, nuts, bolts and gaskets to ensure leak tightness at the test pressure. Manholes shall be davit type for rubber lined vessels.
- 6.05.02 Each of the pressure vessels and horizontal type storage tanks shall be provided with at least one manhole at the top.
- 6.05.03 Each of the vertical type atmospheric storage tanks with diameter 1200 mm or more shall be provided with a manhole on the top. For the Demineralized Water Storage Tanks, manholes shall be provided as per IS-803.
- 6.05.04 Each of the pressure vessels filled with ion exchange resins shall be provided with a handhold of diameter at least 150 mm at a level in the vicinity of bottom of resin bed.
- 6.05.05 The required lining / coating for the inside surface of the manhole / handhold, nozzle and cover plate of the manhole/ handhold shall be same as that of the respective vessel/tank.
6. 06.00 **Nozzle Connections**

- 6.06.01 Bidder shall furnish all materials required for nozzle connections with reference to system requirements. In addition to these, additional nozzle connections, if required by the Purchaser for the inter-connection with other systems / piping / instruments etc. shall also be provided. Such additional requirements may be intimated to the Bidder later at detail engineering stage and Bidder shall provide the same complete with necessary supports and other accessories without any sort of price implication whatsoever.
- 6.06.02 Nozzle wall thickness shall be as per relevant code for design to be followed for the vessel/tank in questions.
- 6.06.03 All flanged connections should be supplied complete with matching counter flanges, bolts, nuts and gasket materials. The flange design (thickness and drilling etc.) shall match with the interconnected piping flanges.
- 6.06.04 Bolts and nuts to be used externally to the vessels shall be of hexagonal head conforming to IS-1367. However fasteners if any within tanks shall be of SS-316 / SS-304 or Hastalloy-B as per the duty conditions / requirements.
- 6.06.05 Gaskets shall be of full face type.
- 6.07.00 Sight glasses shall be provided for the tanks/vessels as specified elsewhere in the specification. The material for sight glass shall be high quality transparent PLEXIGLASS of sufficient thickness to withstand the test pressure. The sight glass shall be provided with suitable gaskets and bolts to ensure leak tightness at the test pressure.
- 6.08.00 **Vessels Supports / Lifting Lugs**
- 6.08.01 Adequate supporting arrangements like legs, straps, saddles, skirt boards, pillars etc. for the pressure vessels and atmospheric storage tanks shall be provided to transfer all loads to civil foundation. All foundation bolts, inserts etc. shall also be provided.
- 6.08.02 All vessels shall be provided with lifting lugs, eye bolts etc. for effective handling during erection.
- 6.08.03 All vessels of internal, diameter of 1200 mm or greater shall be provided with minimum four (4) lifting lugs for safe and effective handling during erection. Smaller vessels shall be provided with atleast two (2) lifting lugs.
- 6.08.04 Material of construction for these vessel supports, saddles, lugs shall conform to IS-2062.
- 6.09.00 **Special Accessories for Tanks**
- 6.09.01 Each of all the tanks shall be provided with over flow connection designed for the filling rate of the respective tank.
- 6.09.02 Water Seal shall be provided for the overflow line of Demineralized Water Storage Tanks. Vent line of Demineralized Water Storage Tanks shall be provided with Carbon-Di-Oxide Absorber / Breather of proven design to prevent contamination from atmospheric air. Carbon-Di-Oxide Absorber / Breather shall preferably be located at finished floor / pavement level.

- 6.09.03 The vent and overflow lines of Acid Bulk Storage / Day / Measuring Tanks shall be provided with fume absorber using suitable packing material, such as pall rings / raschig rings.
- 6.09.04 The vent and overflow lines of Alkali Bulk Storage / Preparation / Day / Measuring Tanks shall be provided with Carbon-Di-Oxide Absorber / Breather as addressed under clause no. 6.05.02 above.
- 6.09.05 Conservation Vent Valve shall provided on each of Demineralized Water Storage Tanks to ensure minimum contact with air. The valve should normally be closed. With vacuum or pressure to the extent of 65mm water gauge into the tank, the valve shall open to relieve the vacuum or pressure.

Material of construction should be as follows:

Body & valve disc	-	Die cast aluminium.
Spindle	-	Steel
Spring	-	Phosphor Bronze
Seal	-	Rubber

7.00.00 **ERECTION**

- 7.01.00 Each of all pressure vessels and atmospheric storage tanks should be directly placed on the civil foundation when supplied in fully fabricated form.
- 7.02.00 All fabricated part, before assembly, shall be transported by the Bidder to installation at site. All preliminary work and fabrication in part or full shall be done at the Bidder's fabrication yard or shop.
- 7.03.00 All material before final installation over the foundation at the respective locality shall be inspected and faired as necessary to ensure that any damage received during transportation is corrected before erection to the satisfaction of the Purchaser. Particular attention shall be given towards removal of buckles and other form of distortion in shell and bottom plates of vertical atmospheric storage tanks. Irregularities and dirt which would prevent metal to metal contact at the jointing faces shall be removed.
- 7.04.00 The method of holding the plates in position during welding and all devices used for this purpose should be approved by the Purchaser. All lap joints shall be held in close contact during welding and the surface in contact shall be thoroughly cleaned before assembly.
- 7.05.00 Holes in plate work to assist in erection should be avoided as far as possible. The location of the holes shall be indicated in the fabrication drawing. The method of filling holes shall be approved by the Purchaser. Lugs attached by welding to the tank and required only for the purpose of erection shall be removed and any projections of weld metal shall be chipped and grounded flush with the plate surface.
- 7.06.00 In the construction of the shell, every care shall be taken to minimize distortion or lack of circularity due to welding or for any other reason.

- 7.07.00 Tanks shall be safeguarded against damage due to wind or any other external causes by providing suitable steel cable guys until completion.
- 7.08.00 All materials used by the Bidder such as electrodes, gaskets, bolts and nuts, paints and any other appurtenance shall be conforming to relevant Indian Standard Code of Practice or equivalent (subject to approval by the Purchaser). Manufacturer's test certificate for guaranteed performance shall have to be provided when called for.
- 7.09.00 The finished bottom plate of vertical atmospheric tanks shall be crowned from the outer periphery to the centre with a slope of 1:36. Sufficient number of plugged holes shall be provided in bottom plate of the tanks for bottom testing.
- 8.00.00 **PROTECTIVE LINING AND PAINTING**
- 8.01.00 Inside surfaces of all pressure vessels and atmospheric storage tanks shall be protected by anticorrosive paints or rubber lining as required / specified. External surfaces of all pressure vessels and atmospheric storage tanks shall be protected by anti corrosive painting.
- 8.02.00 The supply and application of Protective Lining and Painting with reference to pressure vessels and atmospheric storage tanks need to be as per **Sub Section: M7 – Technical Specification for Protective Lining and Painting**, attached herewith.
- 9.00.00 **TESTS AND INSPECTION**
- 9.01.00 All pressure vessels shall be hydraulically tested at 1.5 times design pressure or 2 times the maximum working pressure whichever is higher, for a period not less than one (1) hour.
- 9.02.00 All atmospheric storage tanks shall be tested for leak tightness by filling up with water up to the highest level for a period not less than 8 hours.
- 9.03.00 Full rubber lining is to be tested as per IS-4682 Part I for the following tests:
- (a) Adhesion tests
 - (b) Tests to check resistance to bleeding
 - (c) Measurement of lining thickness
 - (d) Shore hardness test
 - (e) Spark test at high voltages 5 KV / mm of thickness with a gap of 8 mm between the probe and lining.
- 9.04.00 Thickness of painting shall be checked with dry type thickness gauge.
- 9.05.00 Vessels as per IBR shall be tested accordingly.
- 9.06.00 DP test after back gauging and on complete welds on atmospheric tanks and pressure vessels need to be carried out.
- 9.07.00 All non-destructive tests shall be carried out as per the applicable design code / standard for all pressure vessels and atmospheric tanks.

- 9. 08.00 Buttwelds if any on the dished ends shall be radiographed after dishing and shall be stress relieved.
- 9. 09.00 All dished ends for pressure vessels shall be stress relieved after dishing.
- 9. 10.00 All weld procedure and welder qualification certificates shall be verified.
- 9. 11.00 All painting on vessels and tanks shall be checked for the thickness as per the specification mentioned elsewhere.
- 9. 12.00 All materials to be used for the pressure vessels and atmospheric tanks and accessories should be of tested quality and test certificates shall be made available to the Purchaser.

**TECHNICAL SPECIFICATION
FOR
PIPING, FITTINGS AND VALVES**

C O N T E N T S

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**TECHNICAL SPECIFICATION
FOR
PIPING, FITTINGS & VALVES**

1.00.00 INTENT OF SPECIFICATION

This specification covers the design, manufacturing, inspection, shop testing, erection, testing and commissioning at site of all the piping, fittings, valves and all other accessories as specified and as further required.

2. 00.00 SCOPE

The items & materials to be supplied shall include but not be limited to the following:

2. 01.00 Pipes, bends, elbows, tees, branches laterals, crosses, reducing unions, couplings, cap, expansion joints, flanges, blank flanges, saddles, shoes, sampling connections etc. necessary for making a reliable piping system.
2. 02.00 Gaskets, ring joint, backing rings, jointing material etc. as required.
2. 03.00 Instrument tapping connection, stub and thermowells.
2. 04.00 Supply and machining work of flanges, pipe spools and matching pipes to connect flow measuring orifice nozzles etc., pressure accumulators as necessary.
2. 05.00 Valves and Isolation Gates, to start/stop and control / regulate flow.
2. 06.00 Strainers.
2. 07.00 Anchor blocks (for buried / over ground piping), support brackets, clamps, support trestles, hangers, vibration dampener etc. for the piping under the scope of contract.
2. 08.00 Bolts, nuts, fasteners as required for interconnecting piping, valves and fitting as well as for terminal points.
2. 09.00 Steel for pipe supports and embedded steel. Also pipe supports and necessary embedment required to be embedded in concrete for underground / above ground pipes.
2. 10.00 Painting, anti-corrosive coatings, etc. inside and outside of pipes as necessary and as specified.
2. 11.00 All embedded parts required for all tanks/water retaining structures made of RCC including puddle pipes shall be supplied by the Bidder.

3. 00.00 **CODE & STANDARDS**

The design, manufacture, fabrication shop testing & inspection, erection, testing and commissioning of piping fittings and valves shall conform to the latest revisions of the following Indian / International codes / standards and other applicable statutory codes / ordinances, rules, regulations as well as safety codes, in addition to other codes / standards if any as addressed elsewhere in the Tender Specification.

Other National / International Standards may also be considered acceptable (subject to specific approval by Purchaser) with reference to any specific situation / requirement provided they are recognized to be equivalent or superior to the Standards as stipulated in the Tender Specification.

ANSI	-	B 16.5	:	Steel pipe flanges and flanged fittings.
ANSI	-	B 16.9	:	Wrought steel Butt welding fittings
ANSI	-	B 16.11	:	Forged steel socket welding and screwed fittings
ANSI	-	B 16.21	:	Non Metallic Gaskets for Pipe Flanges
ANSI	-	B 16.25	:	Butt welding ends
ANSI	-	B 16.28	:	Wrought Steel Butt Welding short radius elbows and returns
ANSI	-	B 31.1	:	Power Piping code.
ANSI	-	B 36.10	:	Welded & seamless wrought steel pipe
ANSI	-	B 36.19	:	Stainless steel pipe
API	-	5L	:	Specification for Line Pipe
ASME	-	Section II		Ferrous Materials Specification
ASTM	-	A 53	:	Seamless carbon steel.
ASTM	-	A 106	:	Grade C Seamless carbon steel pipe.
ASTM	-	F441 / F441M - 09	:	Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
ASTM	-	F439 - 11	:	Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80

AWWA	-	C-203	:	Coal tar protective coatings and linings for steel water pipe lines - Enamel and Tape - Hot Applied
AWWA	-	C-208	:	Dimensions for Steel Water pipe fittings
AWWA	-	C-504	:	Standard for butterfly valve.
BS	-	1868	:	Specification for steel check valves (flanged and butt-welding ends) for the petroleum, petrochemical and allied industries
BS	-	5158	:	Specification for cast iron plug valves
BS	-	5353	:	Specification for steel plug valves
BS EN	-	593	:	Industrial valves. Metallic butterfly valves
BS EN	-	1796	:	Plastics piping systems for water supply with or without pressure. Glass-reinforced thermosetting plastics (GRP) based on unsaturated polyester resin (UP)
BS EN	-	13397	:	Industrial valves. Diaphragm valves made of metallic materials
BS EN	-	13789	:	Industrial valves. Cast iron globe valves
BS EN	-	14364	:	Plastics piping systems for drainage and sewerage with or without pressure. Glass-reinforced thermosetting plastics (GRP) based on unsaturated polyester resin (UP). Specifications for pipes, fittings and joints
BS EN ISO	-	16138	:	Industrial valves. Diaphragm valves of thermoplastics materials
DIN	-	16966	:	Glass fibre reinforced polyester resin (UP-GRP) pipe fittings and joint assemblies - Requirements for and testing of bushes, flanges, and flanged and laminated joints
IS	-	210	:	Grey Iron Castings
IS	-	318	:	Leaded Tin Bronze Ingots and Castings
IS	-	458	:	Precast Concrete Pipes (with and without reinforcement).
IS	-	554	:	Pipe Threads where Pressure Tight-Joints are made on the Threads – Dimensions, Tolerances and Designation.

IS	-	778	:	Copper Alloy Gate, Globe and Check Valves for Waterworks Purposes.
IS	-	783	:	Code of Practice for Laying of Concrete Pipes.
IS	-	1239 Part 1	:	Steel Tubes, Tubulars and other Wrought Steel Fittings - Specification Part 1 Steel Tubes
IS	-	1239 Part 2	:	Specification Steel Tubes, Tubulars and other Steel Fittings Part 2 Steel Sockets Tubular and other Steel Pipe Fittings
IS	-	1363	:	Hexagon Head Bolts, Screws and Nuts of Product Grade C.
IS	-	1364	:	Hexagon Head Bolts, Screws and Nuts of Product Grades A and B.
IS	-	1367	:	Technical Supply Conditions for Threaded Steel Fasteners.
IS	-	1536	:	Indian Standard for Centrifugally Cast (Spun) Iron Pressure Pipes for Water, Gas and Sewage.
IS	-	1537	:	Vertically Cast Iron Pressure Pipes for Water Gas and Sewage.
IS	-	1538	:	Cast Iron Fittings for Pressure Pipes for Water, Gas and Sewage.
IS	-	1703	:	Water Fittings - Copper Alloy Float Valves (Horizontal Plunger type)
IS	-	1879	:	Malleable Cast Iron Fittings
IS	-	2016	:	Plain washers
IS	-	2062	:	Hot Rolled Low, Medium and High Tensile Structural Steel.
IS	-	2629	:	Recommended practice for Hot dip galvanising of iron and steel
IS	-	2633	:	Method for testing uniformity of coating on zinc coated articles.
IS	-	2379	:	Colour Code for Identification of Pipe Lines.

IS	-	2685	:	Code of Practice for Selection, Installation and Maintenance of Sluice Valves.
IS	-	2712	:	Gaskets and Packings- Compressed Asbestos Fibre Jointing.
IS	-	2825	:	Code for Unfired Pressure Vessels.
IS	-	3006	:	Chemically Resistant Glazed Stoneware Pipes and Fittings.
IS	-	3042	:	Single Faced Sluice Gates (200 to 1200 mm size).
IS	-	3114	:	Code of Practice for Laying of Cast Iron Pipes.
IS	-	3589	:	Steel Pipes for Water and Sewage (168.3 to 2540 mm Outside Diameter).
IS	-	4038	:	Foot Valves for Waterworks Purposes.
IS	-	4682 (Part I)	:	Code of practice for lining of vessels and equipment for chemical - rubber lining.
IS	-	4736	:	Hot-dip Zinc Coatings on Mild Steel Tubes.
IS	-	4984	:	High Density Polyethylene Pipes for Potable Water Supplies.
IS :	-	4985	:	Unplasticized PVC Pipes for Potable Water Supplies.
IS :	-	5312	:	Swing Check Type Reflux (non-return) Valves for Water Works Purpose.
IS :	-	5822	:	Code of practice for laying of electrically welded steel pipes for Water supply.
IS :	-	8062	:	Code of practice for cathodic protection (Part-II) of steel structure
IS :	-	10221	:	Code of practice for coating and wrapping of underground mild steel pipes
IS :	-	14846	:	Sluice Valve for Water Works Purposes (50 to 1200 mm Size).

4. 00.00 **DESIGN, MANUFACTURE, FABRICATION AND ERECTION**

4.01.00 The piping system, fittings and accessories supplied shall conform to high standards of engineering, design, workmanship and be capable of performing in continuous commercial operation in a manner acceptable to Purchaser.

4.02.00 All the piping systems, fittings and accessories supplied under this package shall be designed to operate without replacement and with normal maintenance for a plant service life of 25 years and shall withstand the operating parameter fluctuations and cycle variations which can be normally expected during this period.

4.03.00 Material of construction for pipes under different services shall be as below:

Service	Recommended Material of Construction
River Water	Carbon Steel
Clarified Water	Carbon Steel
Filtered Water	Carbon Steel (inside rubber lined)
Degassed Water	Carbon Steel (inside rubber lined)
Demineralised Water	Carbon Steel (inside rubber lined)
Service Air	Galvanized Steel
Instrument Air	Stainless Steel (schedule 40)
Potable Water	Galvanized Steel
Chlorine (liquid under pressure)	Seamless Carbon Steel (schedule 80)
Chlorine (dry gaseous under pressure)	Seamless Carbon Steel (schedule 80)
Chlorine under vacuum	CPVC (schedule 80)
Chlorine in water	CPVC (schedule 80) / Carbon Steel (inside rubber lined)
Sodium Hydroxide Solution	CPVC (schedule 80) / Carbon Steel (inside rubber lined)
Alum Solution	CPVC (schedule 80) / Carbon Steel (inside rubber lined)

Service	Recommended Material of Construction
Lime Solution	Galvanized Steel
Polyelectrolyte Solution	CPVC (schedule 80) / Carbon Steel (inside rubber lined)
Hydrochloric Acid (concentrated)	Carbon Steel (inside rubber lined)
Hydrochloric Acid (dilute)	Carbon Steel (inside rubber lined)
Sodium Hydroxide (concentrated)	Carbon Steel (inside rubber lined)
Sodium Hydroxide (dilute)	Carbon Steel (inside rubber lined)
Sulfuric Acid Solution (concentrated)	Carbon Steel
Sulfuric Acid Solution (dilute)	Carbon Steel (inside rubber lined)
Scale Inhibitor Solution	Stainless Steel (schedule 40) / CPVC (schedule 80)
Corrosion Inhibitor Solution	Stainless Steel (schedule 40) / CPVC (schedule 80)
Biocide Solution	Stainless Steel (schedule 40) / CPVC (schedule 80)
Filter Backwash Wastewater	Carbon Steel
Ammonia Solution	Seamless Stainless Steel (304 grade)
Hydrazine Solution	Seamless Stainless Steel (304 grade)
Oxygen Line	Aluminum
Crude Condensate	Carbon Steel (inside rubber lined)
Treated Condensate	Carbon Steel (inside rubber lined)
Demineralized Water with ion exchange resins	Stainless Steel (304 grade)
Non Oily Sludge	Cast Iron (underground) Carbon Steel (overground)
Neutralized Wastewater	Carbon Steel (inside rubber lined)

Cooling Tower Blowdown	Carbon Steel
Boiler Blowdown	Carbon Steel
Crude Oily Wastewater	Seamless Carbon Steel
Treated Oily Wastewater	Seamless Carbon Steel
Rainfall Runoff	Carbon Steel
Equalized Wastewater	Carbon Steel
Oily Sludge	Seamless Carbon Steel

The portion of pipe lines at the downstream of isolation valves, conveying flushing water shall be of the material & type same as those of the pipelines which are being flushed.

4.04.00 Material & Dimensional Standards for Piping and Fittings

4.04.01 The welded Carbon Steel Pipes shall conform to the following codes / standards:

Pipes	Material Code / Standard	Dimension Code / Standard
50 mm NB and below	Mild Steel, ERW, IS-1239 Part-1 / ASTM-A 53 Grade B (Welded), Type-E, Schedule 80.	IS-1239 Part-1. Plain ends for Socket Welding.
65 mm to 150 mm NB	Mild Steel, ERW, IS-1239 Part-1 / ASTM-A 53 Grade B (Welded), Type-E, Schedule 40.	IS-1239 Part-1. Bevelled ends for Butt Welding.
200 mm to 450 mm NB	Mild Steel, ERW, IS-3589 Grade Fe 410 / ASTM-A 53 Grade B (Welded), Type-E, Schedule 40.	IS-3589. Bevelled ends for Butt Welding.
500 mm NB and above	Rolled and Butt Welded from IS-2062 Grade A plates or SA-285 Grade C or Equivalent (subject to approval by Purchaser). / Spiral Welded pipes.	IS-3589. Bevelled ends for Butt Welding.

Elbows (R=1.5 D)	Material Code / Standard	Dimension Code / Standard
50 mm NB and below	Forged carbon steel from ASME-SA 105 / Carbon Steel to IS-1239 Part-2 (Heavy grade).	SW ends to ANSI-B 16.11 (3000#) / IS-1239 Part-2.
65 mm to 150 mm NB	ASME-SA 234 Grade WPB / Carbon Steel to IS-1239 Part-2 (Heavy grade).	BW ends to ANSI-B 16.9 / IS-1239 Part-2.
200 mm to 350 mm NB	ASME SA-234 Grade WPB	BW ends to ANSI-B 16.9 / IS-1239 Part-2.
Mitre Bends (R=1.5 D)	Material Code / Standard	Dimension Code / Standard
400 mm NB and above	Fabricated from parent pipe.	ANSI-B 31.1 / AWWA-C 208. 90 ⁰ - 3 cut, 4 piece constructions. 45 ⁰ - 2 cut, 3 piece constructions.
Tees	Material Code / Standard	Dimension Code / Standard
50 mm NB & below	Forged Carbon Steel to ASME-SA 105 / ASME-SA 234 Grade WPB / Carbon Steel to IS-1239 Part-2 (Heavy grade).	SW ends to ANSI-B 16.11 (3000#) / IS-1239 Part-2.
65 mm to 150 mm NB	ASME-SA 234 Grade WPB / Carbon Steel IS-1239 Part-2 (Heavy grade).	BW ends to ANSI-B 16.9 / IS-1239 Part-2.
200 mm NB and above	ASME-SA 234 Grade WPB / Fabricated from parent pipe.(set in / set on type).	ANSI-B 16.9
Reducers	Material Code / Standard	Dimension Code / Standard
50 mm NB & below	Forged carbon steel to ASME-SA 105 / ASME-SA 234 Grade WPB / Carbon Steel to IS-1239 Part-2 (Heavy grade).	SW ends to ANSI-B 16.11 (3000#) / IS-1239 Part-2.
65 mm to 150 mm NB	ASME-SA 234 Grade WPB / Carbon Steel to IS-1239 Part-2 (Heavy grade).	BW ends to ANSI-B 16.9 / IS-1239 Part-2.

200 mm NB and above	ASME-SA 234 Grade WPB / Fabricated from parent pipe.(set in / set on type)	ANSI-B 16.9
Slip On Flanges / Blind Flanges	Material Code / Standard	Dimension Code / Standard
All sizes	IS-226 / IS-2062 Grade A / ASME-SA 105 / ASTM-A 216 Grade WCB. Flanges shall be either machined or forged from plate / casting.	Dimensions / Drilling as per ANSI-B 16.5, Pressure rating 150# / 300# or otherwise as applicable, generally Flat face.
Bolts & Nuts	Material Code / Standard	Dimension Code / Standard
All sizes	IS -1367 Cl 4.6 for bolts IS-1367 Cl 4 for nuts	IS -1367
Gaskets	Material Code / Standard	Dimension Code / Standard
All sizes	3 mm thick wire reinforced rubber. Material shall contain no asbestos.	ANSI-B 16.21.

- 4.04.02 Seamless Carbon Steel Pipe shall conform to ASTM-A 106 Grade C (Schedule 80) / ASTM-A 53 / API 5L. Fittings shall conform to applicable codes / standards and be in conformity with the code / standard for the parent pipe.
- 4.04.03 Galvanized Steel Pipes and Fittings shall conform to the clause 4.02.01 above and be galvanized to IS-4736. Ends of all fittings will however be screwed as per IS-554. Mitre Bends shall not be used. Pipe joints shall be screwed for lower size and flanged for higher size. No hot work on G.I. pipes shall be done. Flanges shall be screwed and hot dipped galvanized.
- 4.04.04 Pipes and Fittings which shall be rubber lined, need to conform the clause 4.02.01 above. The inside surfaces of the items shall be completely debeaded and made suitable for lining. The items will be inside rubber lined with 3 mm thick (minimum) natural rubber in two layers as per IS-4682. Flanges shall be flat face as per ANSI-B 16.5 and full face rubber lined. Pipe to Pipe joint will be flanged only. For small size fittings, SS-316 fittings shall be used if rubber lined carbon steel fittings are not available.
- 4.04.05 Stainless Steel Pipe shall conform to ASTM-A 312 of specified grade (Schedule 40) with dimensions as per ANSI-B 16.39. Fittings shall conform to applicable codes / standards and be in conformity with the code / standard for the parent pipe. Mitre Bends shall not be used. Elbows / Tees / Reducers shall be of Forged Stainless Steel (ASME-SA 182) with SW ends to ANSI-B 16.11 (3000#).

- 4.04.06 Cast Iron pipes shall conform to IS-1536. Fittings shall conform to applicable codes / standards and be in conformity with the code / standard for the parent pipe.
- 4.04.07 PVC Pipes shall conform to IS-4984 Class 4. Fittings shall conform to applicable codes / standards and be in conformity with the code / standard for the parent pipe.
- 4.04.08 High density Polyethylene Pipes shall conform to IS-4984 Class 5. Fittings shall conform to applicable codes / standards and be in conformity with the code / standard for the parent pipe.
- 4.04.09 CPVC pipe (Schedule 80) shall be produced from compounds which conform to and are specified in ASTM-D 1784. CPVC Pipe shall be manufactured in strict compliance with ASTM-F 441. Pressure-Rated CPVC Pipe shall be manufactured in strict compliance with ASTM-F 442. All CPVC piping shall be manufactured from NSF approved compounds and NSF Listed for potable water use. CPVC Fittings (Schedule 80) shall be as per ASTM-F 437 and F 439.
- 4.04.10 Pipe lines carrying water, chemicals, air etc. shall be sized generally based on the following ranges of velocities. However pipe size if any for any particular service is addressed in the Tender Drawings / Data Sheets, the selected size for the applicable service shall not be less than the specified size.

Pipe Size	Velocity in m/sec		
	Below 50 mm	50 mm - 150 mm	200 mm & above
Pump Suction for Water		1.2 - 1.5	1.2 - 1.8
Pump Discharge for Water	1.2 - 1.8	1.8 - 2.4	2.1 - 2.5
Header		1.5 - 2.4	2.1 - 2.4
Compressed air below 2 Kg/cm ² (g)	15 - 20	20 - 30	25 - 35
Compressed air 2 Kg/cm ² & above	20 - 30	25 - 40	35 - 45
Suction to compressor/ Blowers		7 - 8	
Pump Suction for Chemical Solution	1.0 - 1.2	1.1 - 1.3	
Pump Discharge for Chemical Solution	1.2 - 1.4	1.3 - 1.5	

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

- 4.06.00 The following " C" Value shall be used in WILLIAM & HAZEN formula for calculating the friction loss in piping and fittings.

i)	Carbon Steel Pipe	:	100
ii)	C.I Pipe	:	100
iii)	Carbon Steel Pipe (inside rubber lined)	:	120
iv)	PVC / HDPE / GRP / CPVC pipes	:	140

For calculating the pump head, atleast 10% margin shall be taken over the pipe friction losses.

- 4.07.00 Piping Layout

- 4.07.01 Piping shall be grouped together as far as practicable and routed to present a neat appearance and orientation. All piping shall generally be installed perpendicular or parallel to the major equipment, building structure and floor. Pipe routing shall be such as to provide sufficient clearance for removal and maintenance of equipment, easy access to valves, instruments and other accessories. The piping shall not encroach on the withdrawal space of other equipment. Piping shall be routed to avoid interferences with other pipes, hangers, structures, equipment electrical trays, HVAC ducts etc. Convenient supporting points, adequate flexibility for thermal expansion and neat appearance shall be considered in piping layout work.

- 4.07.02 Provision shall be made while preparing piping layout to accommodate all system accessories such as valves/ expansion bellows/instrument stubs/instruments/ specialties as per P&ID.

- 4.07.03 All local instruments on the pipeline shall be located such that the reading can be observed without inconvenience.

- 4.07.04 Overhead indoor piping shall have a vertical clearance of minimum 3.0 m above finished floor level of working areas / walkways. Overhead outdoor piping shall have a vertical clearance of minimum 4.0 m above finished ground level and minimum 7.5 m above finished road level unless addressed otherwise elsewhere in this specification. When several pipe lines are laid parallel, flanged joints must be staggered. Welded and flanged joints should as far as possible located at one third span from supports. If the support is situated right under the welded joints this joint must be reinforced with a strap. Flanged and welded joints must be avoided in the middle of the span. Valves should be located in such a manner so as to ensure their convenient operation from the floor or the nearest platform.

- 4.07.05 In specific cases (subject to instruction by Purchaser for any site specific reason), pipes may be routed overground on RCC pedestals with bottom of pipes minimum 300 mm above finished ground level.

- 4.07.06 Pipe, when specifically addressed, shall be laid in trenches or buried. All buried pipes in general shall be laid with the top of the pipe 1.2 m to 1.5 m below the finished ground level unless mentioned otherwise. Full length of buried piping shall be provided with 100 mm thick sand bed.

- 4.07.07 Openings provided to accommodate pipelines must be closed with bricks and mortar with 10 mm to 12 mm clearance between brick work and pipe. The clear space must

be filled with felt or approved filling compound. The details of wall sealing arrangement shall be approved by Purchaser.

4.07.08 Drains shall be provided at low points and at pockets in piping such that complete drainage of system is possible. Vent connections shall be provided at high points where air or gas pockets may occur. Vent for use during hydrostatic test shall be plugged after the completion of the test. Vents shall not be less than 15 mm size. Plugs / cocks required for vent/drain system shall form part of the piping system and shall be supplied by Bidder as per finalized flow diagram. All vent valves & drain valves shall be arranged with easy reach of operation. All pipelines shall be given proper slope towards the drain points.

4.07.09 To facilitate dismantling of piping at the valves and equipment, break up flange/unions shall be provided. The location shall be decided as per the system requirement during detailed engineering.

4.08.00 Line Joints

Line Joints shall be envisaged as follows:

CS and SS pipes	:	Welded (socket welded for 50 mm NB & below & butt welded for 65 mm NB and above)
Galvanized Pipes	:	Screwed
Rubberlined Pipes	:	Flanged

4.08.01 Welded joints

For making welded joints (socket weld or butt weld) the welding shall be performed by manual shielded metal arc process. Any welder employed for carrying out welding shall be qualified as per ASME-Section IX for the type of joints to be welded. Jointing by butt weld or socket weld shall depend upon the respective piping material specification.

For Stainless Steel piping atleast the root run shall be welded with Tungsten Inert Gas (TIG).

Butt welding edge preparation shall be done as per ANSI-B 16.25.

All welding electrodes and welding rods including special ones, if any shall be furnished by the Bidder.

4.08.02 Screwed joints

Threading of pipes shall be carried out after bending, heat treatment etc. If not possible, threading may be done prior to these operations but proper care should be taken to protect them from damage. Threads shall be to ANSI-B 2.1 (taper) NPT / IS 554, unless specified otherwise.

Teflon tapes shall be used to seal screwed joints and it shall be applied to the male threads only. Threaded parts shall be wiped clean of oil or grease (with appropriate

solvent if necessary) and dried before applying the sealant. Pipe ends shall be reamed or filed out to size of bore and all chips shall be removed. Screwed flanges shall be attached by screwing the pipe through the flange and the pipe as well as the flange shall be refaced accurately.

4.08.03 Flanged joints

All flanges and flange drilling shall be to ANSI-B 16.5 of applicable pressure/temperature class. However in case of interface with the pipe of Purchaser, the flange/interconnection details shall be designed to match the applicable interface piping and concerned details.

When weld neck or socket weld flanges are used, their bore must be made the same as that of the pipe being welded to. Socket welded or threaded flanges may be used, with the appropriate piping system for connection of pipe to the flanged equipment.

Drilling of flanges on piping must match with the drilling of flanges on the valves /equipments to which the piping is to be connected.

While fitting the mating flanges, care shall be taken to properly align the pipes and to check the flanges to trueness so that the faces of the flanges can be pulled up together without producing any stress on the adjacent pipes and equipment flanges.

Flanges shall be generally Slip-On / Blind Flat Face type. The packing ring or gasket of the flanged joint shall be of full face type. Flanged joints shall not be buried.

4.08.04 With reference to maintenance for carbon steel pipes, three piece socket welded unions for sizes 50 mm NB and below shall be used. For higher sizes, flanged joints shall be used.

4.09.00 Fabrication of Pipes

4.09.01 General Requirements

The Bidder shall prepare necessary fabrication drawings based on approved piping layouts.

Flanges and their contact surfaces shall be concentric with the pipe axis and shall be accurately machined and drilled true to template.

Where welded pipe and fittings are used, the longitudinal weld seams of adjoining sections shall be staggered by 90 degree.

Prefabrication shall be carried out in the fabrication shop to ensure quality of work and to minimize work on the field.

Where fabricated reducers have been specified, they shall be fabricated from parent pipes by the 'cut and shut' method.

All bends, tees and reducers shall be fabricated as per the latest edition of power piping code, ANSI-B 31.1 or approved equivalent. Reinforcement wherever required, shall be provided.

Only shop fabricated mitre bends or mitre fittings shall be acceptable. Mitre bends will not be accepted for steel pipes of 350 NB and below. For sizes 400 mm NB and above, the mitre bends shall conform to BS-534.

For easy handling & removal of equipment, valves etc. and for maintenance purpose, break up flanges shall be provided for 65 mm NB and above. For flanged joints of 50 mm NB and below, suitable type of compression flexible coupling shall be provided.

4.09.02 Rolled and Welded /Spiral Welded Pipes

Pipes of larger diameter shall be fabricated from steel plates conforming to IS-2062 by rolling and welding or spiral welded pipes shall be used.

Where pipe lengths need to be erected before the circumferential joints is welded, the pipe ends at these joints shall be beveled so that the top half is welded mostly from outside and the bottom half mostly from inside of pipe.

Beveled (single V / double V) ends shall be provided for butt welding as per Welding Procedure Specification.

4.09.03 Fabrication of flanges for large diameter pipes (sizes 600 mm NB and above)

Flanges fabricated from plates shall conform to AWWA-C 207 / BS-4504 / ANSI-B 16.47.

All welds in fabricated flanges shall be subjected to 10% radiographic examination.

Flanges shall be flat faced machined to 10 microns surface finish. Back face of the flanges shall also be machined to 25 microns surface finish.

Inspection holes shall be provided at suitable locations for pipes 800 mm NB and above as required for periodic observations and inspection purposes.

4.09.04 Rubber Lined Pipes

All rubber lined pipes shall be seamless or bead removed ERW pipes. Inside surface of the pipes shall be completely cleaned and made suitable for lining.

All rubber lined pipes shall have flanged joints. Pipes shall be welded with flanges before rubber lining.

For rubber lined pipe, natural rubber lining should be applied in two (2) layers on the inside surface of pipes, giving a total thickness not less than 3 mm. Surface hardness of rubber lining shall be 65 ± 5 Shore A class.

4.09.05 Welding

Welding shall be carried out by manual shielded metal arc and Tungsten Inert Gas

Welding process. Electrodes used shall be of Purchaser approved make. Electrodes shall be kept dry and electrode containers shall be protected against moisture. Electrodes that show sign of deterioration or damage shall not be used. Automatic or semiautomatic welding shall be done with the specific approval of Purchaser.

The Bidder shall submit procedures for welding, stress relieving, dye penetrant testing radiography etc. for prior approval of the Purchaser.

Weld shall not be made in pipe bends.

4.10.00 Supports for Overground Pipe

4.10.01 Complete supporting system for the pipe line shall be designed, fabricated and supplied by the Bidder. Inside the building, the overhead portion of the pipe line may be supported from the building structures. No support shall be taken from the brick wall. Outdoor pipes shall run on steel trestles wherever required. All the steel structure for the pipe rack and the supporting posts/trestles along with all necessary hangers, clamps, connecting steel, fixing bolts, nuts etc. shall be supplied and erected by the Bidder.

4.10.02 Hangers and supports shall be capable of carrying the sum of all concurrently acting loads. They shall be designed to provide the required supporting effects and allow pipe line movements as necessary. All guides, anchors, braces, dampener, expansion joint and structural steel to be attached to the building/structure, trenches etc. shall be provided. Type of hangers and components for all piping shall be selected and approval obtained from the Purchaser.

4.10.03 The supports shall meet the general guidelines indicated in the following code / standards:

MSS-SP 58	:	Pipe hangers & supports - Materials, design and manufacture.
MSS-SP 69	:	Pipe hangers & supports Selection and application.
ANSI-B 31.1	:	Power Piping Codes

4.10.04 Bidder shall locate, design, fabricate, supply and erect all supports, restraints and anchors required for supporting of over ground portion of piping under this contract

4.10.05 Support drawings for piping shall be got approved from the Purchaser. BOM for each support shall also be submitted.

4.10.06 All material for supports shall be of tested quality.

4.10.07 All structural steel required for supports shall be provided by the Bidder at no extra cost to the Purchaser.

4.10.08 All pipe supporting element, guides, sliding support, beams, channel section, attachment to supports, beam clamps etc. shall be provided by the Bidder.

4.10.09 Support locations will be shown in the layout drawing to be submitted by the Bidder.

4.10.10 Fabrication, supply and installation of brackets, pipe shoes, saddles etc. shall be

- included in the scope of Bidder and the same shall be carried out as per approved drawings.
- 4.10.11 If an outdoor saddle support is assumed to permit sliding movement of piping over the support, consideration shall be given in selection of supporting material at the interface so that no rust formation takes place and the actual sliding movement is feasible in practice.
- 4.10.12 All pipe supports shall be designed to fully sustain the pipe in normal operating position, allow free and ample expansion or contraction except where anchored and prevent excessive stress.
- 4.10.13 Sway braces, cushioned clamps or other vibration control equipment shall be used in order to prevent unwanted movements of the piping due to vibration, shock or other causes. These shall be of such design as to protect piping against these movements regardless of direction.
- 4.10.14 The supports shall be so interspaced as to minimize sagging of the pipes and to keep them within permissible limits where pipes are full with the conveying media.
- 4.10.15 All piping supports shall be designed to avoid interference with other piping hangers, electrical conduits equipment and structures etc.
- 4.10.16 Saddles, supports etc. shall be capable of carrying the sum of all concurrent acting loads and shall be fabricated from plates/pipes sections conforming to SA 53 / IS-2062 or equivalent. They shall be designed to provide the requirement of supporting effects and allow pipe line movements as necessary. The structural work shall be as per IS-800 / BS-4360.
- 4.10.17 The maximum spans of the supports of straight lengths shall not exceed the recommended values indicated in ANSI-B 31.1. The spans shall be suitably reduced considering the following:
- a) Point loads due to valves and specialties, branch lines etc.
 - b) Pipe bends
 - c) Structural Steel beams.
 - d) Facilities for maintenance of flanged joints.
 - e) Minimum loads on equipment.
- 4.10.18 All vertical lines shall be properly supported on the vertical run and additionally provided with adequate number of lateral-restraints where the length of vertical run exceeds 5M.
- 4.10.19 At all sliding surfaces of restraints and supports Bidder shall provide a teflon lining to minimize sliding friction.
- 4.10.20 Pipe clamps shall have a minimum thickness of 5 mm for indoor piping and 6 mm for outdoor piping.
- 4.11.00 Erection

- 4.11.01 The Bidder shall coordinate the erection of the piping system as required with the erection schedule of other concerned systems. The sequence of work shall be carefully planned to minimize interference with other groups working in the same area. The actual sequence to be followed shall be to the approval of Purchaser who may at any time, direct the Bidder to reschedule his work as per the status of work site
- 4.11.02 Prior to making interface connections with equipment / system supplied by others, the Bidder shall obtain the approval of the concerned authority.
- 4.11.03 All workmanship shall be accomplished using accepted methods and procedures of the highest recognized fabrication and erection code / standards. Workmanship not conforming to the intent of this specification shall be liable to rejection by the Purchaser at any time, during the progress of work. The Bidder shall correct the workmanship immediately at no extra cost to the Purchaser.
- 4.11.04 The Bidder shall make all interface joints of the piping system, covered under this specification at the connecting points with equipment/piping supplied by others.
- 4.11.05 It is the responsibility of the Bidder to ensure correct orientation of all valves, instrument stubs etc. in line with final piping drawings.
- 4.11.06 The Bidder shall utilize the existing structures if any, to support the piping as far as practicable. All auxiliary steels required shall be supplied by the Bidder.
- 4.11.07 Before performing any welding, all corrosion products, dust, grease and other foreign material shall be cleaned from the surfaces to be joined.
- 4.11.08 Piping on both sides of the joint shall be adequately supported during all welding. Temporary supports, if used shall be so designed that no stress due to pipe weight comes on the joints during the joining.
- 4.11.09 All pipes shall be located and laid in accordance with the approved layout drawings. No deviation will be allowed unless written consent is issued by Purchaser in specific case(s).
- 4.11.10 Before laying the pipes, the coordinates and levels of the pipes shall be checked by the Bidder. Any discrepancies between the execution and approved drawings shall be brought to the notice of the Purchaser and corrections shall be carried out as per his instructions.
- 4.11.11 During erection of piping, the Bidder shall provide proper number and size of bolts and nuts as per drawings and specification. The Bidder shall provide approved quality of grease mixed with graphite powder thoroughly on all the bolts, nuts and washers immediately after erection and when the flange joints are dismantled for flushing, testing and alignment of equipment etc. to prevent rusting of nuts, bolts and gaskets. The grease and graphite powder shall be supplied by the Bidder
- 4.12.00 Cleaning and Flushing
- The exterior and interior surface of all piping shall be thoroughly cleaned of all sand, mill scale, grease, oils, dirt and other foreign materials. After cleaning, the interior surfaces of all piping shall be thoroughly blown dry and protected with a completely

water soluble preventive coating.

Flange faces shall be coated with an easily removable rust preventive coating.

Machined surface shall be coated with rust preventive paint. The paint shall be consumable in the welding process.

4.13.00 Pipes and Fittings if any, coming under purview of IBR, should meet its requirements and getting the approval from IBR in respect of the same shall be under the scope of the Bidder.

4.14.00 Valves & Isolation Gates

Valves will be used to start/stop or control flow.

All valves, shall be suitable for service conditions i.e. flow, temperature and pressure under which they are required. The valves shall be of standard pressure rating as per the applicable code/ standard. The pressure rating of diaphragm valves shall be selected considering the maximum expected operating differential pressure. Sample valves will be used in sample collection lines.

Gates will be primarily used for isolation of flow in open channels although these should be capable of throttling the flow too.

For location and type of Valves / Isolation Gates, Bidder need to refer to the P&I drawings enclosed with this specification.

4.14.01 Sluice / Gate Valves (for river water / clarified water / filtered water / similar application)

Sluice / Gate valve shall conform to IS-14846 PN1.6 minimum. Stem, seat ring and wedge facing ring shall be of stainless steel construction. Other parts shall be as per IS-14846. Valves shall be of outside screw and rising stem type. Ends will be flanged and compatible with ANSI-B 16.5 Cl. 150 (minimum) piping flanges.

Sluice / Gate valves for sizes 50 mm NB and below shall conform to IS-778 Class-2 / ANSI-B 16.34 straight, rising stem; with outside screw.

Sluice / Gate valves shall be provided with the following accessories in addition to the standard items.

- a) Hand wheel
- b) Gear Reduction Unit Operator for valves 250 mm NB and above.
- c) Bypass valve for valve of sizes 300 mm NB and above.
- d) Draining / Flushing arrangement wherever required.
- e) Arrow indicating flow direction.
- f) Position indicator.

Sluice / Gate Valves shall be provided with back seating bush to facilitate gland renewal during full open condition.

For lower sizes, the gate valves will be screwed bonnet with outside screw rising stem as per IS-778. The material of construction will be gun metal body, with brass stem and trim. Ends will be screwed to ANSI-B 2.1.

Gate valve on galvanized iron pipe shall be gun metal construction as per IS-778 Class 2. Ends will be screwed to ANSI-B 2.1.

4.14.02 Butterfly Valves (for river water / clarified water / filtered water / similar application)

Butterfly valves shall be of double flanged or lugged wafer type of low leakage rate conforming to AWWA-C 504 class 150 (min.) or BS-5155 PN 10 / class 150 (minimum)

The various components of butterfly valves shall be of the following:

i)	Body	:	Cast Iron – ASTM-A 48 Cl.40; BS-1452 Grade220 SG Iron – BS-2789. Cast Iron IS-210 Grade FG 260 Cast Steel – ASTM-A 216 Grade WCB; BS- 1504 or Equivalent grade (subject to approval by Purchaser).
ii)	Disc	:	Cast Iron – ASTM-A 48 Cl.40; BS-1452 Grade220 SG Iron – BS-2789. Cast Iron IS-210 Grade FG 260 Cast Steel – ASTM-A 216 Grade WCB; BS-1504 or Equivalent grade (subject to approval by Purchaser).
iii)	Shaft	:	ASTM-A 296 Grade CF 8M / AISI 316; AISI-420; BS-970 Grade 316; BS-970 Grade 420 S45.
iv)	Seat rings	:	Nitrile rubber, EPDM (Ethylene propylene rubber), Hypalon.

Butterfly valves shall be fitted with sleeve type bearing such as PTFE. Valves of size 350 mm NB and above shall be provided with one or two thrust bearings to hold the disc securely in the centre of valve seat without hydraulic or external axial shaft loads. Sleeve and other bearings fitted into the valves body shall be of self lubricated materials that do not have any effect on the fluid handled and other components of the valves.

All the butterfly valves shall be provided with Hand wheel or lever/wrench operated as per the requirements.

The use of lever operators shall be limited to valves requiring a maximum of 90 degree stem rotation from full open to full closed position. For lever/wrench operated valves, means shall be provided for positively holding the disc in not less than three intermediate positions

For larger sizes i.e. 150 mm NB and above, hand wheel shall be provided.

Manually operated valves shall be provided with reduction gear unit for valves of size 250 mm NB and above. Valve provided with motorised 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 (Handwheel or Gear reduction unit or Motor actuator etc.) shall be designed as per applicable International Standard.

All the butterfly valves shall be provided with an indicator to show the position of the disc.
Ends will be flanged and compatible with ANSI-B 16.5 Cl. 150 (minimum) piping flanges.

4.14.03 Butterfly Valves (for decationized water / deanionized water / demineralized water / desalinated water / similar application)

The butterfly valves shall conform to the requirements addressed under Cl. No. 4.14.02 above along with the requirements delineated below:

- a) Body shall be lined (minimum 3 mm) with natural rubber, ebonite, polypropylene or PVDF.
- b) Disc shall be either lined with PVDF, polypropylene, or natural rubber or shall conform to ASME-SA 479 Grade 316.

4.14.04 Ball Valves (for river water / clarified water / filtered water / similar application)

Ball valves may be used for sizes 40 mm NB and below. Ball valves shall conform to the following technical specifications:

a)	Design Standard	BS:5351
b)	Type	Screwed / Welded / Flanged ends; Full Bore: Split Body & Seat supported construction
c)	Material of Construction	
	Body	Carbon Steel to ASME-216 WCB / Cast Iron to IS-210 Grade 220 or better.
	Ball	Stainless steel ASME-SA 479 Grade 316 or 410.
	Seat ring	PTFE
	Stem	Stainless steel ASME-SA 479 Grade 304 or 316 or 410.
	Seats	Nitrile rubber; PTFE

- d) Valves shall be designed to be directly operable by a wrench / hand lever.

- e) Suitable stops shall be provided for both the fully open & close condition.
- f) All the valves shall be provided with an indicator for showing the position of the ball port.
- g) Ends will be flanged and compatible with ANSI-B 16.5 Cl. 150 (minimum) piping flanges

4.14.05 Globe Valves (for river water / clarified water / filtered water / similar application)

Globe valves shall conform to the following technical specifications:

For sizes 50 mm NB and below

- i) Design Standard : IS-778 Class-2 / BS-1873
- ii) Type : Straight, rising stem, with outside screw.
- iii) Material of Construction

i)	Body, Bonnet, Stuffing Box & seat rings	Leaded Tin Bronze conforming IS-318 Grade 2
ii)	Stem	Stainless Steel, AISI-316
iii)	Disc	IS-318 Grade 2/AISI-316

Note: However, valves in the flushing water lines shall be of type and material specified for the chemicals which are being flushed by the line.

For sizes above 50 mm NB

- i) Design Standard : BS-13789 PN 10 (minimum).
- ii) Type : Double Flanged or wafer body, outside screw and rising stem type.
- iii) Material of construction

a)	Body	Cast iron: IS-210 Grade FG260 / BS-1452 Grade14.
b)	Stem	Stainless steel AISI-410 / 13% chrome steel.
c)	Disc	Cast iron IS-210 Grade 260 / BS-1452 Grade 14.

d)	Packing	:	PTFE
e)	Seat & seat rings	:	13% chromium steel
f)	Gland & gland nut	:	AISI-420
g)	Hand wheel	:	Cast Iron or Malleable Iron

- iv) Back seat shall be provided on the stem or on the disc.
- v) Renewable disc assembly shall consist of disc holder, disc, disc guide, check nut and disc retaining nut with washer.
- vi) Disc of globe valve may be provided with renewable rubber seating ring.
- vii) Handwheels shall be marked with the word. OPEN or SHUT with arrow to indicate direction of opening or closing.

Ends will be flanged and compatible with ANSI-B 16.5 Cl. 150 (minimum) piping flanges

Globe valve on galvanized iron pipe shall be gun metal construction as per IS-778 class 2. Ends will be screwed to ANSI-B 2.1.

Note: However, valves in the flushing water lines shall be of type and material specified for the chemicals which is being flushed by the line.

4.14.06 Diaphragm Valves (for river water / clarified water / filtered water / similar application)

Metallic Unlined Diaphragm valves (manual / auto as specified elsewhere in this specification) may be used for isolation purposes.

The Metallic Unlined Diaphragm valves shall conform to the requirements addressed under Cl. No. 4.14.07 below except the requirements with reference to lining for body and integral flanges.

4.14.07 Diaphragm Valves (for decationized water / deanionized water / demineralized water / desalinated water / dilute and concentrated acidic solution / dilute and concentrated alkaline solution / similar application)

Metallic Diaphragm valves (manual / auto as specified elsewhere in this specification) may be used for isolation purposes.

The metallic diaphragm valves shall conform to the following requirements.

- a) Design Standard : BS EN-13397 or Equivalent (subject to approval by Purchaser) of required

- rating/class. (minimum rating of valves should be PN 10).
- b) Type : Flanged and lined body ends, sealed bonnet, weir pattern, tight shut off type.
- c) **Material of Construction**
- Body/Bonnet : Cast Iron IS-210 Grade FG.260 or Equivalent (subject to approval by Purchaser).
Cast steel ASTM-A 216 Grade WCB.
- Body lining : Soft Natural rubber - 3 mm thick as per IS-4682 (hardness 85-90 on shore A), Ebonite polypropylene, PVDF.
- Diaphragm : Reinforced rubber, Hypalon
- Handwheel : Cast Iron
- Compressor : Stainless Steel
- Stem & Bush : Stainless Steel
- d) Ends will be flanged and compatible with ANSI-B 16.5 Cl. 150 (min.) piping flanges, full face rubber lined and shall be cast / integral with the body.
- e) Handwheels shall be marked with the direction of closure.
- f) Valves shall be provided with a position indicator to show the open and closed condition.
- h) Valves provided with pneumatic actuators shall be provided with a handwheel for manual operation. The valves operators shall be designed as per applicable International Standard.
- i) The testing of valves will be as per BS EN-13397 and rubber lining will be tested as per IS-4682.

Note: For valves which may come in contact with concentrated acid/ alkali, the material of construction of diaphragm shall be as follows:

Diaphragm shall be of reinforced Teflon, EPDM for acid services and reinforced Neoprene / Hypalon for alkali services.

Use of Nonmetallic Diaphragm Valves for any specific / critical application shall be subject to approval by Purchaser and shall conform to the requirements of BS EN ISO 16138 - Industrial valves. Diaphragm valves of thermoplastics materials.

4.14.08 Plug Valves (for lime solution / sludge / similar application)

The plug valves shall conform to the following requirements.

a)	Design Standard	BS-5158 or Equivalent (subject to approval by Purchaser)
b)	Type	Flanged and non lubricated, regular pattern, plug valves.
c)	Material of Construction	
	Body	Cast Iron IS-210 Grade FG 260 or Equivalent (subject to approval by Purchaser)
	Plug	Stainless Steel AISI-316
	Body Sleeve or Seat	PTFE
	Seat	PTFE
	Gland	AISI-304 / AISI-316
	Cover	Cast Steel ASTM-A 216 Grade WCB
	Gland Nut	AISI-304 / AISI-316

- d) Valves shall be operated by permanently fitted wrench or Hand lever. Wrench shall be mounted so that they are parallel to the valve bore axis when the valve is in fully open condition.
- e) All valves shall be provided with an indicator for the position of the plug part.
- f) Suitable stops shall be provided for the fully open and fully closed positions of the valve.
- g) Valves of size of 250 mm NB and above shall be provided with a suitable reduction gear unit.
- h) Ends will be flanged and compatible with AISI-16.5 Cl. 150 (minimum) piping flanges.

4.14.09 Non Return or Check Valve (for river water / clarified water / filtered water / similar application)

Non return valves shall be of swing check (reflux) type or dual plate type.

The valves shall conform to the following specifications.

- i) Design Standard : IS-5312, BS-1868, BS-5153, API-594 / API-60 or equivalent (subject to approval by Purchaser)
- ii) Type : Swing check Type and Flanged ends.
- iii) Material of Construction:

a)	Body & Cover Hinge Disk/Door	Cast iron IS-210 Grade FG 260 / Cast Iron BS-1452 Grade 220 or equivalent (subject to approval by Purchaser)
b)	Hinge Pin and Door / Disc Pin	Cast steel ASTM-A 216 Grade WCB High tensile Brass IS-320 HT 2 or BS-2872 equivalent (subject to approval by Purchaser)
c)	Disc facing ring	Stainless steel
d)	Body Seat ring	Stainless steel
e)	Bearing bushes	Leaded Tin Bronze IS-318 Grade 2
f)	Bolts	Carbon Steel

Ends will be flanged and compatible with ANSI-B 16.5 Cl. 150 (minimum) piping flanges. .

Body shall be permanently marked with an "arrow" inscription indicating the direction of motion of the fluid for all the check valves.

For sizes 50 mm NB and below, check valves shall be gun metal body swing type as per IS-778. Ends will be screwed type to ANSI-B 2.1.

4.14.10

Non Return Valve (for decationized water / deanionized water / demineralized water / desalinated water / dilute and concentrated acidic solution / dilute and concentrated alkaline solution / similar application)

The valves shall conform to Cl. No. 4.09.00 above along with the following requirements:

- a) The body, cover & Disc shall be lined with natural Rubber, PTFE or Viton. The Hinge, Hinge Pin & Disc Pin shall be coated with PVDF, or suitable elastomer. The bearing bushes shall be PTFE or Equivalent (subject to approval by Purchaser) material (subject to approval by Purchaser). Bolting shall be of stainless steel. In the absence of lining/coating, the complete valve shall be of stainless steel construction (AISI-316).
- b) For only acid services Non- Return valves shall be of lined construction & Flap type.
- c) For alkali services, the complete valve shall be stainless steel construction (AISI-316) or of lined construction as specified above.

4.14.11

Valves for Sampling / Instrument Isolation Service

Each sampling valve / instrument isolation valve shall be full bore ball type.

Ball valves shall conform to the requirements stipulated under Cl.4.04.00 above. However, Body material shall be Stainless Steel (AISI-316).

4.14.12 Valves for Air Service

For Air services globe valves or Ball valves may be used for sizes 50 mm NB and below.

For sizes higher than 50 mm NB, either Butterfly valve or Ball valves shall be used.

Globe valves shall generally conform to Cl. 4.05. 00 above.

Ball valves shall conform to the requirements stipulated in Cl.4.04.00 above. However, Body material shall be leaded Tin Bronze (IS-318 Grade2) or stainless steel (AISI-304 / 316).

Butterfly valves shall conform to the Cl.4.03.05 to 4.03.09 of this section. However, the body & Disc shall be either cast iron lined with elastomer such as PVDF or PTFE or stainless steel construction (AISI-304 / 316).

4.14.13 Safety / Relief Valves

The safety valves / relief valves at the downstream of positive displacement type metering pumps shall be of the standard type manufactured by the pump manufacturer and the material of construction shall suit to the fluid handled.

4.14.14 Valves for Resin Transfer Line

In resin transfer line two way eccentric plug valve shall be used. The valves, shall have type 316 stainless steel body and bearings, resilient faced plug and flanged ends.

4.14.15 Isolation Gates

Design standard for gates shall be IS-3042 or Equivalent (subject to approval by Purchaser).

The gates shall be rectangular or square sluice, rising spindle type conforming to class-1 of IS-3042.

Material of Construction

i.	Frame and Door	Cast Iron IS-210 Grade 20
ii.	Spindles, bolts & nuts	M.S. to IS-2062
iii.	Face & seat rings	Gun metal (as per IS-3042).

All the parts of gates shall be applied with the coats of heavy duty bitumastic paint.

Each of the gates shall be provided with handwheel, and a position indicator.

The gates for DM plant drains shall be rubber lined to a minimum thickness of 4.5 mm.

4.15.00

Strainers

4.15.01

Basket Strainers

- a) Basket strainers of simplex design shall have the following materials of construction for raw/clarified/filtered water application.

i.	Body	Fabricated mild steel : IS-2062 (Tested quality)
ii.	Strainers	Wire shall be stainless steel (AISI:316 18 BWG 30 mesh suitably reinforced. Reinforcement material shall also be of stainless steel construction.
iii.	Drain Plug / Nuts	Gun metal

- b) Inside and outside of basket body shall be protected with one coat of high build zinc phosphate primer and three coats of Chlorinated rubber paint to a total thickness of 200 microns.
- c) Suitable Vent and drain valves shall be provided for the strainers.
- d) Screen (strainer) flow area shall be at least four times pipe sectional area. Flow area in any portion of Basket strainer assembly shall not be less than the pipe cross sectional area.
- e) Pressure drop in clean condition shall not be more than 1.0 mwc at full flow.
- f) Basket Strainer shall be provided with lifting lugs and suitable mounting arrangement.
- g) For DM water service, body shall be rubber lined to minimum 4.5 mm thickness (soft rubber of shore Hardness $65 \pm 5^{\circ}A$).

4.15.02

Y-Type Strainer

- a) Y-Type strainer for water application shall be constructed of following materials:

i.	Body	Cast Iron IS-210 Grade FG 260
ii.	Strainers	Wires of stainless steel AISI-316, 18 BWG 30 mesh suitably reinforced. Reinforcement material shall also be of stainless steel construction.
iii.	Drain Plug / Nuts	Gun metal (threaded construction)

- b) Y-Type strainers shall also conform to Cl. 4.15.01 (b), (c), (d), (e) and (f).
- c) Body of the Y-type strainers of alkali, and demineralised water shall be of Cast Iron (IS-210 Grade FG 260) and lined with soft or hard rubber to a thickness of 3 mm.

- d) For acid services, apart from the rubber lined body material, the screen material, shall be Polypropylene or HDPE wire cloth of suitable mesh and thickness.

4.16.00 Resin Traps

The resin traps for the Ion exchange vessels shall be provided for the collection of Ion exchange resin shall conform to the following:

- 4.16.01 The body shall be of mild steel (IS-2062) and lined internally with rubber (Hard/Soft rubber), Saran or polypropylene. The internals (rod and screen) for all resin traps shall be of AISI-316 construction. All screen components shall be welded at each intersection of wire and support rod for good strength, Resin traps screen opening shall not exceed 120 percent of the associated process vessel under drain/backwash collection header nozzle screen opening and shall be suitably selected to retain even the minimum size of the resin selected for the process.

- 4.16.02 The resin traps shall be provided with a draining arrangement with a valve for collection of trapped resins. Resin trap body shall have lifting lug for easy handling during maintenance/erection.

4.17.00 General Requirements for Valves, Gates, Strainers and Resin traps

- 4.17.01 All the items shall be suitable for service conditions i.e. flow, temperature and pressure to which they may be subjected to.

- 4.17.02 All the items shall be of proven design for the duty conditions and the Bidder or manufacturer shall have sufficient experience in using the above equipment in water treatment application in the plants supplied earlier by them.

- 4.17.03 In case Purchaser desires, the experience list/feedback from the users shall be made available to Purchaser for any or all the equipments during the detailed engineering phase.

- 4.17.04 Valves will be used to start/stop or control flow. Gates will be primarily used for isolation of flow in open channels although these should be capable of throttling the flow too. Sample valves will be used in sample collection lines.

- 4.17.05 All valves shall be suitable for service conditions i.e. flow, temperature and pressure under which they are required. All the valves shall be of standard pressure rating of the applicable design code / standard. Non standard pressure rating shall not be accepted. The pressure and temperature rating of the valve shall not be less than the maximum expected pressure and temperature plus 5% additional margin of the system in which valves are proposed to be installed.

- 4.17.06 Valves pressure classes, sizes, types, body materials, and end preparation shall generally be as described herein, unless mentioned otherwise elsewhere in Bid Specification. All valves shall conform to the requirements of the governing codes, and the requirements specified.

- 4.17.07 Valves (including safety, relief and control valves) body materials shall be compatible with the piping with which they are used. If the body material is not of the same type as the material of the connecting pipe work, the valves shall be fitted with suitable welding nozzles to avoid dissimilar butt welds at site.

- 4.17.08 Each modulating control valve shall be provided with isolation valves. Manual bypass valve shall be provided for each modulating control valve to achieve safe and reliable manual operation.
- 4.17.09 All the actuators of the valves shall be designed to handle the maximum expected pressure differential across the valves and to overcome friction forces and unbalance forces due to the flow through valve.
- 4.17.10 Valve bodies and bonnets shall be designed to support the valve operators (handwheel, gear, or motor) with the valve in any position without external support.
- 4.17.11 Valve ends and size limitations are as follows:
- 50mm NB and smaller valves - Class 800 minimum with socket weld ends. (For instruments connections/ isolation valves screwed ends may be acceptable)
 - 65mm NB and larger size valves - Class 150 minimum (butt-weld ends or flanged or wafer style).
 - Flanged steel butterfly valves - 750mm and larger size; pressure class per AWWA / BS-5155.
- 4.17.12 Gate, globe and angle valves shall be outside stem and yoke construction.
- 4.17.13 Valves sizes 65 mm NB and larger shall have a non-rising handwheel.
- 4.17.14 All the actuator operated valves shall be fitted with handwheel for manual operation. The pneumatic actuators shall be selected based on the available air pressure and operating air pressure (maximum and minimum). The supporting calculations for selection of actuators shall be furnished for Purchaser's approval before finalization of all the actuators.
- 4.17.15 Valves coming under the purview of IBR if any shall meet its requirements and the approval of the same shall be obtained by the Bidder.
- 4.17.16 Sizes of the valves shall be same as that of the interconnected pipe sizes except for the control valves.
- 4.17.17 The various items shall be installed such so that they are easily approachable for the operating and maintenance personnel. All valves shall be accessible without chain pulls, as far as possible. Generally Valves shall be located about 1.2 meter to 1.5 meter from the operating platform and also they shall not be located below the ground level such as beneath the trenches etc. In such cases, extended spindle shall be provided with chain operating from operating floor. Valves which are installed below the ground floor shall be provided with a floor mounted pedestal at the top of the operating floor. Valves which are installed below the ground floor shall be provided with a floor mounted pedestal at the top of the operating floor. The position indicator for such valves shall be also provided along with the stand.
- 4.17.18 All valves shall be provided with hand wheels. Wherever necessary, chain operator shall be provided so that the valve may be operated from the ground floor.
- 4.17.19 All valves shall be provided with cast heat marks on casting of Body and Bonnet.

- 4.17.20 Whenever screwed valves will be installed in a pipe line, it will always be followed by screwed three piece union of same material as that of pipe.
- 4.17.21 Short pieces used for welding of different pipe fittings and valves shall not be less than 80 mm in length.
- 4.17.22 However valves which are provided (in the buried pipe line) with a valves chamber shall have manual operator/Handwheel inside the valve chamber. The valve chamber shall be provided with built in ladders/staircases and sufficient operating space within the chamber shall also be provided for easy operation of such valves.
- 4.17.23 All the valves, strainers, resin traps etc. shall be provided with external painting as that of the interconnected piping as specified in Clause 3.03.14 above. However, surfaces such as Stainless Steel, aluminium, copper, brass, bronze and other non-ferrous materials shall not be painted. No paint or filter shall be applied until all repairs, hydrostatic tests and final shop inspections are completed, but shall be applied prior to shipment.
- 4.18.00 Rubber Expansion Joint
- 4.18.01 The inner cover (i.e. the tube) and also the outer cover shall be made up of natural or synthetic rubber of adequate thickness. The carcass between the tube and the cover shall be made up of high quality cotton and rayon cord having suitable number of plies and impregnated with rubber or synthetic compounds. Moreover, to ensure adequate strength, reinforcements consisting of metal rings embedded in the carcass, shall be provided.
- 4.18.02 In all cases, the expansion joints shall be integral flanges at both ends complete with split retaining rings.
- 4.18.03 Each of the expansion joint shall be provided with adequate number of limit rod assemblies which shall be tightened after erection of the entire suction branch of the pumps, in order to avoid transmittal of undue pressure thrust on to the pump foundation. Each of these limit rod assemblies shall consist of a long bolt and two connecting plates which are, in turn securely bolted to opposite flanges. Each plate is to be drilled with three holes, two for bolting to the flange, the third for passage of the stretcher belt. Rubber washers backed with metal washer shall be placed under the head of the bolt and under the nut.
- 4.19.00 Protective Lining and Painting
- The supply and application of Protective Lining and Painting with reference to Piping, Fittings and Valves need to be as per **Sub Section: Section-XIII of V.III-C- Technical Specification for Protective Lining and Painting**, attached herewith.
- 5.00.00 **TESTS AND INSPECTION**
- 5.01.00 Tests & Inspection for Pipes and Fittings
- 5.01.01 Shop Tests
- Shop test shall include all tests to be carried out at supplier's work, works of sub

suppliers and at works where raw materials supplied for manufacture of equipment are produced. The supplier shall carryout a comprehensive inspection and testing program during manufacture at works. Necessary Manufacturing and Field Quality Plans shall be prepared by supplier and submitted for approval by Purchaser for all checks conducted on raw materials, fabrication etc.

Calibrated instruments required for measuring / testing of pipes shall be arranged by manufacturer at their works during inspection.

Purchaser shall be given full access to all tests. The manufacturer shall inform Purchaser of the testing well in advance so that Purchaser at own option may witness the test.

All the test certificates and reports shall be submitted to Purchaser for approval.

All the mechanical and chemical tests including optional tests if any as per the applicable codes / standards shall be carried out and the test certificates for the same shall be submitted for approval by Purchaser. Material Certificate shall be furnished for each grade / lot of pipes. All material test certificates shall carry material specification, size, class, length, chemical composition, physical properties and heat number or other acceptable reference to enable correlation of the certificate with the pipe. IBR / CCE / TAC approval certificates / any other statutory approval certificates as required shall be furnished.

Welding procedure and welder performance qualifications shall be carried out. Mechanical and chemical tests shall be carried out as per code. Spot radiography check shall be carried out for all butt welds. D.P.T shall be carried out for all root run welds. Segmented flanges exceeding 30 mm thickness shall be stress relieved. Tensile test, eddy current test, bend test, flattening test and dimensional checks as per applicable code shall be carried out.

All rubber lining is to be subjected to the following tests as per IS-4682 Part I:

- a) Adhesion test.
- b) Tests to check resistance to bleeding.
- c) Measurement of thickness of lining.
- d) Shore hardness test.
- e) Spark test at High voltage 5 KV / mm of thickness.

Galvanizing shall be carried out as per IS-4736 / IS-2629 and tested as per IS-2633 / BS- 729. The test shall include weight of coating, uniformity of thickness and adhesion test.

All pipes and fittings shall be subjected to hydraulic tests as per applicable code / standard. When rubber lined, hydraulic tests shall be carried out before and after rubber lining.

Buried pipes where wrapping and coating is done, material for wrapping and coating shall be tested as per applicable code. Procedure for wrapping and coating and its testing shall be submitted for approval by Purchaser. Entire wrapping and coating shall be checked for thickness and Holiday test. Peel test shall be done to ensure

proper bonding of coating to surface.

5.01.02 Site Test

Hydraulic tests of the piping system at 1.5 times the design pressure or twice the working pressure whichever is higher shall be carried out for a period of minimum 30 minutes. However, if the Code / standard of supplied piping specifies more stringent requirements than the above criteria, then the hydraulic tests shall be conducted as per the applicable piping code / standard.

Pneumatic tests shall be carried out for all pressure piping that shall not be subjected to water filling.

The Bidder shall make all temporary closures/connections as required for hydro-static/pneumatic testing and clean/remove the same after successful completion of the test.

The procedure for hydro test and pneumatic test shall be submitted by the Bidder for review and approval by Purchaser.

All tests as indicated in FQP approved by Purchaser shall also be carried out.

5.02.00 Tests & Inspection for Valves / Gates / Strainers

5.02.01 Shop Tests

Chemical composition of all material, castings, forgings, etc. shall be tested for various components of the valves, gates, strainers and test certificates shall be submitted for approval by Purchaser.

Mechanical tests including optional tests if any shall be performed as per the applicable code / standard and the test certificates for the same shall be submitted for approval by Purchaser. The performance requirements of the valves shall also be tested as per the applicable code / standard.

Elastomer wherever coated or lined for the valves shall be tested for the corrosion resistance against the medium for which those are selected as per applicable code / standard and the test certificates shall be furnished for approval by Purchaser.

Rubber lining on Valves / Gates / Strainers / Resin Traps shall be checked in accordance with IS-4682 Part I including Spark Testing at high voltage (5 KV/mm of thickness).

All the valves shall be hydraulically tested for the body, seat, back seat and all valves shall be pneumatically tested for seat as per the applicable code / standard to which these are designed irrespective of the working pressure for which valves are selected.

Wherever specifically required, pressure drop across each type and each size of the valve at various flows shall be conducted, and test reports shall be submitted for approval by Purchaser. Type test report for this test (if already carried out by the manufacturer) may be submitted to fulfill this requirement.

Gates shall be tested against leakage and strength as required in the code / standard.

Strainer shall be hydraulically tested its strength and the pressure drop across the strainer assembly shall be verified at design flow for clean condition.

5.02.02 Site Tests

All valves, gates, resin traps, strainers and other fittings after erection at site shall be tested to hydraulic test pressure of two times the operating pressure or 1.5 times the maximum allowable pressure whichever is higher for a period of 120 minutes.

All valves / gates (Manual / Automatic) shall be operated throughout 100% of the travel manually and as well as from control panel and these should function without any trouble whatsoever.

**TECHNICAL SPECIFICATION
FOR
HORIZONTAL CENTRIFUGAL PUMPS**

**TECHNICAL SPECIFICATION
FOR
HORIZONTAL CENTRIFUGAL PUMPS**

C O N T E N T S

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TECHNICAL SPECIFICATION FOR HORIZONTAL CENTRIFUGAL PUMPS

1.00.00 INTENT OF SPECIFICATION

The specification covers the design, performance, manufacturing, shop testing, erection, testing and commissioning at site, of the horizontal centrifugal pumps.

2.00.00 CODES AND STANDARDS

2.01.00 The design, manufacture and performance of the horizontal centrifugal pumps shall conform to the latest revisions of the following codes and Indian standards, in addition to other stipulations and standards mentioned elsewhere in the specification :

- a) IS-1520 : Horizontal centrifugal pumps for clear cold fresh water.
- b) IS-5120 : Technical requirement rotodynamic special purpose pumps.
- c) IS-5639 : Pumps handling chemicals and corrosive liquids.
- d) IS-5659 : Pumps for process water.
- e) Standards of Hydraulic Institute, U.S.A.

2.02.00 The material of construction for the various components of the pumps shall conform to the applicable standards like "American Society of Testing & Materials (ASTM)" and Indian Standards.

3.00.00 DESIGN AND CONSTRUCTION

3.01.00 Pumps shall be of horizontal/vertical split casing with speed preferably be limited to 1500 RPM. Design and construction of various components of the pumps shall conform to the following general specifications. For material of construction of the components, data sheets in Appendix-I of SECTION-III may be referred to.

3.01.01 Casing

The casing shall be structurally sound to provide housing for the pump assembly and shall be designed hydraulically to minimize radial loads at part load operations.

3.01.02 Impeller

The impeller shall be as per the proven design of the manufacturer. It shall be keyed to the shaft and locked in position. The rotor assembly shall be statically and dynamically balanced and designed with critical speed substantially above the operating speed.

3.01.03 Impeller/Casing Wearing Rings

Replaceable type wearing rings shall be provided at suitable locations for each pump. The rings shall be so fitted as to prevent turning while the pump is in operation.

3.01.04 Shaft

The shaft shall be adequately sized to withstand all stress from rotor weight and hydraulic loads etc. The shaft shall be ground and polished to final dimensions.

3.01.05 Shaft Sleeves

Pump shafts shall be protected by renewable type shaft sleeves which shall extend well beyond the pump glands. The sleeves shall be highly polished and shall be securely fastened to the shaft to prevent any loosening.

3.01.06 Bearings

Heavy duty bearings, adequately designed for the type of service specified and for long and trouble-free operations, shall be furnished. The design shall be such that the bearing lubricating oil does not contaminate the liquid being pumped.

3.01.07 Thrust Bearings

Adequately designed thrust bearings to absorb pump thrust or other unbalanced force, if any, shall be provided.

3.01.08 Lubrication system shall be designed in such a way that in case of total power failure, there will not be any damage while coasting down to stop.

3.01.09 Stuffing Boxes

Stuffing boxes of packed ring construction or of mechanical seal type as desired in the Data Sheet - Appendix-II attached with this specification shall be provided. The necessary piping, valves, fitting etc. for the gland sealing connection shall be provided. For mechanical seals, the mating surfaces shall be suitably hard faced to ensure long life.

3.01.10 Pump Shaft-Motor Shaft Coupling

The pump shaft and motor shaft shall be connected with a suitably designed flexible coupling of approved design preferably with a spacer to facilitate dismantling of the

pump without disturbing the motor. Necessary coupling guards for the coupling shall also be furnished.

3.01.11 Base Plate

A common base plate for mounting the pump and the corresponding driver motor shall be furnished. The base plate shall be of fabricated steel and of rigid construction, properly ribbed as required. Driplip with drain tap suitable for type of service specified shall be furnished.

3.01.12 Drain, Vent and Priming Connections

Each pump shall be provided with a casing drain, vent and priming connection at suitable locations.

3.01.13 Drive Motor and Its Control

Please refer Electrical Specification enclosed herewith this specification.

3.01.14 Anchor Bolts, Sleeves, Inserts, Lifting Lugs, Eye Bolt, etc.

All anchor bolts, foundation plates, sleeves, nuts, inserts etc. to be embedded in concrete for the equipment are to be supplied. The length of the foundation bolts shall be liberally sized to reach below the reinforcement level.

Each equipment shall be provided with suitable lifting lugs, eye bolts etc. to facilitate maintenance.

3.02.00 Consistent with good operating characteristics and high efficiency, each pump shall have a continuously rising head capacity characteristics curve without any zone of instability. Power flow characteristic shall preferably be non-overloading type beyond rated duty point. The characteristic curves of each set of pumps shall match each other for equal sharing in case of parallel operation. The pump motor set shall be designed in such a way that there is no damage due to reverse flow through the pump which may occur due to any mal-operation of the system.

3.03.00 The pumps shall be suitably designed also for smooth and trouble free continuous solo operation in the event of trip out of the remaining pumps running in parallel.

3.04.00 The pumps shall be designed to have best efficiency at the rated duty point. The pumps shall be suitable for continuous operation within a wide range above and below the rated duty point. Such range of operation within which category of pumps can satisfactorily operate on continuous basis, shall be clearly indicated.

3.05.00 Drive motors for each category of pumps shall be suitable for use on 415V $\pm 10\%$, 3 ϕ , 50 Hz $\pm 5\%$ and neutral grounded system. Drive motors shall have 15% spare margin over the maximum power requirement of the pump within the range of operation.

4.00.00 TESTING

4.01.00 **Testing and Inspection at Manufacturer's Works**

4.01.01 All tests required shall be conducted to ensure that the equipment furnished shall conform to the requirements of this specification and in compliance with requirements of the applicable codes.

The particulars of the proposed tests and the procedures for the tests shall be submitted for approval before conducting the tests.

4.01.02 The representatives of Purchaser shall be given full access to all tests. Prior to pump performance tests, the manufacturer shall inform the Purchaser allowing adequate time so that if the Purchaser desires, his representatives can witness the test.

4.01.03 All materials and casting used for the equipment shall be of tested quality. The test certificates shall be made available to Purchaser.

4.01.04 The pump casing shall be hydraulically tested at 200% of pump rated head or at 150% of shut-off head, whichever is higher. The test pressure shall be maintained for at least half an hour.

4.01.05 The pump rotating parts shall be subjected to static and dynamic balancing tests.

4.01.06 All pumps shall be tested at the shop for capacity, head efficiency and brake horse power and cavitation. The tests are to be done according to the requirement of the "Hydraulic Institute" of USA, ASME Power Test Code PTC-8.2 (latest edition) and Indian Standards as applicable.

4.01.07 The pump accessories e.g. the thrust bearing, the motor pump shaft coupling etc. will be subjected to tests as per Manufacturer's standard.

4.01.08 The combined vibration of pump and motor should be restricted to the limits specified by Hydraulic Institute Standards, USA, when the pump is in operation at any load singly or in parallel.

4.01.09 Tests on motors shall be conducted as per electrical specification enclosed herewith this specification.

4.01.10 The reports and certificates of all the above mentioned tests to ensure satisfactory operation of the system shall be submitted to the Purchaser before despatch.

4.01.11 Cast heat marks are to be provided on castings for casing and impeller.

4.02.00 Tests at Site

After erection at site, pumps under different services shall be operated to prove satisfactory performance as individual equipment as well as a system.

Telangana State Power Generation Corporation Ltd.
1x800 MW Kothagudem TPS

EPC Bid Document
e-PCT/TS/K/02/2014-15

**TECHNICAL SPECIFICATION
FOR
VERTICAL CENTRIFUGAL PUMPS**

DEVELOPMENT CONSULTANTS
(e-PCT-TS-K-02-2014-15 -V-IIIC-Sec-X.doc)

V.III-C/S-X: 1

Telangana State Power Generation Corporation Ltd.
1x800 MW Kothagudem TPS

EPC Bid Document
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TECHNICAL SPECIFICATION
FOR
VERTICAL CENTRIFUGAL PUMPS

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DEVELOPMENT CONSULTANTS
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V.III-C/S-X: 2

TECHNICAL SPECIFICATION FOR VERTICAL CENTRIFUGAL PUMPS

1.00.00 INTENT OF SPECIFICATION

The specification covers the design, performance, manufacturing, shop testing, erection, testing and commissioning at site, of the vertical centrifugal pumps.

2.00.00 CODES AND STANDARDS

2.01.00 The design, manufacture and performance of the vertical centrifugal pumps shall conform to the latest revisions of the following codes and Indian Standards in addition to other stipulations and standards mentioned elsewhere in the specification :

- a) IS-1710 : Vertical turbine pumps for clear, cold, fresh water.
- b) IS-5120 : Technical requirement for rotodynamic special purpose pumps.
- c) IS-5639 : Pumps handling chemicals and corrosive liquids.
- d) IS-5659 : Pumps for process water.
- e) Standards of Hydraulic Institute, USA.

2.02.00 The material of construction for the various components of the pumps shall conform to the applicable standards like "American Society of Testing & Materials (ASTM)" and Indian Standards.

3.00.00 DESIGN AND CONSTRUCTION

3.01.00 Pump Type

The pumps shall be vertical wet pit type with open shaft or enclosed shaft construction depending on the type of liquid to be pumped. Material of construction shall be as per the data sheets in Appendix-II. The pump shed shall preferably be limited to 1500 RPM.

3.02.00 Discharge Head Assembly

The pump shall have fabricated discharge head disposed above the ground. The head shall be capable of supporting the pump and motor on the foundation; expansion joint shall be provided immediately at the pump discharge; but no thrust block shall be provided for the unbalanced hydraulic thrust thus developed. The anchor bolts and pump fixing arrangement shall be suitably designed to take up the back thrust due to the expansion joint.

The head shall contain a packed type stuffing box to prevent any leakage.

A water stinger may be fitted to the top shaft to protect the motor from water spray.

3.03.00 Bowl

In addition to housing the impellers properly, the bowls shall provide a smooth path to water passage and shall be hydraulically designed to minimise radial thrust.

3.04.00 Impeller

The impeller shall be closed or open as per standard design of the manufacturer. All rotating parts including the impeller shall be statically and dynamically balanced. The critical speed of all the rotating parts shall be substantially above the design speed.

3.05.00 Pump Shaft and Motor Shaft Coupling

The pump shaft shall be connected to motor shaft by a heavy duty flexible coupling.

3.06.00 Column Pipe and Shaft

The line shaft and the shaft enclosing tube shall be made in convenient sections and shall be joined securely by union couplings. The column pipe shall also be made in sections and shall be joined by flanged coupling. In case of flanged joint gaskets shall be provided at each connection.

For sludge handling, vertical cantilever pump with no submerged bearing shall be provided.

3.07.00 Shaft Sleeves

Replaceable shaft sleeves shall be furnished. The shaft sleeve shall be securely locked to shaft to prevent loosening while in operation.

3.08.00 The necessary supporting frame, base-plates, sole-plates, mounting-plates, etc. as required shall be supplied under this specification, alongwith anchor bolts, foundation bolts, pipe sleeves etc.

3.09.00 Thrust Bearings

Thrust bearing of adequate design shall be furnished for taking the pump weight as well as maximum hydraulic thrust. The bearing may be lubricated by grease or oil. The design should be such that the bearing lubricating oil does not contaminate the liquid being pumped. Cooling of thrust bearing, if necessary, shall be done by liquid tapped from the discharge of the pump itself. The thrust bearing shall be designed on the basis of 20,000 working hours minimum for the load corresponding to the duty point.

3.10.00 Line Shaft and Bowl Bearing

Adequate number of properly designed bearings shall be furnished to prevent undue vibration.

3.11.00 Lubrication system shall be designed in such a way that in case of total power failure, there will not be any damage while coasting down to stop.

3.12.00 Shaft Enclosing Tube

For sludge/turbid/dirty water/chemical services, the pump shaft shall be of enclosed tube construction. For the lubrication of shaft necessary clarified/filtered water required shall be arranged. Necessary piping, valves, fittings, booster pumps etc. as required shall be included in scope.

- 3.13.00 **Suction Bell**
- The pump shall be complete with adequately dimensioned suction bell to guide and streamline intake fluid.
- 3.14.00 **Adjustment of Impeller**
- The pump shaft shall have suitable arrangement for vertical adjustment of impeller position from an accessible point.
- 3.15.00 **Pump Characteristics**
- Head capacity curve should be rising upto the shut-off head condition. Power versus capacity curve shall be non-overloading type beyond rated duty point.
- The characteristic curves of each set of pumps shall match each other for equal load sharing in case of parallel operation. The pump shall however, be also designed for smooth and trouble-free continuous solo operation in the event of trip-out of the remaining pumps running in parallel.
- 3.16.00 The pumps shall be designed for reverse flow through them. The drive motor shall be capable of bringing the pump to its rated speed in the normal direction from the point of maximum possible reverse speed when power to the drive is restored.
- 3.17.00 The pumps shall be designed to have best efficiency at the rated duty point.
- The pumps shall be suitable for continuous operation within a wide range above and below the rated duty point. Such range of operation within which the pumps can satisfactorily operate on continuous basis, shall be clearly indicated.
- 3.18.00 Drive motors for the pumps shall be suitable for use on $415V \pm 10\%$, 30 , 50 Hz, $\pm 5\%$ and neutral grounded system. Drive motors shall have 15% spare margin over the maximum power requirement of the pump within its range of operation.
- 4.00.00 **TESTING**
- 4.01.00 **Testing and Inspection at Manufacturer's works**

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- 4.01.01 All tests required shall be conducted to ensure that the equipment furnished conforms to the requirements of this specification and is in compliance with requirements of the applicable codes. The particulars of the proposed tests and the procedures for the tests shall be submitted to Purchaser for approval before conducting the tests.
- 4.01.02 The representatives of Purchaser shall be given full access to all tests. Prior to pump performance tests, the manufacturer shall inform the Purchaser allowing adequate time so that if the Purchaser so desires, his representative can witness the test.
- 4.01.03 All materials and casting used for the equipment shall be of tested quality. The test certificates shall be made available to the Purchaser.
- 4.01.04 The pump casing shall be hydraulically tested at 200% of pump rated head or at 150% of shut-off head, whichever is higher. The test pressure shall be maintained for at least half an hour.
- 4.01.05 The pump rotating parts shall be subjected to static and dynamic balancing.
- 4.01.06 All pumps shall be tested at the shop for capacity, head, efficiency, brake horse power and cavitation. The tests are to be done according to the requirements of the Hydraulic Institute of USA, ASME Power Test Code, Indian Standards, as applicable.
- 4.01.07 The pump accessories e.g. the thrust bearing, the motor pump shaft coupling etc. will be subjected to tests as per manufacturer's standards.
- 4.01.08 The combined vibration of pump and motor should be restricted within limits specified by Hydraulic Institute Standards, USA when the pump is in operation at any load singly or in parallel.
- 4.01.09 Tests on motors shall be conducted as per electrical specification enclosed with this specification.
- 4.01.10 Test reports and certificates of the above mentioned tests to ensure satisfactory operation of the system shall be submitted to the Purchaser before despatch.
- 4.01.11 Cast heat marks shall be provided on castings for casing and impeller.
- 4.02.00 Test at Site

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After erection at site, pumps under different services shall be operated to prove satisfactory performance as individual equipment as well as a system.

**TECHNICAL SPECIFICATION
FOR
POSITIVE DISPLACEMENT PUMPS**

**TECHNICAL SPECIFICATION
FOR
POSITIVE DISPLACEMENT PUMPS**

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TECHNICAL SPECIFICATION FOR POSITIVE DISPLACEMENT PUMPS

1.00.00 INTENT OF SPECIFICATION

This specification covers the design, performance, manufacturing, shop testing, erection, testing & commissioning at site, of the positive displacement pumps.

2.00.00 GENERAL DESIGN FEATURES

This specification provides guideline for design, manufacturing and testing of positive displacement pumps with variable capacity to inject chemicals, generally used in the treatment of water in metered amounts.

2.01.00 Pumps shall be simplex/duplex type, positive displacement hydraulically operated diaphragm design, driven by squirrel cage induction motor through suitable speed reduction unit.

2.02.00 The stroke shall be continuously adjustable to give a capacity variation 0-100% range, while the pump is running or stopped. Adjustment of capacity shall be done automatically, wherever required, by pneumatic stroke positioner in proportion to a 0.2 - 1.0 Kg/Sq.Cm air signal or manually. For automatic pumps, in addition to the automatic control, manual control facility shall also be provided. Manual control facility shall be of micrometric adjusting type.

2.03.00 Capacity variation may be effected by changing eccentricity of the driving crank or by suitable hydraulic circuit. Pump accuracy shall be industry standard, $\pm 1\%$ of capacity setting.

2.04.00 Pumps shall be provided with an integral relief valve, spring operated, to release pressure when delivery line blockage occurs.

2.05.00 Crank case shall be constructed of high quality cast iron, which will also house the gear box and guides for cross head.

2.06.00 Material of construction should be as follows :

◆ Crank case	Cast iron.
◆ Pump head	Polypropylene.
◆ Valve and valve housing	Polypropylene.
◆ Wheel	Cast iron to a 48.

◆ Worm	AISI 4142.
◆ Shafts (worm)	En 19.
◆ Diaphragm	Chemically inert teflon.
◆ Base plate	MS.
◆ Foundation bolts	MS.

- 2.07.00 Suitable gland seal should be provided to prevent leakage.
- 2.08.00 Electric drive motor particulars should follow Electrical Specification, enclosed herewith.
- 3.00.00 TESTING
- 3.01.00 Testing and Inspection at Manufacturer's Works
- 3.01.01 The Manufacturer shall conduct all tests required to ensure that the equipment furnished conforms to the requirements of this specification and is in compliance with requirements of the applicable codes.
- The particulars of the proposed tests and the procedures for the tests shall be submitted to Purchaser for approval before conducting the tests.
- 3.01.02 The representatives of Purchaser shall be given full access to all tests prior to pump performance tests. The Manufacturer shall inform the Purchaser allowing adequate time so that if the Purchaser so desires, his representatives can witness the test.
- 3.01.03 All materials and castings used for the equipment shall be of tested quality. The test certificates shall be made available to Purchaser.
- 3.01.04 The pump casing shall be hydraulically tested at 200% of pump operating pressure or 15 Kg/Sq.Cm(g) whichever is higher. The test pressure shall be maintained for at least half an hour.
- 3.01.05 The rotating parts of pump drive shall be subjected to static balancing.
- 3.01.06 All pumps shall be tested at the shop for capacity volumetric accuracy, repeatative accuracy, power and volumetric efficiency. The tests are to be done according to the requirements of the "Hydraulic Institute" of U.S.A. ASME Power Test Code and Indian Standards or as per API.- 675.
- 3.01.07 The pump accessories e.g. gear box, speed reduction unit etc. will be subjected to tests as per Manufacturer's standards.
- 3.01.08 The combined vibration of pump and motor should be restricted within limits specified by Hydraulic Institute Standards, USA, when the pump is in operation singly or in parallel.

- 3.01.09 Test reports and certificates of all the above mentioned tests to ensure satisfactory operation of the system shall be submitted to the Purchaser before despatch.
- 3.01.10 Performance test shall be carried out for the setting of pressure relief valve.
- 3.02.00 Test at Site

After erection at site, pumps under different services shall be operated to prove satisfactory performance as individual equipment as well as a system.

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**TECHNICAL SPECIFICATIONS
FOR
SCREW PUMPS**

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**TECHNICAL SPECIFICATIONS
 FOR
 SCREW PUMPS**

01.00.00 GENERAL

This section covers general requirement of design, construction features, manufacture, inspection and performance testing of screw / gear pump for water, oily water, fuel oil and sludge applications.

2.00.00 CODES AND STANDARDS

The equipment supplied shall comply with the latest applicable Indian Standards listed below. Other national standards are acceptable provided they are established to be equal or superior to the Indian Standards mentioned herewith.

IS : 5120. 1977	Technical requirements of rotodynamic purpose pumps
BS : 599. 1966	Method of testing for pumps
HIS	Hydraulic Institute Standards, USA
API: 676. 1980	Positive Displacement Pumps - Rotary
VDMA 24284. 1970	Positive Displacement Pumps - Code for Acceptance
	Test
IS: 210.1993	Grey Iron Castings
IS : 2062, 1992	Steel for general structural purposes
ANSI B16.5	Pipe flanges and flanged fittings
ASME Sec II	Engineering
	Materials

03.00.00 TECHNICAL REQUIREMENTS

03.01.00 Design & Performance Requirements

- 03.01.01 The pump shall be horizontal, rotary, positive displacement type with gear or screw as rotary element.
- 03.01.02 The pump shall be capable of developing the required total head at rated flow under continuous operation. The maximum efficiency of the pump shall be within $\pm 10\%$ of rated flow.
- 03.01.03 Pumps of a particular category shall be identical and shall be suitable for parallel operation with equal load sharing. Components of identical pumps shall be Interchangeable.
- 03.01.04 Pumps shall run smoothly without undue noise and vibration. The noise level at a distance of 1 m from the equipment shall not exceed 85 dBA.
- 03.01.05 The pumps shall be suitable to handle fluid of characteristics as indicated in technical data sheet.
- 03.01.06 The pumps shall be suitable to handle the specified fluid for the complete range of operating conditions. The pump capacity shall be selected based on lowest possible viscosity and driving motor power shall be selected based on highest possible viscosity.
- 03.01.07 Each pump shall be connected to its drive motor directly and shall be mounted on a common base plate. The pump set along with drives shall be designed to permit rapid and economical maintenance.
- 03.01.08 All pumps shall be provided with suitable mechanical seals of proven design and material.
- 03.01.09 The supplier shall assume full responsibility in the operation of pump and motor as a unit.
- 03.02.00 Construction Requirements
- 03.02.01 Pump Casing
 Casing and supports shall be designed to have sufficient strength and rigidity to prevent any adverse effect on internal clearances and to limit change of alignment to 50 micrometers at the coupling

flange caused by the worst combination of pressure, torque or allowable piping stress.

Pump casing shall be provided with a vent connection along with piping, fittings & valves unless pump is self-venting by the arrangement of nozzles. Casing drain, as required, shall be provided complete with drain valves, piping and plugs. It shall be provided with a connection for suction and discharge pressure gauge as standard feature.

Jacket for cooling or heating shall be provided, if specified in technical particulars. Passages shall not open into casing joints.

Inlet and outlet connections shall be flanged. Flanges shall be raised face and shall conform to ANSI B 16.5. Counter flanges with necessary bolts. nuts. gasket etc. shall be supplied along with the pump.

03.02.02 Rotating Elements

Rotating parts shall be properly aligned. Rotor and shaft shall be stiff enough to prevent contact between the rotor bodies and the casing. It shall be of material that have wear, corrosion and erosion resistance compatible with the application.

03.02.03 Mechanical Seals

The Pumps shall generally be employed with mechanical seals, which shall be arranged that replacement of seal should be possible with minimum downtime. T sealing faces should be highly lapped surfaces of materials known for their frictional coefficient and resistance to corrosion against the liquid being pumped

The seal end plate or rotating cover and bolting shall be designed to retain the SI with sufficient rigidity to prevent distortion that might impair seal operation. T stationary seal member shall be positively retained to prevent its rotation. For 1 seals under vacuum service, the seal design must ensure sealing against atmospheric pressure even when the pumps are not operating.

If seal flushing and cooling is provided by the pumped fluid, the pump supplier shall ensure that sufficient flow reaches the primary seal faces to provide for cooling and maintenance of a stable film at

the seal faces.

03.02.04 Stuffing Box

Stuffing box, if provided, should permit replacement of packing without removing any part other than the gland. Asbestos shall not be used as a packing material.

Stuffing Boxes of packed ring construction type preferably to accommodate five rings of packing (minimum four rings of packing) plus a lantern ring shall be provided wherever specified. Packed ring stuffing boxes shall be properly lubricated and sealed as per service requirements and manufacturer's standards. If external gland sealing is required, it shall be done from the pump discharge. The Bidder shall provide the necessary piping valves, fittings etc. or the gland sealing connection.

03.02.05 Bearing

Heavy duty antifriction bearings, adequately designed for the type of service specified in the technical data sheet and for long, trouble free operation shall be furnished.

The bearings offered shall be capable of taking both the radial and axial thrust coming into play during operation. Antifriction bearings shall be designed for a rated life of either 25000 hours with continuous operation at rated conditions or 16000 hours at maximum axial and radial loads and rated speed.

Proper lubricating arrangement for the bearings shall be provided. The design shall be such that the bearing lubricating element does not contaminate the liquid pumped. Where there is a possibility of liquid entering the bearings suitable arrangement in the form of deflectors or any other suitable arrangement must be provided ahead of bearing assembly.

Bearings shall be easily accessible without disturbing the pump assembly. A drain plug shall be provided at the bottom of each bearing housing.

03.02.06 Pump & Motor shaft Coupling

The pump and motor shafts shall be connected with an adequately sized flexible coupling of proven design with a spacer to facilitate dismantling of the pump without disturbing the motor. Necessary coupling guards shall also be provided.

03.02.07 Base plate

A common base plate for the pump and motor shall be provided. The base plate shall be of fabricated steel (minimum 6 mm thickness) and of rigid construction suitably ribbed and reinforced. Base plate and pump supports shall be constructed and the piping unit so mounted as to minimize misalignment caused by mechanical forces such as normal piping strain, internal differential thermal expansion and hydraulic piping thrust. The base plate shall be suitably drilled for the anchor bolts. The base plate shall have drip pan and suitable draining arrangement.

03.02.08 Relief Valve

To protect against damage due to accidental closure of discharge valve, each pump shall be provided with a relief valve of adequate capacity,

Relief valve shall be able to handle the pump rated capacity when fully open, at a pressure not more than 10 percent above the set pressure.

03.02.09 Material of Construction

The material of construction of various components shall be as indicated in technical particulars. These are to be considered as minimum requirement and it is the responsibility of supplier to select and offer proper material of construction for the required service,

03.02.10 Assembly and Dismantling

Assembly and dismantling of each pump with drive motor shall be possible without disturbing the grouted base plate or alignment.

03.02.11 Drive Motor

The motor shall be sized to meet the maximum specified operating conditions. including external gear and/or coupling losses. Continuous Motor rating (at 50 ° C ambient) shall be atleast ten percent (10%) above the maximum load demand of the pump in the entire operating range including the run out condition to take care of the system frequency & voltage variation.

The enclosure of motor shall comply various requirements of flame proof construction as per IS-2148 and degree of protection shall be as per IP-55.

Other design and construction features of the drive motor shall be as specified, elsewhere, under Standard Electrical Specifications.

4.00.00 TESTS

Material test certificates from recognized laboratories shall be furnished for review\for various components.

Following are the minimum shop and site tests to be conducted by the supplier:

4.01.00 Shop Tests

4.01.01 Hydrostatic Test

Pressure containing parts, including cooling and heating jackets, shall be test hydrostatically with liquid at a minimum of 1.5 times the maximum allowable working pressure but at not less than 1.38 bar gauge.

Tests shall be maintained for a sufficient period of time to permit complete examination of parts under pressure. The hydrostatic test shall be considered satisfactorily when no leaks are observed for a minimum of 30 minutes.

4.01.02 Mechanical Balancing

All rotating components of the pumps shall be subjected to static and dynamic balancing at shop as per ISO 1940. The dynamic balancing shall be done at or near the operating speed and the supplier shall furnish its acceptance norms for approval before conducting the test.

4.01.03 Non-destructive Testing

Non-destructive testing of the pump components shall be conducted in accordance with relevant standards. Prior to testing, the test procedure and repair procedure shall be submitted for approval. All components subjected to testing shall be identified and only those which are tested successfully shall be used for the manufacture of final product. All test results shall be submitted by the supplier for approval

All cast iron parts shall be tested in accordance with IS - 210. Test bars shall be cast or physical tests from the same ladle of metal as the casting they represent.

Steel forgings used in pump shall be tested for both physical properties and chemical composition. steel forgings shall be ultrasonically tested.

4.01.04 Performance Testing

All pumps shall be performance tested at the Manufacturer's Works as per testing code. The test shall be conducted to determine the following characteristics:

- a) Speed
- b) Discharge Pressure
- c) Suction Pressure
- d) Capacity
- e) Power

The test shall be conducted preferably with the tested job motor.

04.02.02 Noise and vibration shall be measured during the performance testing, for reference purposes.
For pumps operating in parallel, the load sharing should not vary by more than 5%.

The pumps showing any abnormal behaviour during the performance testing or the pumps as required shall be stripped down for a thorough examination after the performance test. The performance test report shall be prepared by the supplier and submitted for approval, before despatch of the pumps.

04.02.00 Site Tests

04.02.01 After installation, the pumps supplied shall be operated to prove satisfactory performance as individual equipment as well as a system. The noise and vibration level of the pumps shall be measured and it should be within the design values. For pumps operating in parallel, the load sharing should not vary by more than 5%. If performance at site is found to be unsatisfactory, then the supplier shall rectify or replace the equipment.

04.02.03 Test Procedure Instruments

The test procedures to be followed and instruments to be used for testing shall be subject to the approval. All instruments to be used for stage and performance testing shall be calibrated at reputed third party laboratories.



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TECHNICAL SPECIFICATION FOR
CONDENSATE POLISHING UNIT
1X800 MW TSGENCO KOTHAGUDEM TPS
STAGE -VII, PALONCHA

SPEC NO: PE-TS-410-155A-A001

VOLUME: II-B

SECTION: D1

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DATE:

**TECHNICAL SPECIFICATION FOR
PRESSURE & STORAGE VESSEL(CONT.)**



TITLE:
**TECHNICAL SPECIFICATION FOR
CONDENSATE POLISHING UNIT
1X800 MW TSGENCO KOTHAGUDEM TPS
STAGE –VII, PALONCHA**

SPEC NO: PE-TS-410-155A-A001

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1.00.00 GENERAL

The following principal pressure and atmospheric vessels for the system has been covered in this part of specification.

1. Condensate polisher service vessel/Mixed bed polisher.
2. Resin Separation and Cation Regeneration vessel.
3. Anion regeneration vessel.
4. Mixed resin storage Vessel.
5. Alkali diluent Heating cum Storage Vessel.(hot water tank)
6. Activated carbon filter
7. Alkali Preparation Tank
8. Alkali Day Tank
9. Resin Injection/make-up Hopper
10. Acid Measuring Tank.

1.01.00 Of these, the items specified from sno 1 to 6 shall be designed as pressure vessels and the rest shall be atmospheric vessels.

1.01.01 All other vessels, not specifically listed here, but required for the Bidder's system shall also meet the general requirements of this specification.

1.01.02 Process requirements of these vessels shall be governed by the requirements of the Condensate Polishing System, which will determine their design conditions. Following sections only indicate some of the minimum requirements which must be met, and the actual design of these vessels shall be better than these, if that is required from process considerations.

2.00.00 GENERAL DESIGN FEATURES

2.01.00 Design

2.01.01 Design of all pressure vessels shall conform to ASME Section VIII or acceptable equivalent international standard. Design pressure shall be the maximum expected pressure to which the vessels may be subjected to plus 10% additional 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 pumps suction if any. Design pressure of condensate service vessels is indicated elsewhere in this specification. For all other pressure vessels, design pressure shall be at least 10 Kg/cm² (g).

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

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

2.01.04 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.

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

2.02.00 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. Vessel and atmospheric tank ends shall be of dished design and



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constructed by forging, pressing or spinning process. Conical or flat ends shall not be accepted. All dished ends shall be stress relieved.

- 2.03.00 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 tanks. Further, a minimum 100 mm free board shall be provided above the top of overflow level to the top of the tank. Wall thickness of atmospheric tanks shall not be less than 6 mm.
- 2.04.00 Vessels coming under preview of IBR shall be designed accordingly.
- 2.05.00 Interior surfaces of all tanks shall be clear of stiffeners and other structural supports. Tanks shall be reinforced and stiffened externally as required.
- 2.06.00 All welds on inner tank surface shall be free of voids, gaps craters, pits, high spots, sharp edges, abrupt ridges and valleys or undercut edges. High spots, irregularities and sharp edges shall be removed by grinding. Inside weld seams shall be ground flush and smooth applicable for corrosion resistant coating or lining.
- 2.07.00 All internal baffles, wear plates, pipes etc. shall be continuously welded on both sides at all contact points with full fillet welds which shall be free of voids, gaps, craters, high spots, sharp edges, and undercutting. Sharp edges shall be ground to a 3 mm minimum radius.
- 2.08.00 Weld splatter shall be removed.
- 2.09.00 All welding shall be performed by ASME qualified welders under Section-IX of ASME Boiler and Pressure Vessel code and welding electrodes shall be as per relevant Codes/Standards viz. AISC Section 1.17 etc.
- 2.10.00 The plates for cylindrical tanks shall be accurately formed in bending rolls to the diameters called for, and the completed shells be concentric and plump. Plates shall be cold-rolled by plate bending machine in a number of passes to true curvature and joined by welding.
- 2.11.00 Vessels seam shall be so positioned that they do not pass through vessel connections.

3.00.00 MATERIAL OF CONSTRUCTION

- 3.01.00 Please refer DATA SHEET-A.

4.00.00 APPURTENANCES

4.01.00 Manholes

- 4.01.01 All the pressure vessels and horizontal type storage tanks shall be provided with manhole of 500 mm diameter minimum size, preferably at the top head, complete with cover plate, lifting handle, davit cap, nuts, bolts, gaskets etc. to ensure leak tightness at the test pressure.
- 4.01.02 The vertical type storage tanks shall be provided with a manhole of 500 mm dia on the top cover, if the diameter of the tank is 1200 mm or more. For the DM water storage tanks, manholes shall be provided as per IS:803.
- 4.01.03 All the vessels and tanks shall be normally provided with a six inch gasketed handhole located near the bottom of the straight side.
- 4.01.04 The required lining/coating for the inside surface of the manhole/handhole, nozzle and cover plate of the manhole/handhole shall be same as that of the respective vessel/tank.

4.01.05 Sight Glasses

All the vessels mentioned shall be provided with pad type sight glasses on their vertical sides. Locations



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of these sight glasses shall be as follows:

4.01.06 One with the centre line at the normal level of the bed top, and one near the bottom of the straight side, for each of these vessels.

4.01.07 In addition, item no. 1.00.00 shall be provided with sight glasses, with their center lines at each of the normal separated resin interfaces.

4.02.00 **Lifting Lungs**

All vessels of diameter 1200mm or greater shall be provided with a minimum of 4 lifting lugs. Smaller vessels shall be provided with at least 2 lifting lugs.

4.03.00 **Vessels Supports**

Adequate supporting arrangements like straps, saddles, skirt rings, or legs of steel shall be provided to transfer all loads to the respective skid structures.

4.04.00 **Vessel Internals**

The internals for pressure Vessels shall be designed for a low pressure drop to promote uniform distribution and flow through the vessels and to withstand the full design pressure of the vessel in both directions.

Specification requirements for vessel internals are as follows:

4.05.00 **Inlet water and Regenerant Distributors**

Hub and laterals with diffuser splash plates or header and perforated laterals. Material of construction shall be type 316 stainless steel, except for acid service which shall be of Hastelloy B.

4.06.00 **Underdrains**

Same as above with screened laterals with internal perforated pipes, and rubber-lined false bottom. For resin separation/regeneration/mixed resin vessels, it may have fully screened bottom (NEVA – clog type with para Septanurse screen, fully supported by subway grid, or equal).

4.07.00 For lined vessels, they shall also be lined in the same manner as the internal surfaces of these vessels. For the caustic diluent heating/storage tank, they shall be of type 304 stainless steel construction.

4.08.00 **Internal Fasteners**

All internal fasteners shall be of type 316 stainless steel and heavy duty locknuts shall be used throughout.

4.09.00 **Piping Connections**

All lined vessel connections and connections in unlined vessels 25 NB and larger shall be to minimum ANSI 300 lb class. Flat face flanges shall be used throughout. Nozzle material shall be ASTM-A-106. Grade B. schedule 80 pipe. All flanged connections shall be supplied complete with matching counter flanges, nuts, bolts and full-face gaskets.

4.10.00 All vessel connections in unlined tanks smaller than 25 NB shall be screwed to ANSI 2.1 for schedule 80 pipe.

4.11.00 **Resin Traps**

Outlets of each of the condensate polisher service vessel and the waste effluent header of the common external regeneration facility, shall be provided with a resin trap. These resin traps shall be a minimum,



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conform to the following:

4.11.01 The resin trap shells shall be of steel construction and lined internally with saran or Polypropylene. The internals for all traps shall be johnson well screen type, of 316 stainless steel in both directions, resin traps located in processes effluent lines shall have a screen opening that does not exceed 120 percent of the associated process vessel under drain screen opening. Resin traps located in waste effluent headers shall have a screen opening of approximately 60 mesh.

4.11.02 Each resin trap shall be fully piped and valved for inplace manual back flushing.

5.00.00 SPECIFIC DETAILS

5.01.00 Alkali Diluent Heating – Storage Tank (Hot water tank)

This vessel shall be sized to hold a minimum of 5000 liters of 80 deg C demineralised water required for the regeneration of condensate polisher. In sizing this vessel, preheating of the anion resins shall not be considered as a requirement. The cold water feed line shall enter the tank through or near the top head and extend downward to within 15 cm of the tank bottom. Recovery time shall not exceed 4 to 5 hours.

All tank internals, including the inlet water tail pipe, shall be fabricated of type 304 stainless steel.

5.02.00 Atmospheric Tanks

Wall thickness of these tanks shall not be less than 6mm.

5.03.00 Resin Injection Hopper

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

a) Capacity

The resin make-up hopper tank shall be sized to handle up to 150 liters of as received new resin per single injection or maximum attrition loss whichever is higher.

b) Material

The resin make-up hopper tank shall be fabricated of mild carbon steel having a minimum thickness of 6mm and rubber lined.

5.04.00 Chemical preparation and day tanks

These shall be vertical cylindrical tanks. They shall be of carbon steel fabrication, lined and provided with full height level gauges right up to the overflow levels.

The alkali preparation tank shall be provided with a dissolving basket of type 316 stainless steel constructions, and a motorized slow speed stirrer mounted eccentrically to the tank by a bracket fixed to the side wall. The stirrer shall have impellers of type 316 stainless steel.

The alkali day tank shall be provided with an airtight cover complete with a breather arrangement, to prevent absorption of carbon dioxide from the atmosphere by the alkali solution contained in it. The overflow connection shall also be provided with a suitable seal for this purpose.

The tanks for ammonia solution (if applicable) shall also be provided with similar arrangements to prevent escape of ammonia vapor to outside.



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5.05.00 **LINING**

All internal lining of vessels provided under this specification shall be of natural rubber, meeting the following minimum requirements.

5.05.01 **Hardness**

Lining used may be soft rubber having a shore durometer reading of 4070 on the D scale, or semi-hard rubber having a durometer reading of 4570 on the D scale. Variations in hardness of the rubber lining between the different areas of a specific tank shall be within +/-5 durometer reading.

5.05.02 **Chemical Resistance**

The lining material shall be suitable for prolonged service in the chemical environment described below:

- a) Hydrochloric acid, 2 to 8% concentration, at temperature from 10 deg C to 50 deg C.
- b) Sodium hydroxide, 1 to 4% concentration, at temperature from 30 deg C to 50 deg C.
- c) 100 to 500 mg /l of sulphuric and hydrochloric acid combined. Ratio of concentration of these two acid 1 : 5 to 5 : 1 and temperatures from 10 deg C to 40 deg C.
- d) 1 to 10mg/l of sodium hydroxide at temperature from 10 deg C to 40 deg C.

The linings will be subjected to the condition (a) or (b) for intermittent periods of approximately one hour out of eight hours, and to conditions (c) or (d) remainder of the time.

5.05.03 **Thickness**

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.

5.05.04 **Surface Preparation**

Prior to rubber lining all surfaces must be prepared in the following manner.

- a) Degrease surface prior to blasting.
- b) The surface is to be blasted with steel grit or sharp silica sand to a white and bright metal surface.
- c) All traces of grit and dust should be removed with a vacuum cleaner or by brushing. Care must be taken to avoid contaminating the surface.
- d) Immediately after blasting and removal of grit, the first coat of primer or cement shall be applied and allowed to dry.

5.05.05 **Protection**

After the lining is completed the vessels shall not be subjected to any prolonged exposure to direct sunlight in course of its transportation erection, etc. They shall not also be stored in direct sunlight. No further welding or burning shall be carried out on the vessel, after application of the lining.

All lining projecting outside of the vessel, shall be protected adequately from mechanical damages during shipment, handling, storage etc.

Suitable warning, indicating the special care that must be taken with respect to these lined vessels, shall be stenciled on their outside surfaces with the letter at least 12mm high.



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Example:

“Warning – Tank is lined”

“Do not weld or Burn”

“Do not Store in Direct Sunlight” etc.

6.00.00 CODES AND STANDARDS

The design, manufacture, shop testing, site fabrication and erection, testing and commissioning of the pressure and storage vessels shall conform to the latest revisions of the following standards, in addition to other standards mentioned elsewhere in the tender document subject to any modification and requirement, as specified here in after.

- a) IS: 803 - Code of practice for design, fabrication and erection of Vertical Mild Steel cylindrical welded oil storage tanks.
- b) IS: 816 - Code of practice for use of metal arc welding for general construction in mild steel.
- c) IS: 817 - Code of practice for training and testing of metal arc welders.
- d) IS: 822 - Code of procedure for inspection of welds.
- e) IS:1363 - Black hexagonal bolts, nuts and locknuts (dia 6 to 39 mm) and black hexagon screws (dia to 24 mm).
- f) IS:1367 - Technical supply conditions for threaded fasteners.
- g) IS:2062 - Specification for weld able structural steel.
- h) IS:2002 - Steel plates for pressure vessels for intermediate and High temperature service including boilers.
- i) IS:2825 - Code of unfired pressure vessels.
- j) IS:3133 - Manhole and inspection opening for chemical equipment.
- k) IS:4049 - Specification for formed ends for tanks and pressure vessels.
- l) IS:4682 - Code of practice for lining of vessels and equipment for chemical processes Rubber Lining.
- m) BS:2594 - Specification for carbon steel welded horizontal cylindrical storage tanks.
- n) ASME - Boiler and pressure vessel Section VIII code.
- o) ASTM - American Society for Testing and Materials.

7.00.00 FABRICATION

7.01.00 The vessel ends for storage tanks of vertical type shall have dished ends at top & bottom. However, the ends of horizontal storage tanks, and all the pressure vessels shall be dished design of Tori-spherical type designed.

7.02.00 The plates to be used for fabrication shall preferably have a minimum width of 1500 mm.



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- 7.03.00 All the joints (circumferential / longitudinal) shall be continuous butt welded, inside and outside. Connection shall be flush with inner surface of tanks and welded continuously on both sides of shell. Sharp inside edges shall be rounded to a minimum 3 mm radius.
- 7.04.00 Welding sequence shall be adopted in such a way so as to minimize the distortion due to welding shrinkage. Bidder shall indicate in his drawing the sequence of welding proposed by him which should meet prior approval of the BHEL and customer. Welding shall not be carried out when the surface of the parts to be welded are wet from any cause and during periods of rain and high winds unless the welder and work are properly shielded.
- 7.05.00 All pressure vessels and storage tanks except Demineralised water (D.M.) shall be fabricated complete and tested at manufacturer's works to ensure better workmanship.
- 7.06.00 **Tank Connections**
- 7.06.01 Bidder shall furnish all pipe material required for tank connection for the process requirement. In addition to these, additional connections, if required by the BHEL and customer for the inter-connection of their piping, instrumentation etc. shall also be provided. Such additional requirement will be intimated to the successful Bidder later and Bidder shall provide these fittings to match with the BHEL and customer's items. Adequate pipe support attachments in the external surface of the tank/vessel shall be provided for Owners pipes for all the vessels/tanks. All lined vessels connections shall be conform to minimum ANSI 300 lb class. Nozzle material shall be ASTM-106 Grade B, Schedule 80.
- 7.06.02 All flanged connections should be supplied complete with matching counter flanges, nuts bolts and gasket materials. The flange design, (thickness and drilling etc.) shall match with the interconnected piping flanges.
- 7.06.03 Bolts and nuts to be used externally to the vessels shall be of hexagonal head conforming to IS:1367. However, internal fasteners if any, shall be of IS:316 /SS-304 or Hastalloy-B as per the duty conditions.
- 7.06.04 Gaskets shall be of full face type.
- 7.06.05 Sight glasses shall be provided for the tanks/vessels as specified in the standard specification. The material for sight glass shall be high quality transparent PLEXIGLASS of sufficient thickness to withstand the test pressure. The sight glass shall be provided with suitable gaskets and bolts to ensure leak tightness at the test pressure.
- 7.07.00 **Vessels Supporting Lifting Lugs**
- 7.07.01 Adequate supporting arrangements like straps, saddles, skirt boards, pillars etc. shall be provided to transfer all loads to civil foundation. All foundation bolts, inserts etc. shall also be provided.
- 7.07.02 All vessels of internal, diameter of 1200 mm or greater shall be provided with minimum four (4) lifting lugs for safe and effective handling during erection. Smaller vessels shall be provided with at least two (2) lifting lugs.
- 7.07.03 Material of construction for these vessel supports, saddles, lugs shall conform to IS:2062 of tested quality.
- 7.08.00 **Special Accessories Storage Tanks**
- 7.08.01 Vessel internals wherever required shall be provided as detailed out elsewhere in the specification.
- 7.08.02 All the pressure vessels and tanks shall be provided with drain connections along with drain valves of suitable size. Further all the atmospheric storage tanks shall be provided with over flow connection designed for the filling rate of the respective tank.
- 7.08.03 All the pressure and tanks shall be provided with the vent connections. The design shall be as to offer adequate area for venting. Venting area shall be such that over pressure/vacuum is not created in the tank during maximum filling/drain-off rate. The maximum draw off rate for the DM storage tanks shall be intimated later to the successful bidder.



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- 7.08.04 Various instrumentation and the fittings required for the same shall be supplied as elaborated in data sheets.
- 7.08.05 The vent and overflow lines of alkali preparation /measuring / day tanks and vent line of DM storage tanks shall be provided with Carbon dioxide absorber of proven design to prevent contamination from atmospheric air. Carbon dioxide absorber shall preferably be located at ground level. The vent and overflow lines of Acid measuring tanks shall be provided with fume absorber using suitable packing material, such as pall rings/raschig rings.

TECHNICAL SPECIFICATION FOR
POWER CYCLE PIPING VALVES AND SPECIALTIES

CONTENT

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3.00.00	CODES AND STANDARDS
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6.00.00	DESIGN AND CONSTRUCTION
7.00.00	INSPECTION, TESTING AND INSTALLATION
8.00.00	DRAWINGS, DATA, INFORMATION AND MANUALS

ATTACHMENTS

ANNEXURE-I	MATERIALS OF CONSTRUCTION FOR PIPING AND FITTINGS
ANNEXURE-II	MATERIALS OF CONSTRUCTION FOR VALVES

POWER CYCLE PIPING VALVES AND SPECIALTIES**1.00.00 GENERAL INFORMATION**

1.01.00 This section covers all the piping, valves and specialties which connects the different equipment like the boiler, turbine, condenser, pumps, heaters etc. to make the power cycle complete.

2.00.00 PERFORMANCE REQUIREMENT

The piping system acts as the pressure boundary for the fluid in circulation; water and steam in this case, which is subject to high pressure, temperature, change of phase and various types of transient and steady state operation. The piping system shall be designed and constructed for integrity, long life, high reliability acceptable pressure drop, smooth and good operation and control from start-up to the maximum sustained load.

3.00.00 CODES & STANDARDS

3.01.00 The design, manufacture, inspection and testing of the equipment covered under this specification shall conform, in general, to the standards and codes (latest edition) mentioned below :

- | | | | |
|---------|--|---|---|
| 3.01.01 | ANSI B-31.1 | : | Code for Pressure Piping - "Power Piping". |
| 3.01.02 | Indian Boiler Regulations | : | (IBR), with latest amendment. |
| 3.01.03 | ANSI B-16.5 | : | "Steel pipe flanges and flanged fittings". |
| 3.01.04 | ANSI B-16.9 | : | Wrought steel Butt welding fittings. |
| 3.01.05 | ANSI B-16.11 | : | "Socket Welding Ends". |
| 3.01.06 | ANSI B-16.25 | : | "Butt Welding Ends". |
| 3.01.07 | ANSI B-16.34 | : | "Steel Valves - Flanged and Butt Welding Ends". |
| 3.01.08 | Design fabrication, assembly and testing of pipes, fittings shall generally conform to the requirements of ANSI B-31.1. But the portions, which come under the purview of Indian Boiler Regulations (IBR), shall completely comply the requirements of IBR as a minimum. | | |
| 3.01.09 | Any other internationally accepted codes and standards are also acceptable. However, the compliance of ANSI codes and IBR will be considered as | | |

minimum for acceptance of the piping and all appurtenances.

4.00.00 **SCOPE OF WORK**

4.01.00 **Scope of Supply**

Scope shall include complete piping, valves & specialties as required for all systems, units and auxiliaries.

Items not mentioned but deemed necessary by the Bidder for making the system complete, reliable and efficient shall also be included.

4.01.01 The equipment and materials to be supplied under this specification shall include but not be limited to the following :

- a) Supply of all power cycle piping including bends, elbows, tees, branches, laterals, crosses, reducing union, couplings, caps, saddles, shoes, flanges, blank flanges, Y-pieces etc. as required for the piping system under the scope of this specification.
- b) Matching pipes, matching pieces like reducers/enlargers etc., counter flanges with bolts, nuts, washers, temporary and permanent gaskets, threaded union etc. for all terminals as required.
- c) Supply and machining work of flanges, pipe spools and matching pipes to connect flow measuring orifices/nozzles with the main pipe work. The pipe spools shall be supplied along with necessary test certificates of the pipes, after necessary machining to the required bore, for assembly of flow nozzle element. The assembled flow nozzle shall be installed in the piping system. Additional length of pipes equal to length of all fully assembled flow nozzle & orifice plates pipe piece shall be supplied and the same shall also be erected prior to cleaning of the pipes by flushing or steam blowing or chemical cleaning or both. After completion of cleaning of piping the assembled flow nozzles shall be erected replacing the temporary pipe spools.
- d) All motorised valves, manually operated isolating and regulating valves, non-return valves, steam traps, relief/safety valves, strainers, pressure reducing orifices, expansion joints and other flexible connections, complete with the counter flanges and matching connecting pieces as required within the terminal points of entire power cycle piping system.
- e) Anchors, hangers & supports, vibration dampeners, restraints, shock absorbers etc. as required. Any platform necessary for maintenance and operation of valve and equipment located 1.5m above any permanent floor including access ladders, supporting structures etc.
- f) All secondary structural steel members required for pipe supports from building steel structures and from embedded steel including pipe supports in trenches.

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- g) Funnels, tundishes for drips & drains including all miscellaneous drain piping and drain piping from tundish outlet up to drain points. All drain and vent lines shall be conveniently terminated either in flash tanks or permanent drain trenches of the Power Station.

All steam and saturated water open drains shall be drained through a water seal in drain funnels/tundish with a water connection in funnels/tundish for maintaining water seal level in them.

All oily effluent drains should be separately routed and connected to separate pit.

- h) For the isolation and check valves located on the main steam (MS), hot reheat (HR), cold reheat (CR), L.P. bypass and extraction lines, suitable line drains shall be provided just upstream and downstream of each of these valves. No drain is needed at the downstream of L.P. bypass isolation valve. Each of these drains shall be independently led to the condenser with branching off to atmosphere.

Line drains from MS, HR, CR, L.P. bypass & high pressure (above 40 Kg/Sq.Cm.) extraction lines shall be provided with double isolation valves in series for each branch - each located at the two extreme ties of the line drain route. The valve near the condenser should be motorised one. The balance line drains shall be provided with only one isolation valve for each branch.

- i) Bolts, nuts, washers, temporary and permanent gaskets, fasteners as required for interconnecting piping, valves & fittings as well as for terminal points.
- j) Complete insulation material for piping, valves, specialties & auxiliary equipment specified in this specification and as called for in the specification for thermal insulation.
- k) Painting of all piping, valves & specialties at site.

4.01.02 Bidder shall furnish his own layout and technical details of piping, valves, specialties and accessories along with his offer.

Following general requirements shall however be provided :

- a) Instrument Connections

The following instrument tappings shall be provided :

- i) Pressure Tappings

The Contractor shall furnish stubs and root valves for all gauge, transmitter and pressure test connections as required. The number of root valve for each connection shall be two (2) for system design pressure equal to or greater than 40 KG/Sq.cm.g.

-
- ii) Temperature Tappings

The Contractor shall supply all stubs and mount the thermowells.
 - iii) Flow Measurement Tappings

The Contractor shall provide stubs and root valves similar to the above for all differential pressure taps at flow nozzle and orifice plate installations.
 - b) Pipe stubs and blanking plates required for chemical cleaning and hydro testing.
 - c) Flanges, spool pieces, gaskets, ring joints, jointing materials, aluminium and stainless steel forged marking plate and temporary piping for steam blowing.
 - d) Drain/drip pockets on steam piping as per stipulation of ASME, TDP Vol.-I and general requirement.
 - e) Expansion marker for high temperature steam lines.
 - f) Fine threaded Radiography holes with stubs and suitable matching plugs, which shall be finally seal welded for piping, more than 25 mm nominal thickness.

For conducting performance test of Turbo-Generator and Boiler, the required pressure, temperature, flow measurement points shall be provided.
 - g) Provision for creep measurement on the piping operating in creep region viz. main steam and hot reheat.
- 4.01.03 Electrodes and filler wires required for stainless steel and alloy steel welding during shop fabrication at works and erection/installation at site.
- 4.01.04 All temporary pipes and accessories, supporting arrangement for cleaning, flushing and steam blowing of the main steam, cold reheat and hot reheat piping including HP/LP by pass piping and auxiliary steam piping.
- 4.02.00 **Scope of Services**
- 4.02.01 The Contractor shall design the piping system and perform necessary stress analysis of all piping and dynamic analysis as necessary.
- 4.02.02 For stress analysis purpose, individual piping systems shall be considered. All anchors are to be designed, supplied and erected by the Contractor.
- 4.02.03 Stress analysis and hanger selection for all piping including piping attachment for hangers/supports, all auxiliary supporting structures are included in the scope of the Contractor.

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- 4.02.04 The Contractor shall submit the design calculations for pipe sizing, thickness with specified diameters of pipes and stress analysis data to Owner/Engineer for review/reference/records. Pressure drop calculation for main steam, cold reheat and hot reheat piping to be submitted by the Contractor to show the adequacy of pipe sizes.
- 4.02.05 Preparation of detailed fabrication drawings (isometric) of shop fabricated piping which are of size 50 mm NB and above should be based on the "Released for Construction" drawings.
- "As built" drawings of the power cycle piping layout shall also be prepared by the Contractor based on any layout modifications made at site over "Released For Construction Drawings".
- 4.02.06 The Contractor shall design and detail all piping supports including restraints, guides, stops, snubbers, dampers etc. based on the final stress analysis and hanger load data. The Contractor's design of all supports shall be submitted to the Engineer for review.
- 4.02.07 The Contractor shall furnish separate sketches for each support, restraint, anchor, snubber, dampers etc. These sketches shall include the location with reference to column co-ordinates, identification number, bill of material, design loads, operating load, spring stiffness, amount of spring pre-compression, etc. and method of attachment to the pipe and steel structure.
- 4.02.08 In order to ensure that all piping, supporting elements, anchors and restraints have been installed and adjusted in accordance with the drawings and other written instructions of the Contractor, the hangers associated with the main steam, hot reheat, cold reheat, HP & LP by-pass, feed water, auxiliary steam piping etc. shall be inspected as follows :
- a) After hydro test, with the piping in the cold position, with all travel stops removed, with the pipe completely insulated and in all respects ready for start-up.
 - b) Piping in the hot position, with the unit operating at maximum load.
 - c) Piping in the hot position after 6 months of operation.
 - d) Piping in the cold position during first complete shutdown after at least 6 months of operation.
- The contractor shall depute his personnel for this purpose to site if the plant is officially handed over to the owner before such inspection after 6 months of operation.
- 4.02.09 At the time of each inspection, the Contractor shall determine the necessity for revision, adjustment or replacement of pipe supporting elements, restraints and anchors. Any changes proposed shall be incorporated by the Contractor after Owner/Engineer's concurrence.
- 4.02.10 All shop tests satisfying the requirements of Indian Boiler Regulations (IBR), ANSI standards, the standards enumerated herein and/or as specified.

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- 4.02.11 Furnishing drawings, data, design calculations, stress analysis results.
- 4.02.12 Furnishing certified copies of test results for all tests and examinations specified in the specification and for the mandatory tests and analysis required by the ASTM material specification, for the materials used for piping and the pressure parts of the valves.
- 4.02.13 Obtaining approval from Chief Inspector of Boilers as per Indian Boiler Act, including the following :
- a) For all pipelines coming under the purview of Indian Boiler Regulations (IBR) necessary approval of the design and layout drawings shall be obtained from the Chief Inspector of Boilers, and furnished to the Purchaser/Engineer. Necessary certificates of design, manufacture and tests in specified Form of IBR, for each fabricated pipe with proper identification shall be submitted.
 - b) For fittings & specialties, viz. valves, flanges, traps & other specialties, etc. of all pipelines coming under the purview of IBR, Certificate of design, manufacture and tests in specified Form of IBR with appropriate identification shall be furnished to the Owner/ Engineer.
 - c) Erection & testing of the pipe lines coming under the purview of IBR shall meet all the requirements of IBR and certificate of manufacture & tests in specified Form of IBR, for each of the erected pipe lines shall be submitted to the Purchaser/ Engineer prior to the application of insulation and/or flushing the line before commissioning
- 4.02.14 Steam blowing or chemical cleaning of piping systems, as specified elsewhere in the specification, after complete erection is to be carried out, which also includes supply, erection and dismantling of temporary piping, valves and fittings.
- 4.03.00 Omission of specific reference to any item or material or work which is necessary for completion of the piping systems, shall not relieve the bidder of the responsibility of furnishing all material and services for a complete installation satisfying the operational and other requirements stated in the specifications.
- 4.04.00 Drawing indicating the layout of pipe work shall be prepared in line with the flow diagrams and shall be provided as part of the Contract. These drawings shall indicate the position of all supports, guides, restraints and anchors; all drain and vent connections and the position of all pipes. All piping systems shall be arranged to allow adequate falls in the direction of flow, except where otherwise approved by the Engineer. At the points of drainage, drain pockets of ample size and approved construction shall be fitted as per details indicated in the enclosed drawings.

5.00.00 SPECIFIC DESIGN CRITERIA

Sl. No.	Item	Criteria
1.00	Design, fabrication & Erection	
1.01	Design, fabrication, testing & erection of Power Cycle Piping, valves & specialties for critical piping system under purview of IBR, as specified.	To satisfy IBR, ANSI/ ASME B31.1 latest code.
1.02	Design, fabrication, testing & erection of Power cycle piping, valves & specialties for non-critical piping system, which are not purview of IBR, as specified.	To satisfy ANSI/ASME B31.1 latest code.
1.03	Design of safety valve installation.	To conform with the Non-mandatory rules for the design of safety valve installation of ANSI/ASME B31.1. Open discharge installation preferred.
2.00	Piping Flexibility Analysis	
2.01	Piping to be analysed	All piping having sizes equal to or above 50 mm NB & design temperature 100 Deg.C and more.
2.02	Code to be followed	ANSI/ASME B31.1 latest & also satisfying IBR latest.
2.03	Loading conditions to be considered Note: Contractor shall justify with reasoning in case any one of the specified loads is not considered in analysis.	a) Internal pressure b) Thermal loads due : i) Piping thermal expansion ii) Anchor displacement due to thermal movements of piping anchors.
		c) Piping weight consisting of weight of piping, valves, bends, fittings, insulation etc. as well as weight of support components like clamps, shoes, suspension rods, trapeze etc. & weight of contained fluid.
		d) Test or cleaning fluid load.
		e) Equivalent static loads due to discharge of safety valve (SV), Electromatic relief valve (ERV), simultaneous discharge of SV & ERV where applicable.
		f) Dynamic load due to steam hammer (if applicable).
		g) Seismic loads due : i) Equivalent static load due to seismic inertia effect. ii) Equivalent static load due to seismic anchor displacement.

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Sl. No.	Item	Criteria
		h) Wind load where applicable.
2.04	<p>Loading Combinations</p> <p>Note: Contractor shall clearly indicate the basis of his judicious selection or loading combination for support, restraints and anchor design.</p>	<p>Design load for supports, restraints, anchors & supporting structures shall be obtained by proper selection of one or combination of two or more of the loads as per item 2.03 above based on the possibility of independent or simultaneous occurrence.</p> <p>Component of thermal expansion reaction range expected to appear at cold condition, as per Equation 9 & 10 of ANSI/ ASME B31.1 shall be considered in loading combinations.</p> <p>An overload factor of 1.30 shall be considered over the computed loads except occasional loads before combining them.</p>
2.05	Combination of Stresses	The computed stress under different loading conditions shall be combined as per Equation 11, 12 & 13 of ANSI/ASME B31.1 & the stress shall be within allowable limits.
2.06	Allowable Stress Values	For piping materials other than ASME/ ASTM materials, values shall be derived as per the criteria defined in Appendix-P of ASME Boiler & Pressure Vessel Code, Section-VIII, Division 1 while computing pipe wall thickness, and flexibility analysis shall be conducted as per ANSI/ASME B31.1. However higher pipe wall thickness derived between IBR regulation & ANSI/ASME B31.1 code shall be considered.
2.07	Factor to be considered in flexibility analysis	<p>a) Contractor shall consider value of stress range reduction factor "f" for cyclic conditions due to temperature reversals equal to ONE.</p> <p>b) Stress intensification factors at all transitions, fittings & all branches as per ANSI/ASME B31.1.</p> <p>c) Variation in supporting effort by variable spring due to pipe movements.</p>
2.08	Piping layout	Flexibility analysis of Piping is to be conducted as per the offered piping layout. In case any modification of piping layout is felt essential to maintain stresses & terminal reactions within allowable ranges, same are to be carried out by the Contractor after discussion with Owner.
3.00	Design Pressure & Temperature	As per IBR. Wherever not clearly stipulated in IBR, criteria stipulated in ASME/ ANSI 31.1 for selecting design pressure & temperature shall be followed.

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Sl. No.	Item	Criteria
4.00	Material of construction of piping, valves & specialties	ASME/ASTM materials
5.00	Hangers, supports etc.	
5.01	Type	<p>a) Variable spring :</p> <p>i) Where the variation in supporting effort between hot and cold condition does not exceed 20% of the load.</p> <p>ii) The resulting effect of load take-up/release by a group of hangers in a span does not overstress the piping span or cause overloading at equipment terminals.</p> <p>iii) Thermal deflection between hot & cold conditions does not exceed 40 mm.</p>
		b) Constant load - For thermal deflection between hot and cold conditions exceeding 40 mm. and or, for load variation beyond 20%
		c) Spring hangers should not be loaded more than 80% of the spring travel range.
		d) Rigid hangers & restraints - To be judiciously selected, without exceeding the stipulated limits of terminal forces & moments & stress level. Struts shall be considered where compressive load is expected.
		e) Snubbers, dampers etc. - To take seismic/dynamic loads, thrust due to safety valve discharge. Effort shall be made to limit its use by judicious placement of rigid hangers.
		f) Bottom support spring hangers to be avoided as far as possible.
5.02	Design, materials, fabrication testing and erection of hangers, supports, anchors, guides etc.	a) As per ANSI/ASME B31.1 latest code.
		b) Hanger suspension rods, tie-rods/struts should have proper arrangement & adequate length, so that thermal movements in direction which are free are not constrained and should not make an angle more than 4 degrees with vertical due to horizontal pipe movements.

Note : In case turbine steam stop valve is not anchored, steam hammer analysis of the main steam & HP/LP By-pass pipe line on stop valve closing shall be carried out.

6.00.00 DESIGN AND CONSTRUCTION
6.01.00 General Considerations

6.01.01 Pipe sizing and piping system design shall conform to the requirements of power piping code ANSI B31.1. Statutory requirements as laid down in Indian Boiler Regulations (latest edition) will also be taken care in pipe system designs. Pipe wall thickness as calculated by ANSI Code formula will also be checked for IBR requirements for piping systems falling under IBR purview.

6.01.02 Inside diameters of piping shall first be calculated for the flow requirement of various systems. The velocity limits for calculating the inside diameters are listed below :

- | | | |
|----|--|--|
| a) | Main Steam hot and cold reheat pipes | 75 m/sec. |
| b) | Auxiliary steam (Aux. steam to take care of various design flows). | 40 m/sec. |
| c) | Feed Water | |
| | i) Suction | 2.0 m/sec. |
| | ii) Discharge | 6.0 m/sec. |
| d) | HP bypass | |
| | i) Upstream | 75 m/sec. |
| | ii) Downstream | 150 m/sec. |
| e) | LP bypass | |
| | i) Upstream | 75 m/sec. |
| | ii) Downstream | 150 m/sec. |
| f) | Extraction steam | |
| | i) Superheated steam | 60 m/sec. |
| | ii) Saturated steam | 30 m/sec. |
| g) | Condensate | |
| | i) Discharge | 5.0 m/sec. |
| | ii) Suction | 1.5 m/sec. |
| h) | Heater Drains: | 1.5 m/sec |
| i) | Heater Vents: | 25 m/sec |
| j) | Other piping | As per good proven engineering practice. |

Note: This standard sets the maximum limits of the flow velocity.

Lower velocities may be selected if found necessary.

Inside diameters thus calculated shall be checked for allowable pressure drop for various systems. Pressure drop in main steam line shall not be more than 90% of the pressure differential between superheater outlet header and HP turbine inlet valves at BMCR. Similarly, combined pressure drop in cold and hot reheat piping will not exceed 90% of the available pressure differential between HP turbine exhaust and LP turbine inlet valves minus the reheater drop. The available pressure differential in the complete reheat line from HPT exhaust to IPT inlet shall not be more than 10% of the pressure at HPT exhaust. Wherever possible 5D/6D radius bends will be used to minimise the pressure drop in the main steam, cold & hot reheat piping systems.

Pipes shall be sized for the worst (i.e. maximum flow, temperature and pressure values) operating condition. In case of BFP suction pipe sizing "transient analysis" shall be carried out for optimum sizing of the system in order to establish the pipe inside diameter for minimum pressure drop in system to match with the pump NPSH requirements under worst operating conditions. The Boiler Feed Discharge pipe-work shall be designed for the maximum final feed water temperature down-stream of H.P. heaters and the maximum closed valve pressure of the boiler feed pump upto and including downstream valve at FRS in the following two cases, whichever gives a higher pressure.

- a) Temperature of water from deaerator
- b) Deaerator storage tank working at its maximum possible pressure with saturated water.

Feed regulating station (FRS) located at upstream of HP heaters and no isolating valve provided at economizer inlet, the design pressure of boiler feed discharge piping at downstream of FRS shall be worked out corresponding to design pressure of the boiler. This shall be for HP heaters provided with spring loaded relief valve(s) or having provision of media operated three way valves at inlet/ outlet of HP heater(s) as per approval of IBR so as to prevent BFP shut off pressure being communicated to downstream piping system and HP heaters.

In addition to this the rest of the design basis shall be same as for other water services described above.

- 6.01.03 Thickness calculation shall be made on the basis of procedure and formula given in ANSI/ASME B 31.1. Stress values of piping material for calculation shall be selected from tables given in ANSI B31.1. Thickness thus calculated shall then be checked based on the procedure and formula given in IBR and based on higher of the two calculations (after adding manufacturing tolerance), the next heavier commercial wall thickness shall then be selected from thickness schedules (e.g. sch.40, sch 80, etc) in ASME B36.10 for OD controlled pipes and from manufactures' schedules for ID controlled pipes.

However, in cases where the calculated thickness for OD controlled pipe falls beyond the thickness corresponding to the listed schedule nos. as given in

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ANSI B36.10 for the pipe size, both ID and OD controlled pipes to manufactures' schedules are acceptable.

OD controlled pipes shall be to the dimensional standards ANSI B36.10 for carbon & alloy steels pipes and ANSI B36.19 for stainless steel pipes.

To account for losses due to corrosion, erosion etc. during the plant service life, an allowance of 1.6 mm/0.75 mm shall be considered in the minimum wall thickness calculation of pipes as per ASME B31.1/IBR respectively.

The design pressure and temperature, down-stream of any pressure reducing valve upto and including the first block valve shall be the same as that at up-stream of pressure reducing valve. The piping at down stream of de-superheater shall be designed for spray failure condition. The length of piping system considered for spray failure condition shall not be less than the length required for proper spray mixing as recommended by de-superheater supplier.

However, in no case, the selected pipe thickness shall be less than Sch.80 for alloy steel & carbon steel pipes of sizes 50 Nb & below. The selected thickness for SS pipes shall not be less than Sch.40S of ANSI B36.19.

Further, for the piping systems likely to be subjected to two phase flow, i.e. down stream of control valves on heater drain lines etc. and for the length of piping which is required for the proper mixing of spray water at downstream of de-superheater, the selected thickness shall not be less than :

(a.) Sch.40 for pipe sizes above 50 NB, but below 300 NB and

(b.) Sch. STD for pipe sizes 300 NB and above.

- 6.01.04 No pipe work shall be run in trenches carrying electrical cables.
- 6.01.05 Pipes shall not be less than 20 mm bore unless authorised by the Engineer.
- 6.01.06 Site fabricated pipes shall be installed only where they do not exceed 50 mm. bore and where their use has been approved in writing and shown on a scale drawing.
- 6.01.07 All piping shall be identified by means of colour strips and by adequate lettering, conveniently spaced and located. Identification colours and lettering shall be as approved.
- 6.01.08 Air release and drain branches shall be provided wherever necessary depending upon the layout and arranged so that the drains and air release valves are located for easy operation.
- 6.01.09 All valved drains in vacuum services shall be provided with screwed cap.
- 6.02.00 **Stress and Flexibility Analysis**
- 6.02.01 Overall procedure of stress & flexibility analysis shall be as per latest revision of ANSI B31.1/IBR and according to material used.

- 6.02.02 Complete and comprehensive stress and flexibility analysis of the piping shall be done by computer using an approved standard program.
- 6.02.03 All piping of design temperature exceeding 100°C and nominal size equal to or above 50 mm except otherwise mentioned in Specific Design Criteria shall be stress analysed considering the effects stipulated therein.
- 6.02.04 The method of analysis due to seismic effects on static equivalent basis shall be submitted to Owner for approval prior to start of the analysis.
- 6.02.05 Stresses in pipes and fittings due to the above effects shall be limited to level prescribed by IBR wherever applicable. Other stress criteria not prescribed by IBR shall be guided by ANSI B31.1. Suitable stress intensification factors shall be assumed. Allowable stresses shall be computed by methods prescribed by IBR wherever applicable. However, such allowable stresses shall not be more than those prescribed by the relevant codes/standards.
- 6.02.06 The results of stress analysis shall be submitted for approval by Engineer before start of Fabrication or Erection clearly confirming the following :
- a) The terminal forces and moments are within permissible limit.
 - b) Forces and moments on supports, anchors and restraints attached to building/supporting structures are within permissible limit.
 - c) Stresses on piping are within acceptable limit stipulated in the applicable codes.
 - d) Pipe movements are acceptable for the spacing in between adjacent pipes and between pipes and adjacent structures/ equipment etc.
 - e) Stress checking for occasional loading.
 - f) All other stress/flexibility checking as stipulated in IBR/ American codes whichever is stringent.
- Above stress analysis results shall be used for checking the piping design.
- 6.02.07 The finalised flexibility analysis in the form of a report indicating procedure of analysis, pipe sizing based on specified diameter, spring hanger summary, design load charts for Anchors. Restraints and hanger supporting structures delineating different loading conditions, stress charts, loading on terminal anchors, along with isometric drawings of piping for flexibility analysis shall be submitted to Purchaser for review.
- 6.02.08 All high temperature lines shall be provided with expansion markers with scales at certain hanger locations, as decided by the Engineer. The Contractor shall guarantee and prove during trial run, after a few cycles of operation that the range of thermal movements in three directions from cold to hot condition at the expansion marker locations are within $\pm 20\%$ of the calculated values.

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If the error exceeds the above limit, necessary adjustments and rectifications shall be carried out by him at no extra cost, till the above requirement is fulfilled.

6.03.00 Material Specification

6.03.01 Material for pipes and fittings shall be as stipulated in Annexure-I enclosed. Bidder may note that ASTM materials have been considered for Main Steam, Hot reheat, Cold reheat, HP & LP bypass pipings and all the tendering information in the specification for such pipes have been given based on this material of piping. In case bidder wants to offer alternative piping material, same may be accepted by the Purchaser depending on the merits of alternative material. In that case pipe stress analysis, hanger selection etc. for such pipings are to be carried out by the Contractor accordingly.

6.03.02 Pipe attachments for supports, anchors and restraints, which are coming in direct contact with pipes and are inside the insulation of high temperature pipes shall have similar materials as the piping concerned. All other materials of supports, anchors and restraints shall be of tested quality and as per manufacturer's standards.

6.03.03 For rubber lined pipe, lining should be applied in three (3) layers, giving a total thickness not less than 4.5 mm.

6.04.00 Fabrication

Except where otherwise specified all piping shall have butt-welded connections with a minimum of flanged joints necessary for maintenance. All high pressure steam valves and accessories shall have welded connections. Where flanges are adjacent to welded fittings, weld neck flanges shall be used.

Branches shall, in general, be formed by welding. Standard fittings may be used in positions and for sizes where approval have been given in detail drawings. Pipe bends and tees shall be truly cylindrical and of uniform section. All welded branches shall be reinforced where needed as per the applicable codes/ regulations.

Unless otherwise specified, for all welded lines with pressure above 7 kg./sq. cmg. and/or temperature above 200 Deg.C branch connections for branch sizes up to 25% of welded mains shall be made with special forged steel welded fittings.

6.04.01 The piping systems shall be constructed in accordance with the requirements of ANSI B31.1. The requirements of IBR 1950 (with latest amendments) shall be complied with for the piping systems, which are under the purview of IBR.

6.04.02 Piping shall be fabricated in the shop in the largest transportable sections to minimise the number of field weld joints. The choice of field weld joints locations shall be based on the traverse of the pipe through walls, floors, sleeves or other restrictive areas. Support attachments for major piping shall be done at shop.

6.04.03 All workmanship shall be carried out using methods and procedures of best

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recognised pipe fabrication practice and must be done in a good and workman like manner in accordance with latest revisions. ANSI standards, ASME Codes, PFI standards and IBR as applicable.

6.04.04 All high-pressure steam valves and accessories shall have welded connections.

6.04.05 Mitred bends and elbows will not be accepted unless otherwise specified. Only forged tees, 90° elbows and 45° elbows are acceptable. In case the Bidder wants to deviate from this requirement on the ground of non-availability of such forged items, the bidder may submit alternative offer for Owner's consideration with sufficient documents to justify the same. In such a case the concerned fittings shall be manufactured with necessary reinforcing pads, bend thinning allowance etc. to satisfy code requirements.

6.04.06 All pipes bends shall be made true to angle with no negative tolerance and shall have a smooth surface free of flat spots, crease and corrugations.

A cross section through any bend portion of the pipe shall be true in diameter. All pipe bends shall have a radius of not less than 3 times the nominal pipe size unless otherwise mentioned. Pipe bends shall be made from straight pipe pieces of sufficiently higher thickness so that after thinning, the minimum thickness of bends shall not be less than the minimum thickness required for the straight pipe. Thinning allowance shall be considered as per ANSI B 31.1. The ends of pipe and welded fittings shall be bevelled according to details shown in the relevant piping codes.

6.04.07 Pipes of size 65 mm NB and above shall be shop fabricated and of size 50 mm NB and below shall be field run.

6.04.08 All welding shall be made in such a manner that complete fusion and penetration are obtained without any excessive amount of filler metal beyond root area. The reinforcement shall be applied in such a manner that it shall have a smooth contour merging gradually with the surface of adjacent pipe and welded fittings. Backing rings shall not be used on any pipe welds, unless otherwise approved by the Engineer.

Pipe and attachments shall be properly aligned prior to welding. If tack welds are used the tacks shall be either fused into the first layer of weld or else chipped out.

All welding for steam and feed pipe work shall be electrical welding using the shielded arc process and electrodes in accordance with the relevant code. For pipes up to and including 100 mm. bore, provided the pipe does not exceed 12.7 mm. in thickness, gas welded butt joints will be accepted without backing rings.

Welded joints in pipe work shall be pre-heated to a temperature as required by the agreed standard or code or to the approval of the Engineer. The temperature shall be maintained during the welding operation and a record of metal temperature shall be obtained by means of a recording thermometer throughout the welding operation.

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All welds shall be built-up by the application of multiple layers or passes. The thickness of metal applied for each layer or pass shall not exceed 3 mm. Each layer shall be cleaned and lightly peened before the next layer is applied.

Before being assigned to welding work, each operator shall have passed a qualification test as prescribed in the applicable Code/ Regulations. Each approved welder shall have an identification number which shall be indicated on all welds.

6.04.09 Welded joints shall be stress relieved as per ANSI B31.1./IBR. Stress relieving temperature shall be measured by thermocouple pyrometers or other suitable equipment. Readings of temperature against time shall be recorded.

6.05.00 **Welding**

6.05.01 General

Full scale joints preparation sketches (to be included with the welding procedure) shall show all dimensions including tolerances for bevel angle, land size and off-set and root gap. Adequate copies of detailed welding procedure for approval of IBR shall be furnished.

6.05.02 Cutting and Bevelling

- a) Carbon steel piping : End preparation for butt welding shall be done by machining/flame cutting.
- b) Chrom-Moly steel : End preparation for butt welding shall be done by machining.
- c) Socket welding : Socket weld end preparation shall be done by saw or machine cutting.

6.05.03 Welding Electrodes and Rods

All special welding electrodes and filler wires to be supplied and used for the work under this specification shall be of reputed make, approved/tested quality with valid test certificate and shall have proven performance record for similar application. Approval of the Owner as well as IBR should be sought in selection of the electrodes for specific uses.

The certificate of electrode shall incorporate all the chemical and physical test data and tests witnessed by a representative of the Inspecting Authority recognised under IBR.

6.06.00 **Hangers, Supports, Anchors and Restraints**

6.06.01 Hangers and supports shall be capable of carrying the sum of all concurrently acting loads.

6.06.02 All the hangers/supports shall be of reputed make, approved/tested quality

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and shall have proven performance record for similar application. They shall be designed to provide the required supporting efforts and allow pipeline movement with thermal changes without causing overstress. The design shall also prevent complete release of the piping load in the event of spring failure or misalignment and all parts of supporting equipment shall be fabricated and assembled so that they will not be disengaged due to movement of the supported piping. Necessary guides, anchors, braces and structural steel to be attached to building/boiler structure as well as any braces and/or dampeners required to eliminate piping vibration and seismic loading shall be provided.

- 6.06.03 In general piping shall be supported in such a manner to maintain drainage slopes, prevent interference with structure and piping and keep flexible supports in proper adjustment so that they will move within their design operating ranges. Normally pipe supports and anchors shall be selected at those points in the building where provision has been made for the loads imposed. The cutting of floor/roof beams or the reinforcement in slabs will not be permitted. Piping attached to a plant item shall be supported in such a way that the weight of the piping is not taken by the plant item.

Support spacing shall be as per good engineering practice. However, in no case it shall be less than support spacing stipulated in ANSI B31.1.

- 6.06.04 The design of the pipe supports and hangers and their locations shall be guided by the following general principles:

- a) Criteria of loading shall be as per "Specific Design Criteria" enclosed.
- b) Design loads for anchors, restraints, hanger supporting structures shall be as per the criteria stipulated in "Specific Design Criteria".
- c) Supports shall be adequate for extra loading due to hydrostatic tests and when piping system is full of water during chemical cleaning.
- d) Supports for relief valve stacks shall be adequate for both the pipe weight and the thrust developed when the valve is open.
- e) There should not be any interference of the hangers with other piping, pipe supports, cable trays structure, equipment etc.
- f) Besides vibration elimination, hangers shall ensure that the amplitude of oscillations in the pipe work owing to shock and vibration due to variation of fluid flow from zero to full capacity remains within approved limits.

- 6.06.05 Attempts shall be made to use variable spring and rigid hangers as much as possible. Rigid hangers shall preferably be used where vertical movement of the pipe is negligible.

Variable spring supports/hangers may be used provided the following conditions are met.

- a) The variation in supporting effort between hot and cold condition does

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not exceed 20% of the load, which is higher of the operating condition, and cold setting load.

- b) The resulting effect of load take-up/release by a group of hangers in a span does not overstress the piping span or cause overloading at equipment terminals.
- c) Thermal deflection between hot and cold conditions does not exceed 40 mm.

Otherwise, constant load type support/hangers must be used. On the other hand rigid hangers can be used where possible without exceeding the stipulated limits of terminal forces and moments and the stress subject to the Purchaser/Consultant's approval.

An exception may be made in the instance where the piping movement occurs at a hanger supporting a portion of a piping riser on which rigid support is also located. In this case, variable spring hangers may be used for any amount of expansion up to the full recommended working range of the spring, provided the change in the supporting effect of the variable spring is added to the design load of the rigid support assembly. However, the acceptance of such a system will be at Purchaser's/Consultant's discretion.

- 6.06.06 All design and fabrication including loading and allowable stresses shall be in accordance with ANSI B31.1. Note shall be taken of the requirements against earthquake at site. Hangers and supports for systems shall be completely engineered and prefabricated for all piping 50 mm. and above. Sufficient random materials shall be furnished for field support of all lines of smaller diameter.
- 6.06.07 For pipes of design temperature 100°C. and more, bottom supports shall be avoided as far as possible and hanger type supports shall only be used. However, where bottom support cannot be avoided, the same shall be provided with suitable shoes along with balls/rollers/rockers to minimise frictional resistance against thermal movements. The material of shoe as well as the ball/rockers/rollers shall be suitable for the design temperature of the supported pipe and shall be of sufficient hardness so as to permit a reasonably long life keeping its roundness and maintaining a low friction factor. Where a constant load type support is required, the bottom support shall also be of constant load type.
- 6.06.08 Where stress analysis calculations are performed, the location of anchors, guides and restraints shall be based on the results of the final stress analysis. Such anchors, guides and restraints shall be designed for the maximum forces and moments encountered. Spring hangers shall be selected to allow the movements determined by the stress analysis.
- 6.06.09 The Contractor shall design and provide all supplementary steel required to properly secure and support all pipe supports, guided restraints, anchors, shock absorbers, etc. furnished. Purchaser shall provide only the main steel work or, embedded plates in the concrete.
- 6.06.10 Accurate weight balance calculations shall be made to determine the required

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- supporting force at each hanger location and the pipe weight load at each equipment connection.
- 6.06.11 Provision shall be made for support of piping, which may be disconnected during maintenance work.
- 6.06.12 Supports shall be designed to prevent transfer of excessive loads from support to support or to equipment as the line expands or contracts. Support components shall be attached in places where they will not damage other construction either during or after installation. Cantilever type support shall not be taken from brick wall. Brackets may be used where piping is adjacent to vertical surfaces, suitable for support use, these shall be supported from columns/RCC structures.
- 6.06.13 All large pipes and all long pipes shall have at least two supports each arranged so that any length of pipe or valve may be removed without any additional supports being required.
- 6.06.14 Support steel shall be of structural quality. Perforated strap, wire or chain shall not be used. Support components shall be connected to support steel by welding, by bolting or by beam clamps. Boltholes shall be drilled, not burned. Support components may be bolted to concrete using approved concrete anchors.
- 6.06.15 Double nuts or lock-nuts shall be used on hanger rods and bolts in all cases.
- 6.06.16 Variable springs shall be furnished with travel stops. The travel stops shall be factory installed at the "cold" position.
- 6.06.17 Spring hangers should not be loaded more than 80% of the spring travel range.
- 6.06.18 Both constant load and variable spring support/hanger shall be provided with outside indicators for deflection and load. Provision for the site adjustment of load at least $\pm 10\%$ shall be incorporated. Also spring locking arrangement and turnbuckles of load/position adjustment shall be provided for all hangers.
- 6.06.19 Constant load type spring support/hangers shall be so selected as to permit, for the specific load, an over-travel of at least 25 mm or 20% (whichever is greater) of the specified range of vertical travel. The initial setting of the hangers/supports shall be such that half of the "over-travel" is allowed in either direction. Constant support hangers shall have a support variation of no more than 6% throughout the total travel range.
- 6.06.20 Rigid support shall be designed with adequate margins of safety so that variations in load distribution on them are of little consequence. All rigid hangers shall be provided with means for vertical adjustment after erection.
- 6.06.21 Where the piping system is subject to shock loads, such as thrust imposed by the actuation of safety valves (SV), hanger design shall include provision for shock absorbing devices of approved design.
- Vertical restraints near safety valves shall be preferred for taking SV discharge thrust, provided equipment terminal reactions remains within

allowable limit.

Attempts shall be made to avoid use of shock absorbers, dampers etc. as far as possible to take care of occasional loading like seismic effect etc. by proper engineering of the piping design and effective use of restraints. However, shock absorbers, VISCO- dampers, wherever felt necessary are to be supplied and erected by the bidder.

- 6.06.22 Layout of piping shall be properly designed to avoid excessive vibration by effective use of restraints. However, wherever felt necessary, shock absorbers, VISCO-dampers shall be supplied and erected by the bidder.
- 6.06.23 Hanger rods (except Rigid hangers where both tension and compression may occur) shall be subjected to tensile loading only. At hanger locations where lateral movement is anticipated, suitable linkage and rocking washers shall be provided to permit swing.
- 6.06.24 For all hangers, the length of suspension shall be so selected that the hanger rod may never make an angle of more than 4° with vertical due to horizontal pipe movements. If this cannot be avoided by erecting the hanger vertically for cold condition, it shall be suitably off set so that the above requirement is fulfilled in cold as well as hot conditions. Hangers shall be designed so that they cannot become disengaged by movements of the supported pipe.
- 6.06.25 Supports, guides and anchors shall be so designed that excess heat will not be transmitted to the building steel.
- 6.06.26 Tie rods/struts shall preferably be used for restraints to achieve low friction restraining.
- The Tie-rods/struts shall have proper arrangement and adequate length, so that, thermal movements in other directions, which are intended to be free are not constrained and there is no appreciable shift in centreline of pipe or the elevation of the supporting point on pipe due to sway. The design shall have provisions for adjusting the length to take up any slack and securely locking in position permanently once adjustment is done.
- 6.06.27 All relevant hangers shall be designed to take the dynamic movements for dynamic loading in addition to the thermal movements.

6.07.00 **Valves and Accessories**

6.07.01 General Requirements

- a) All valves shall be of approved make and type and shall have cast/ forged steel bodies with covers and glands of approved construction. The valves shall be provided with electric motors/solenoids and actuators as required.
- b) Valves and specialties to be supplied shall be used for various steam and water services of the power cycle system and shall be located indoor/ outdoor and on horizontal/vertical runs of the pipe lines. However, locating the valves on vertical runs should be avoided as far

as possible.

- c) All valves shall, unless otherwise approved, have ends prepared for butt-welding and the internal diameter shall be the same as the internal diameter of the pipes to be joined. Where valves are accepted with flanges, they shall comply with the requirements of the approved Code of Practice for the respective pressure and temperature conditions of the piping system.
- d) All valves shall receive tests at Manufacturer's or Contractor's works in accordance with the specific requirements of the approved Codes of Practice so that the same is acceptable to IBR where applicable. Valves shall be rising stem or otherwise as approved by the Purchaser.
- e) Gate valves have been specified with the intention of achieving isolation and tight shut-off. In full open condition, these valves should offer minimum of resistance to fluid flow.
- f) Globe valves have been specified with the intention of achieving good control of fluid passing. The plug and seat will have therefore suitable profiles for obtaining such controlling action.
- g) Check valves have been specified in order to prevent reverse flow through them.
- h) Steam traps with strainers will be used in the drain lines from various steam pipes such that only condensed steam can be drained.
- i) All valves shall function smoothly without sticking, rubbing or vibration on opening or closing.
- j) Material, design, manufacture, testing etc. for all valves and specialties along with the accessories shall conform to the latest editions of codes as specified or approved equivalent and acceptable to IBR.
- k) By-pass valves shall be provided for high pressure and larger size valves as per standards followed and as felt necessary for smooth and easy operation, even though not specifically mentioned in the specification.
- l) Motor operated valves shall be designed as specified hereinafter.
- m) Valves subjected to vacuum shall have sufficient long deep-seated packing. Valves in general shall preferably be of such design as to permit repacking while in service by providing back seating arrangement duly tested during manufacture.
- n) All flanged valves and specialties shall be provided with two (2) counter flanges, bolts, nuts, washers, gaskets etc.
- o) Valves and specialties along with counter flanges coming under the

purview of IBR shall meet all the requirements of IBR duly approved by the Purchaser.

- p) For pneumatically actuated valve, if any, the Bidder shall provide necessary instrument air connection near the valve. All accessories including solenoid valves etc. as necessary for the actuation of this valve shall be supplied.
- q) For all sizes below 50 mm, socket welded end valves may be used.
- r) All valves shall have outside screwed spindles and screwed thread of spindle shall not pass through or into the stuffing box. Where valves are exposed to the weather, protective covers shall be provided for the spindles, which shall be subject to approval.
- s) Valves requiring sealing water shall be adequately deep and shall be equipped with lantern ring to admit pressurised water for gland-sealing. Gland sealing water shall be tapped from one tapping point on the condensate extraction pumps discharge header and shall be reduced in pressure as per the requirement.
- t) The stops which limit the travel of any valve in the "Open" or "Shut" position shall be arranged exterior to the valve body.
- u) All regulating valves shall be designed to prevent erosion of the valve plugs and seats when the valves are operated partially opened. The valves shall have contoured plug.
- v) Approved access arrangements shall be provided for all valves and particular attention shall be given to those valves fitted with gearing, which require lubrication of the valve itself.
- w) Valves which cannot be operated from the floor or walkways shall be provided with suitable extension rods and linkages. If such a valve is provided with integral bypass then similar arrangement shall be done for the bypass valve also. The extension shall be such that the hand wheel is at a height of approximately one metre above the level of the floor or platform from which the valve is to be operated. Where required they shall be provided with head-stocks and pedestals of rigid construction and where gears or level wheels are used these shall be of cast steel or suitable quality cast iron with machine cut teeth. Where extension spindles are fitted, all thrust when opening or closing the valves shall be taken directly on the valve body. The extension linkage shall be so designed to take care of the thermal movements of the valve body with the pipe on which the valve is installed. The connection of the extension spindle to the valve stem shall be through a flexible coupling.

The extension spindle shall be of the same materials as that of the valve stem. The floor stands shall have column, not less than Group-B of ASTM-126. Necessary nuts and bolts for mounting the floor stands on foundation shall have to be provided. Adequate means of easy lubrication shall have to be provided for valves and operating

extension components.

- x) Stems shall preferably be arranged vertically with gland at the top, however, in no circumstances must the stem be inclined downward from horizontal or gland be at the bottom. Globe valves shall be installed with the pressure under the disc. Valves shall not be fitted in inverted position.
- y) Where necessary, for accessibility, grease nipples shall be fitted at the end of extension piping and where possible these shall be grouped together and mounted on a common panel situated at a convenient position. A separate nipple shall be provided to lubricate each point. The Contractor shall supply the first fill of oil or grease for these parts. The Contractor shall supply a suitable manually operated grease gun for the standard type of nipple provided.
- z) The spindles for all valves for use outside the building shall have weatherproof protection covers of approved construction.
- aa) All valves shall be fitted with indicators so that it may be readily seen whether the valves are open or shut. In the case of those valves fitted with extended spindles, indicators shall be fitted both to the extended spindles and to the valve spindles.
- bb) Plastic or bakelite valve hand wheels will not be accepted.
- cc) All valves shall be closed by rotating the hand wheel in a clockwise direction when looking at the faces of the hand wheel. The face of each hand wheel shall be clearly marked with the words 'Open' and 'Shut' with arrows adjacent to indicate the direction of rotation to which each refers.
- dd) Each valve hand wheel shall be fitted with a circular nameplate of a approved material indicating the valve tag number, duty or service intended and the function of the valve. The nameplates shall incorporate the colour code corresponding to the service of the piping.
- ee) Wherever practicable, heavy valves of total weight including actuator, drive motor, integral by-pass etc., equal to or greater than 500 kg. shall be provided with suitable lugs to permit direct suspension by hanger rods or direct resting on bottom support, as applicable.
- ff) Special attention shall be given to the operating mechanism for large size valves in order that quick and easy operation is obtained and maintenance is kept to a minimum.
- gg) Eyebolts shall be provided where necessary to facilitate handling heavy valves or parts of valves.
- hh) The Bidder shall supply with his bid and in addition during the course of the Contract, comprehensive drawings showing the design of valves, test pressure and working pressure/temperatures. They should include a parts list referring to the various materials used in the valve

construction.

- ii) For high temperature application above 600°F (315°C), all gate valves shall preferably be of wedge type construction.
- jj) All sampling and root valves shall be of integral body bonnet type.

6.07.02 Design Requirements

- a) Design working pressure and temperature as well as pressure rating of all valves and specialties has been listed in Annexure-II of this Section. Valves and Specialties are to be supplied conforming to specified pressure rating.

- b) Steel body gate valves shall preferably be in accordance with American Petroleum Institute, U.S.A., Standard No.API-600 or other approved international standards.

Carbon steel gate valves in size 50 mm and below shall be in accordance with API-602 or any other approved international standards.

- c) Globe valves shall generally conform to BS-1873 or approved international standards, subject to other requirement specified in the specification.

- d) Check valves shall conform to BS-1868 or approved international standards and shall be of swing check type.

The body seat for swing check valves shall be inclined at such an angle as to minimise chatter.

To enable the internal parts to be examined or renewed without removing the valves from the pipeline, the flanged cover should be used. The body shall be stamped with an arrow to indicate the correct flow direction.

- e) Safety Valve

The safety relief valves shall be direct spring loaded type and shall be provided with casing levers. The valves shall be of rugged construction suitable for long periods of uninterrupted service. The safety relief valves shall conform to the requirements of ASME Boiler and pressure vessel code, Section-VIII and IBR as applicable and shall be installed as per recommended rules for the design of safety valve installations in ANSI B31.1.

- f) Motor Operated Valves

- i) Motor operated valves shall be fitted with both hand and motor operating gears and where a by-pass valve is provided this also shall be provided with both hand and motor operated gear and interlocks to ensure that the by-pass valve is opened

- before the main valve. Each valve shall be complete with a device for automatically stopping the motor when the valve gate has reached the "full open" or "full close" position (with a minimum increase in the torque). The motor shall be placed in such a position relative to the valve that there is no possibility of leakage of liquid, steam or corrosive gas from valve joints on the motor or control equipment.
- ii) The hand operating and motor operating mechanism shall be so interlocked that the hand operating mechanism is disconnected before the motor is started. Valves shall be provided with seating control and except where specifically approved by the engineer for small valves, a slipping clutch or other torque-limiting device shall be incorporated in the motor drive. The opening or closing the valve shall be controlled by means of push buttons labelled respectively "open" and "stop". The control shall be so arranged that the motor can be stopped with the valve in any position by means of "stop" push button and after having been stopped, can be re-started in either direction by the "open" or "close" push buttons hand operating mechanism shall be placed in an accessible position from the floor.
- iii) Necessary output signal (4-20 mA) shall be given for provision of positioning indicator in U.C.B.
- g) For reheater isolation, for hydraulic testing as well as wet lay up reheater isolating devices shall be provided on cold reheat and hot reheat lines, at boiler outlet. Isolating device shall consist of a robust cast steel body with carbon steel (ASTM A216 GR WCB) material for cold reheat application and alloy steel (ASTM A 217 GR WC 9) for hot reheat application suitable for pressure and temperature condition which they will be subjected. These shall be of welded type construction and shall form part of the pipeline during normal operation without any leakage. Before hydrostatic test top cover and bonnets are removed and a separate test closure assembly with sealing rings are inserted to close the flow patch. The test closure assembly shall be of disc type construction with appropriate seal and a preloading lever to form a complete tight assembly for effective closure during hydraulic testing. Drains shall be provided on both side of the device to detect leakage.
- h) Drain Valves, Steam traps and Strainers
- i) Drain Valves
- All drain valves shall be of approved type and shall have cast or forged steel bodies with covers and glands of approved construction. Spindles shall be of stainless steel and the materials of internal parts shall be suitable for operation at the maximum working pressure and temperature of the piping to which they are connected. Valves should be full-way type, unless otherwise specified and in full open position the bore of

the valve should not be obstructed by any part of the gate. The internal diameter of all valves at the bore and at the ends adjacent to the pipe work shall be similar to the internal diameter of the connecting pipe work. Valves shall be designed for continuous operation in partially open condition without erosion of the valve seats or faces. Where valve seats are shrouded the design of the shroud shall be such as to prevent foreign matter lodging in the valve seat.

All drain traps shall be of approved make, size and type and shall be complete with air cock and casing mechanism. All internal parts shall be constructed from approved material and shall be renewable. Trap bodies and covers shall be of cast or forged steel and shall be suitable for operation at the maximum working pressure and temperature of the steam piping to which they are connected.

ii) Steam Traps and Strainers

- The steam traps shall be inverted bucket or thermodynamic type complete with integral or separate strainers.
- The internal components of traps shall be of AISI-316 stainless steel construction. Material of construction of the body shall be selected by the Bidder based on the service conditions stipulated.
- All Y-type strainers, wherever provided with steam traps or otherwise, shall have AISI-316 stainless steel screen of not more than 20 mesh size. Screen open area shall be at least three (3) times the pipe internal cross-sectional area. The strainer shall have a screwed blow-off connection with a removable plug. Material of construction of the body shall be selected by the bidder based on the duty conditions specified.
- All traps and strainers shall have socket weld ends as per ANSI B16.11 for size NB 50 mm and smaller and butt weld ends as per B 16.25 for size NB 65 mm and above.
- Steam drain traps shall be provided with strainers, inlet and discharge valves and by-passes and test cocks as schematically indicated in the enclosed drawing. Materials and other details of these valves shall meet the specified requirement.

i) Pump Suction Strainer

The strainer at condensate Transfer pump should be removable type conical strainer assembly. The spool pipe shall have flanged ends suitable for direct mounting on condensate Transfer pump suction

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flange. The material of construction of spool pipe shall be the same as that of pumps suction piping. The strainer element shall be of perforated sheet with aperture size of 6 mm and wrapped with AISI-316 stainless steel wire mesh of 500 micron nominal aperture. The clear opening area of the strainer shall be at least 5 times the pipe area.

j) Non-return Valves

i) All non-return valves shall be of approved type and make and the pressure drop shall be subject to approval. Non-return valves for steam services and on pump discharge sides shall be provided with approved dash pots, where required, and with prior approval.

ii) The body seat for swing check valves shall be inclined at such an angle as to minimise chatter.

iii) To enable the internal parts to be examined or removed without removing the valves from the pipeline, the flanged cover should be used. The bodies shall be stamped with an arrow to indicate the correct flow direction.

iv) Provision shall be made to drain both sides of a horizontal non-return valve where such a valve adjoins an isolating valve for non-return valves mounted on vertical pipe integral by-pass shall be used to facilitate draining as stated earlier.

k) De-super heaters

De-super heaters along with spray water supply and control system shall be provided on the auxiliary steam lines, etc. as required. A de-superheater shall be designed for the design conditions of the piping on its upstream side and shall also take care of its severe condition of working. As far as possible, the de-super heaters shall be mounted on a vertical line to avoid the problem of water accumulation in it. However, if installed horizontally, the inside diameter of the de-superheater shall be the same as that of the pipe on which it is mounted and the pipe shall be provided with drain pocket and trap station.

7.00.00 **INSPECTION, TESTING AND INSTALLATION**

7.01.00 **Testing of Piping at Works**

7.01.01 Material Test and Analysis

All materials shall be furnished in strict accordance with the codes specified and in accordance with the detailed specification. All sources of material shall be disclosed and relevant test certificates for the physical and chemical properties of the material shall be made available to the Owner/Engineer before the final shop inspection.

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7.01.02 Hydrostatic Test

All piping shall be subjected to the hydrostatic test pressure at shop as required by the IBR or any other applicable standards. Test pressure shall however be not less than the following :

$$\text{Test Pressure} = 1.5 \times \frac{\text{Allowable Stress at Room Temp.}}{\text{Allowable Stress at Design Temp.}} \times \text{Design Pressure}$$

The Contractor shall guarantee his work as capable of withstanding such hydrostatic tests and consent to repair or replace at his expense any item, which fails to pass such tests at site. Hydrostatic test of all pipes coming under IBR shall be offered for witnessing by the representative of the Inspecting Authority recognised by IBR.

7.01.03 Wall Thickness Tests

Wall thickness tests shall be made on a length of pipe of each type to determine the actual wall thickness at outer wall of bend on such piping.

The tests shall be done before fabrication on the piping system and results submitted to Owner/Engineer for approval.

7.02.00 **Capacity Tests for Pipe Supports**

Each constant load and spring support shall be tested before delivery to ensure that the variation in support capacity provided through the specified ranges (i.e. the difference in load between hot conditions and cold condition) does not exceed 6 percent for constant load supports and 20 percent for variable spring supports.

All materials shall be of tested quality. Hanger springs shall be properly calibrated.

7.03.00 **Testing of Valves & Specialties at Works**

7.03.01 All materials shall be of tested quality and the contractor shall submit the relevant material test certificate for the approval of Owner/Consultant.

7.03.02 All Valves and Specialties as well as counter flanges to be used in steam service shall have IBR certification marked on them and IBR certificates in appropriate proforma, shall be submitted.

7.03.03 Gate valves shall be subjected to shop tests in accordance with API-598 including the high-pressure closure test. Globe valves shall be tested in accordance with BS-1873 and check valves in accordance with BS-1868.

7.03.04 All gaskets used for test shall be of the same material and design as specified for the finished product.

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7.03.05 Each relief valve shall be subjected to hydrostatic test, seat pressure test, seat leakage test and test for relieving capacity.

The valve body test pressure shall be at least twice the set pressure.

The seat test pressure should be at least equal to the set pressure. During this test, the valve seat shall be demonstrated to be watertight for a period of at least two (2) minutes.

7.03.06 Functional tests : The fully assembled or completed valves including the operators and accessories shall be functionally tested to demonstrate the operability of the valve and the operator. This may be done by cycling typical valves 3 or 4 times from open to close position. The manual operation of the motor operated valves using the manual override to demonstrate freedom from friction shall also be conducted.

7.04.00 Tests on Strainers and Traps at Works

7.04.01 All strainers shall be subjected to hydrostatic test. The test pressure shall be twice the design pressure.

7.04.02 All steam traps shall be subjected to hydrostatic test at twice the design pressure. IBR certification shall be furnished for all steam traps.

7.05.00 Test reports and certificates of the mentioned tests and other tests as required to ensure satisfactory operation shall be submitted to Owner/Consultant before despatch of equipment IBR certification as required shall be furnished.

7.06.00 All rubber lining should be subjected to tests as per IS:4682 (Part-I).

7.07.00 Tests at Site

Contractor shall carry out tests at site to prove to the Owner that the equipment of the plant complies with requirements stipulated and is erected in accordance with requirements. Before the plant is put on trial run the Contractor will be required to conduct tests to demonstrate to the Owner that each item of the plant is capable of correctly performing the functions for which it was specified. These test may be conducted concurrently with those required under commissioning sequence. Tests required shall in general be as follows :

- a) All piping, valves and specialties after installation, will be tested hydraulically at a pressure, one half times that of the maximum attainable pressure in the system or 2 times the design pressure whichever is higher, to check against leak tightness.
- b) All manually operated valves/gates shall be operated throughout 100% of the travel and these should function without any trouble whatsoever.
- c) Visual check on all structural components, welding, painting etc. and if doubt arises these will be tested again.

- d) All test instruments and equipment shall be furnished by the Bidder to the satisfaction of the Owner.
- e) Checks on electrical items as mentioned in relevant electrical specification.

7.08.00 Pre-Commissioning Testing

7.08.01 Alignment Test

After completion of erection and before start-up, alignment test shall be carried out by the Contractor to check levelling, clearance, eccentricity etc. Measurement will be witnessed and acceptance will be certified by the Engineer.

7.08.02 Heat Treatment

All necessary preheating, post heating and stress relieving operation of welds/fabricated, items are part of the erection work and shall be supervised by the Contractor in accordance with relevant regulations and standard.

The Bidder shall arrange all required supervising staff for heat treatment and stress relieving works.

Heat treatment may be required to be carried out at any time during day and night to ensure the continuity of the progress. The Contractor shall provide supervising staff accordingly.

All data such as heating temperature, heating rate, sparking time, maximum temperature during heat treatment shall be properly recorded. All the data recorded during heat treatment shall be the property of the Owner.

7.08.03 Radiography Test

The Contractor shall carryout radiography tests of all field-welded joints coming under IBR the acceptability standard of which shall be as per IBR (latest revision). For other field welded joints radiography or other ND testing methods shall be employed as per ASME or equivalent. All radiography shall be carried out in presence of a competent supervisor of the contractor and his certificate of identification of the films of the radiographs shall be given invariably in all cases.

The repair work shall be suggested by the Contractor immediately after detection of the defective zone to the complete satisfaction of the Engineer. Regarding acceptance of the joints, decision of the Engineer shall be final.

All X-ray films of joints radiographed at site shall become the property of the Owner.

Contractor shall carryout the following optional non-destructive tests after completion of erection of all piping and equipment.

Ultrasonic test per weld joint.

Hardness test for 10% weld joints for each system of piping and/or as specified in the approved Field Quality Plan (FQP).

7.08.04 **Hydrotest**

Hydrotesting shall be conducted for all pressure parts after installation at required pressure irrespective of carrying out 100% radiography of field welded joints. All necessary blanking arrangement required for such hydrotesting shall be furnished by the Contractor. The hydro testing of piping coming under the I.B.R. shall meet the requirements of I.B.R. and all necessary test pump, temporary piping etc. shall be supplied by the Erection Contractor, irrespective of carrying out radiography on 100% basis of the field welded joints.

After the hydrostatic test, the Erection Contractor shall carry out thorough flushing of all lines with water to ensure removal of foreign materials like welding rods, metal chips etc. to the satisfaction of Engineer. After the flushing of the lines, all the water shall be drained and the piping shall be blown with air for drying the cleaned surface and the lines shall be air blasted to ensure proper cleaning of line to the satisfaction of engineer.

As a rule, hydro test shall be performed after all eventual pipe branching have been completed and valves installed. Should it be required to hasten erection work, hydrotest may be performed in sections.

All safety valves coming under purview of Indian Boiler Regulation shall be set and other tests shall be conducted to the satisfaction of concerned Boiler Inspector. All other safety valves shall also be set and sealed to the satisfaction of the Engineer.

All instruments necessary for the tests shall be supplied by the Contractor and calibrated before test as per relevant code.

The Contractor shall make necessary changes and corrections without any extra cost as may be felt by the Owner/Engineer to meet the guarantee and other technical particulars.

7.09.00 **Installation**

7.09.01 For all steam blown lines temporary strainers shall be installed at the equipment terminals so as to prevent any inflow of particles where that may cause any damage or harmful effect. For example, such strainers shall be placed on main steam and hot reheat line terminals at turbine end unless the turbine stop valves/interceptor valves have integral strainers suitable for the purpose. The temporary strainers shall be kept on line for sometime after the plant starts normal operation, as per the discretion of the Engineer. So, the design of strainers shall be based on the design conditions of the pipes on which they are installed. Where flow meters are to be installed in pipes requiring steam blowing, initially the pipes shall be erected with the flow meter branch pipes replaced by temporary spool pieces. After the end of steam blowing operation the temporary spool pieces shall be removed and the flow

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meter branch pieces shall be erected in position. In case such a pipe has also to be subject to cold pull-up, temporary anchoring of the main pipe on either ends of the temporary spool piece shall be done before replacing it by the flow-meter branch pipe.

All piping shall be installed in a manner such that expansion will take place in the direction desired and so that vibrations will be minimised. The contractor shall be responsible for the expansion provisions and flexibility of all field run piping. No piping shall be cold-sprung or cold-pulled unless there remains absolutely no other means to bring down the hot stress or terminal forces/moments within acceptable limit. All such cold pull up shall be shown in the piping drawings, along with a write-up describing clearly the method adopted for cold-pulling. All necessary attachments for cold-pulling, along with temporary anchors, as and wherever required, shall be provided.

The forces and moments on the temporary anchors and attachments shall be submitted. The cold pull-ups and all the above-mentioned documents shall be subject to the approval of the Owner.

- 7.09.02 All expansion bellows shall be installed with a minimum of two tie rods or bolts across each bellows to prevent the bellows from opening under pressure. The connection of the tie rods or bolts to the pipe shall make adequate provision for angular movement of the pipe and bellows.

Pump suction pipes shall be installed in such a manner that no air can be trapped in the suction piping. Suction pipes shall be supported in such a manner that there will be no high spots where air can be trapped. The in trades of suction branch lines shall be in no place lower than the in trades of the manifold at the point where the branch line connects to the manifold.

Standard "Factory Made" fittings shall be used in all piping. Shop or site fabricated mitred fittings shall not be used unless accepted by the Owner.

- 7.09.03 During erection no weights must be lifted by means of tackle fastened to the beams or slabs of the floor or roof except where provision has been specifically made for this purpose.

Supporting straps around flanges of pipes or valves or around welded joints will not be accepted. Anchors shall be attached to pipe by approved means. All supports should be shop fabricated and should be positioned before erection of the piping takes place and near to joints & valves wherever possible.

- 7.09.04 The Contractor shall provide all the necessary wall boxes and collars where pipes pass through walls, floors and roofs, also the necessary supports for any trenched pipes. Roof collars shall be fitted with a high sealing to prevent water falling through the holes.

The wall boxes and floor collars shall be constructed so that they can if necessary be erected after the pipes are in position. Pipes passing through roof collars shall be provided with an approved pipe sleeves, weather hood and cowl which shall be fixed by the Bidder. Floor collars shall extend to an approved height above the floor level and the pipes shall be fitted with hoods where required.

- 7.09.05 Drainpipe work shall be designed as per ANSI B31.1.
- High pressure drains (above 40 kg/sq.cm) shall have two valves in series and that near the condenser or flash box shall be motor operated arranged to open and close to ensure minimum wear on one valve.
- High-pressure drains shall have a screw-down non-return valve at the point of discharge near the manifold of the Flash tank to prevent backflow of flashed steam.
- Low-pressure drains shall have steam traps of an approved design complete with strainers, isolating valves and by-pass valves.
- Low-pressure drains shall have an isolating valve at the point of take-off from the pipe or vessel to be drained or as near as possible for convenient operation.
- Pipe wall thickness shall be as per international standard approved by Owner/Engineer during detailed engineering.
- Drain pockets of an approved size and construction shall be provided for all steam lines.
- Arrangement of valves in the drain line shall be as shown in the Bidder's P & I Diagram.
- 7.09.06 All electrical actuators and pneumatic/hydraulic actuator shall be erected, aligned, adjusted and finally set to the satisfaction of the Owner. This includes adjustment and setting of torque and limit switches.
- 8.00.00 **DRAWINGS, DATA, INFORMATION & MANUALS**
- 8.01.00 **Drawings, data, Information to be furnished by the Bidder along with the Bid**
- 8.01.01 A complete list of all piping systems and corresponding materials included in the scope of work.
- 8.01.02 A complete list of all valves with their quantities and ratings.
- 8.01.03 Manufacturer's catalogue indicating design and construction of spring hangers, valves, specialties offered.
- 8.01.04 Manufacturer's catalogue indicating complete range of available size and rating of pipes and fittings.
- 8.02.00 **After Award of Contract**
- 8.02.01 Layout drawings as well as Isometric drawings (for line sizes NB 50 mm and larger) showing the routing of various piping and location of hangers, restraints, anchors, valves etc.

- 8.02.02 Detail fabrication drawings of all shop fabricated piping system indicating design parameters and complete bill of material (Relevant Standards and grades to be indicated) and information/ data pertaining to the hydrostatic and non-destructive test requirements.
- 8.02.03 Detail dimensioned drawing of each valve, specialties, indicating tag no., pressure rating, manufacturing standard, bill of material and hydrostatic test pressures. The drawing shall include the end preparation details and shall indicate the position of the hand wheel/operator. Technical particulars of motor operators wherever applicable shall also be indicated.
- 8.02.04 Detail dimensioned drawing of each type of hangers and supports including guides, anchors, snubbers etc. with bill of materials (relevant standards and grades to be indicated).
- 8.02.05 General arrangement drawing for each hanger/support/anchor etc. indicating identification number, auxiliary supporting structural details, other details and information as required in the specification and typical details of Hangers & supports drawing enclosed with the specification.
- 8.02.06 Wiring diagram for all limit switches of motor operated valves.
- 8.02.07 Detail drawing with design calculation for the special Y-fittings on pipes, if any.
- 8.02.08 The loading data required for design of structures.
- 8.02.09 Miscellaneous Data/Documents
- a) Complete schedule of pipe lines in a format as approved by the Engineer indicating at least the line number, line description, pipe class (as per specification designation) design pressure and temperature, hydrostatic test pressure, insulation thickness, valve specification code, pipe material indicating standard and grade, number of BW/SW/Flanged joints and whether IBR certification needed.
 - b) Complete schedule of valves in format as approved by the Engineer indicating at least tag no, location, size, pressure class, design parameters, operation, make, quantity, special requirement if any etc.
 - c) Bill of material of hangers and supports in a format approved by the Engineer indicating at least the hanger/support number, type, operating load, cold setting load, Hydrostatic test load, movement of attachment point in X, Y and Z direction, line no. on which the hanger/support is located, insulation thickness of the pipe line, hanger rod length, angular deflection of hanger rod from vertical under hot and cold conditions etc.
 - d) Approval certificates from IBR in relevant forms regarding design, fabrication and testing of piping and valves for the piping system which are under the purview of IBR.
 - e) Design calculation for pipe wall thickness finally adopted.

- f) Reinforcement calculations as per ANSI B 31.1 for all set on type branch connections.
- g) A document containing the flexibility analysis procedure and results showing the forces and moments at various support points, anchors, equipment terminals etc. as elaborated before in this specification.
- h) Procedure of shop and site tests, test reports and test certificates for all tests conducted at shop.
- i) Quality assurance schedule, including report containing all pertinent details of the heat-treating cycle for all pipes, fittings, valves, specialties etc.
- j) Detailed erection procedure for piping, valves, specialties and auxiliary equipment including complete details of welding of joints to be done at site. All necessary instructions/recommendation shall be given for satisfactory erection of piping, valves specialties and auxiliary equipment.
- k) Erection, operation and maintenance manuals.

ANNEXURE-I**MATERIALS OF CONSTRUCTION FOR PIPING & FITTINGS**

Materials used in piping, fittings & specialties shall be as stipulated in the IBR and various codes as specified. However, the following basic guidelines shall in any case be followed for pipe materials :

Service	Material, Equivalent/Superior to
i) Temp. Up to 410 Deg.C	Carbon Steel, ASTM A-106, Gr. B or C Seamless. ASTM A-105/ A-234 WPB/WPC
ii) Temp. Above 410 Deg.C to 510 Deg.C	Alloy Steel, ASTM A-335, P11 ASTM A-182 F11; A-234 WP11
iii) Temp. Above 510 Deg.C to 540 Deg.C	Alloy Steel, ASTM A-335, P22/P91 ASTM A-182 F22/F91; A-234 WP22/91
iv) Temp. Above 540 Deg.C to 600 Deg.C	Alloy Steel, ASTM A-335, P91 ASTM A-182 F91; A-234 WP91
v) Corrosive	Stainless Steel.

ANNEXURE-II

MATERIALS OF CONSTRUCTION FOR VALVES

Materials for Valves shall be equivalent/superior to the following, for non-corrosive services:

Working Class	Valves Size	Material	
		Body Bonnet Cover	Stem Hinge Pin
i) Temp. Up to 410°C	65 mm & above	ASTM A-216, Gr. WCBWCC	13% Cr. Steel (ASTM A-182, Gr. F6a)- min. hardness 200 HB
	50 mm & below	ASTM A-105	
ii) Temp. Above 410°C to 510°C	65 mm & above	ASTM A-217, Gr. WC6	ASTM A-182, Gr. F6a - min. hardness 200 HB
	50 mm & below	ASTM A-182, Gr. F11	
iii) Temp. Above 510°C to 540°C	65 mm & above	ASTM A-217, Gr. WC9	ASTM A-182, Gr. F6a - min. hardness 200 HB
	50 mm & below	ASTM A-182, Gr. F22	
iv) Temp. above 540°C to 600°C	65 mm & above	ASTM A-217, Gr. WC/C12	ASTM A-182, Gr. F6a - min. hardness 200 HB
	50 mm & below	ASTM A-182, Gr. F91	

Note : Non-return valves in corrosion service shall be swing check type, suitably lined.

TECHNICAL SPECIFICATION FOR LOW PRESSURE PIPING, VALVES AND SPECIALITIES

CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	GENERAL INFORMATION
2.00.00	CODES AND STANDARDS
3.00.00	SCOPE OF WORK
4.00.00	GENERAL DESIGN AND CONSTRUCTION
5.00.00	DRAWINGS, DATA, INFORMATION & MANUALS
6.00.00	BROAD GUIDELINES FOR ERECTION AND INSTALLATION OF L.P. PIPING

ATTACHMENTS

ANNEXURE-I	SPECIFICATION OF PIPES FOR DIFFERENT SERVICES
ANNEXURE-II	SERVICE OF VARIOUS CATEGORIES OF VALVES
ANNEXURE-III	SPECIFICATION OF VALVES

LOW PRESSURE PIPING, VALVES AND SPECIALTIES**1.00.00 GENERAL INFORMATION**

This section covers all the low-pressure piping up to 400mm NB size, associated valves and specialties that include but is not limited to the following systems.

- 1.01.00 Service Air System - shall consist of distributions service air to different buildings.
- 1.02.00 Instrument Air System - shall comprise of distribution of instrument quality air to pneumatically operated instruments/ valves/dampers.
- 1.03.00 Demineralised Water Supply system including hot well make-up water piping from condensate storage tank.
- 1.04.00 Demineralised Water closed cycle cooling system.
- 1.05.00 Service water system.
- 1.06.00 Potable water system.
- 1.07.00 Any other low pressure piping as found necessary during detail engineering shall also be included.

2.00.00 CODES AND STANDARDS

2.01.00 In addition to the requirements spelt out in Volume IIA, the design, manufacture, inspection and testing of the piping, fittings, valves and specialties covered under this specification shall conform, in general, to the standards and codes (latest edition) mentioned below:

- | | | | |
|---------|--------------------------|---|---|
| 2.01.01 | IS-1239
[Part-I & II] | : | Mild steel tubes, tubular and other wrought steel fittings. |
| 2.01.02 | IS-3589 | : | Electrically welded steel pipes for water, gas and sewage (150 to 2000 mm nominal diameter) |
| 2.01.03 | IS-554 | : | Dimensions for pipe threads where pressure tight joints are required on the threads. |
| 2.01.04 | IS-1363
[Part-I & II] | : | Hexagonal head bolts, screws and nuts (size range M5 M36) |

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2.01.05	IS-1364	:	Precision and Semi-precision hexagon bolts, screws, nuts and lock nuts (diameter range 6 to 39 mm)
2.01.06	IS-3138	:	Hexagon bolts & nuts (M42 to M150)
2.01.07	IS-5312	:	Swing check type reflux (non-return) valves.
2.01.08	IS-2379	:	Colour code for the identification of pipelines.
2.01.09	IS-2016	:	Plain washers
2.01.10	IS-2712	:	Compressed asbestos fibre jointing
2.01.11	ANSI B-16.5	:	Steel pipe flanges and flanged fittings
2.01.12	ANSI B-16.9	:	Wrought steel Butt welding flanged
2.01.13	ANSI B-16.11 : ANSI B-36.10 :		Forged steel fittings, Socket-welding and Threaded. Steel pipes thickness
2.01.14	API-600	:	Steel gate valves
2.01.15	BS-2633	:	Class I Arc welding of ferrite steel pipe work for carrying fluids.
2.01.16	BS-534	:	Specification for steel pipes and specials for water and sewage.
2.01.17	BS-5351	:	Specification for Ball valves.
2.01.18	AWWA-C-504	:	Specification for Butterfly valves.
2.01.19	AWWA-C-208	:	Dimension for fabricated steel water pipe fittings.
2.02.00	Other international codes and standards may also be offered by bidder. However, same may be subject to acceptance by the Purchaser.		

3.00.00 SCOPE OF WORK

- 3.01.00 The equipment and materials to be supplied shall include but not be limited to the following:
- a) Supply of all low pressure piping including bends, elbows, tees, branches, laterals, crosses, reducing union, couplings, caps, saddles, shoes, flanges, blank flanges, Y-pieces etc. as required for the piping system under the scope of this section.
 - b) Matching pipes, matching pieces like reducers/enlargers etc., counter flanges with bolts, nuts, washers, temporary and permanent gaskets, threaded union etc.
 - c) Supply and machining work of flanges, pipe spools and matching pipes to connect flow measuring orifices/nozzles with the main pipe work.

- d) All isolating and regulating valves, non-return valves, steam/air traps, relief/safety valves (wherever applicable), strainers, pressure reducing orifices etc. complete with the counter flanges and matching connecting pieces as required within the entire low pressure piping system.
- e) Anchors, hangers and supports, etc. as required. Any platform necessary for maintenance and operation of valve and equipment located 1.5 m above any permanent floor or platform including access ladders, supporting structures etc.
- f) All secondary structural steel members required for pipe supports from building steel structures and from embedded steel wherever provided including pipe supports in trenches. However, trench piping should be avoided to the extent possible.
- g) Funnels, tundishes for drips and drains including all miscellaneous drain piping and drain piping from tundish outlet up to drain points. All drain and vent lines shall be conveniently terminated to floor drain points/permanent drain trenches.
- h) Flanges, counter flanges, blank flanges, bolts, nuts, washers, temporary and permanent gaskets, fasteners caps etc. as required for interconnecting piping, valves & fittings.
- i) Cleaning and Painting of all piping, valves & specialties at manufacturer's shop.

3.02.00 Following general requirements shall however be provided

- a) Instrument Connections including instruments, root valves, sensing lines etc.
- b) Pipe stubs and blanking plates etc. required for chemical cleaning and hydro testing.

For conducting acceptance test, the required pressure, temperature, flow measurement points shall be provided.

3.03.00 All miscellaneous instruments

4.00.00 **GENERAL DESIGN AND CONSTRUCTION**

4.01.00 **General Considerations**

4.01.01 The piping systems included in this section shall be designed to operate continuously without replacement during the plant service life of 30 years.

4.01.02 The piping system shall be complete in every detail and in accordance with the highest standard of workmanship.

- 4.01.03 All design and fabrication shall be in accordance with codes/standards specified.
- 4.01.04 No pipe work shall be run in trenches carrying electrical cables.
- 4.01.05 Pipe size above 50 NB shall be shop fabricated and of size 50 NB and below shall be field run.
- 4.01.06 All piping shall be identified by means of colour strips and by adequate lettering, conveniently spaced and located. Identification colours and lettering shall be as approved.
- 4.01.07 Air release and drain branches shall be provided wherever necessary depending upon the layout and arrangement so that the drains and air release valves are located for easy operation.
- 4.01.08 Unless otherwise specified, all pipe work shall be suitable for a minimum pressure of 10.0 kg/sq. cm(g) at 80 deg. C or as required by the design of the different piping system, if higher.
- 4.01.09 **Drain Pipe Work**
- a) Low pressure drains shall have an isolating valve at the point of take-off from the pipe or vessel to be drained, or as near as possible for conventional operation.
 - b) Unless otherwise stated, all drain piping shall be of 25 mm NB minimum and all vent pipings shall be of 15 mm NB size minimum. For pipes up to 50mm NB, pipe wall thickness shall be as per schedule 80 of ANSI B36.10.
 - c) Unless otherwise stated, wherever a main or branch of any pipeline is terminated with a valve, such terminal valve shall be provided with a blank flange/blanking cap at the free end.
- 4.01.10 Specification of pipes used in different services included in the L.P piping section has been detailed in Annexure-I.
- 4.02.00 **Material Specification**
- 4.02.01 Materials for pipes and fittings shall be as stipulated in Annexure-I. In case bidder wants to offer alternative piping material, same may be accepted by the Purchaser depending on the merits of alternative material.
- 4.02.02 Pipe attachments for supports, anchors and restraints, which are coming in direct contact with pipes, shall have similar materials as the piping concerned. All other materials of supports, anchors and restraints shall be of tested quality and as per manufacturer's standards.

4.03.00 **Fabrication**

Except where otherwise specified all piping shall have butt-welded connections with a minimum of flanged joints necessary for maintenance. Where flanges are adjacent to welded fittings, weld neck flanges shall be used.

Branches shall, in general, be formed by welding. Standard fittings may be used in positions and for sizes where approval has been given in detail drawings. Pipe bends and tees shall be truly cylindrical and of uniform section. all welded branches shall be reinforced where needed as per the applicable codes/regulations.

4.03.01 Piping shall be fabricated in the shop in the largest transportable sections to minimize the number of field weld joints. The choice of field weld joints locations shall be based on the traverse of the pipe through walls, floors, sleeves or other restrictive areas. Support attachments for major piping shall be done at shop.

4.03.02 All pipes bends shall be made true to angle with no negative tolerance and shall have a smooth surface free of flat spots, crease and corrugations. A cross section through any bent portion of the pipe shall be true in diameter, within plus or minus 3% of the pipe diameter. Pipe bends shall be made from straight pipe pieces of sufficiently higher thickness so that after thinning, the minimum thickness of bends shall not be less than the minimum thickness required for the straight pipe. Thinning allowance shall be considered as per the relevant code.

4.03.03 For bends in pipes straight piece of pipes shall be bent by the contractor to required bend radius. However, forged bends (Bend radius = 1.5 x pipe diameter) wherever required shall be provided.

4.03.04 The ends of Pipe and welded fittings shall be bevelled according to details shown in the relevant piping code. All welding shall be made in such a manner that complete fusion and penetration are obtained without an excessive amount of filler metal beyond root area. The reinforcement shall be applied in such a manner that it shall have a smooth contour merging gradually with the surface of adjacent pipe and welded fittings. Backing rings shall not be used on any pipe welds, unless otherwise approved by the Engineer.

4.03.05 Cutting and Bevelling

- a) Carbon steel piping - End preparation for butt welding shall be done by machining/flame cutting.
- b) Socket welding - Socket weld and preparation shall be done by saw or machine cutting.

4.04.00 Hangers, Supports, Anchors

Normally pipe supports and anchors shall be selected at those points in the buildings where provision has been made for the loads imposed. The cutting of floor/roof beams or the reinforcement in slabs will not be permitted. Piping attached to a plant item shall be supported in such a way that the weight of the piping is not taken by the plant item.

4.04.01 Support spacing shall be as per good engineering practice. However in no case it shall be less than support spacing stipulated in ANSI B31.1.

4.04.02 Accurate weight balance calculations shall be made to determine the required supporting force at each hanger location and the pipe weight load at each equipment connection.

4.04.03 All large pipes and all long pipes shall have at least two supports each arranged so that any length of pipe or valve may be removed without any additional supports being required.

4.04.04 Support steel shall be of structural quality. Perforated strap, wire or chain shall not be used. Support components shall be connected to support steel by welding, by bolting or by beam clamps. Bolt holes shall be drilled not burned. Support components may be bolted to concrete using approved concrete anchors.

4.05.00 Valves and Accessories

4.05.01 General Requirements

a) All valves shall be of approved make and type and shall have cast/forged bodies with covers and glands of approved construction and materials as specified in Annexure-II & III. In general all pumps (other than sump pumps), discharge valves shall be motor operated only. Tank inlet valves shall be motor operated only.

b) Valves and specialties to be supplied under this specification will be used for various air and water services and will be located indoor/outdoor and on horizontal/vertical runs of the pipelines. However, mounting of valves in vertical pipe runs should be avoided as far as possible.

c) All valves shall, unless otherwise stated, have the internal diameter same/as the internal diameter of the pipes to be joined.

d) All valves shall receive tests at manufacturer's or contractor's works in accordance with the specific requirements of the approved Codes of Practice. Valves shall be rising stem or otherwise as approved by the Purchaser.

e) Gate valve and Ball valve have been specified with the intention of achieving isolation and tight shut-off. In full open condition, these valves should offer minimum of resistance to fluid flow.

- f) Globe valves have been specified with the intention of achieving good control of fluid passing. The plug and seat will have therefore suitable profiles for obtaining such controlling action.
- g) Check valves have been specified in order to prevent reverse flow through them.
- h) All valves shall function smoothly without sticking, rubbing or vibration on opening or closing and shall be suitable for most stringent service conditions i.e. flow, temperature and pressure under which they may be required to operate.
- i) Material, design, manufacture, testing etc. for all valves and specialties along with the accessories shall conform to the latest editions of codes.
- j) By pass valves shall be provided for larger size valves as per standards followed and as felt necessary for smooth and easy operation, even though not specifically mentioned in the specification.
- k) All flanged valves and specialties to be supplied under this section shall be provided with two (2) counter flanges, bolts, nuts, washers, gaskets etc.
- l) All valves shall be of approved design and manufacture. Where valves are of similar size and type they shall be interchangeable with one another. Valves shall have welded or flanged connections subject to the Purchaser's approval.
- m) All valves shall have outside screwed spindles and screwed thread of spindle shall not pass through or into the stuffing box. Where valves are exposed to the weather, protective covers shall be provided for the spindles, which shall be subject to approval.
- n) Gate, Globe and Ball valves shall be provided with the following accessories in addition to other standard items:
 - i) Hand wheel with embossed open and shut directions.
 - ii) Local position indicator.
 - iii) Motorised operation as specified by Engineer.
- o) Gate valves, in addition shall be provided with following extra features
 - i) Bypass valve for larger valves
 - ii) Draining arrangement
 - iii) Enclosed Gear operators for valves 300 mm size and above for ease in operation.
 - iv) Motorised operation as specified by Engineer.
- p) All gate and globe valves shall be rising stem type.

- q) All valves shall be provided with hand-wheels, chain, operator, extended spindle and floor stand wherever required so that they can be operated manually by a single operator from the nearest operating floor either at a lower or higher elevation as the case may be. If such a valve is provided with integral bypass then similar arrangement shall be done for the bypass valve also.
- r) All valves and specialties shall be provided with brass Tag Discs indicating Tag numbers and nomenclature of the valve including duty or service intended and the function of the valves specialties.
- s) Stems shall preferably be arranged vertically with gland at the top, however, in no circumstances must the stem be inclined downward from horizontal or gland be at the bottom. Globe valves shall be installed with the pressure under the disc. Valves shall not be fitted in inverted position.
- t) Where necessary, for accessibility, grease nipples shall be fitted at the end of extension piping and where possible these shall be grouped together and mounted on a common panel situated at a convenient position. A separate nipple shall be provided to lubricate each point. The Bidder shall supply the first fill of oil or grease for these parts. The Bidder shall supply a suitable manually operated grease gun for the standard type of nipple provided.
- u) The spindles for all valves for use outside the building shall have weatherproof protection covers of approved construction.
- v) All valves shall be fitted with indicators so that it may be readily seen whether the valves are open or shut. In the case of those valves fitted with extended spindles, indicators shall be fitted both to the extended spindles and to the valve spindles.
- w) Plastic or bakelite valve hand wheels will not be accepted.
- x) All valves shall be closed by rotating the hand wheel in a clockwise direction when looking at the faces of the hand wheel. The face of each hand wheel shall be clearly marked with the words 'Open' and 'Shut' with arrows adjacent to indicate the direction of rotation to which each refers.
- y) Wherever practicable heavy valves of total weight including actuator, drive motor, integral by-pass etc., equal to or greater than 500 kg. shall be provided with suitable lugs to permit direct suspension by hanger rod or direct resting on bottom support, as applicable.
- z) Special attention shall be given to the operating mechanism for large size valves in order that quick and easy operation is obtained and maintenance is kept to a minimum.
- aa) Eyebolts shall be provided where necessary to facilitate handling heavy valves or parts of valves.

bb) The Bidder shall supply with his bid and in addition during the course of the Contract, comprehensive drawings showing the design of valves, test pressure and working pressure/temperatures. They should include a parts list referring to the various materials used in the valve construction.

cc) All sampling and root valves shall be of integral body bonnet type.

4.05.02 For Design Requirements for different valves refer Annexure-II & III.

4.06.00 **Safety/Relief Valves**

Safety/Relief valves shall be of direct spring loaded type and shall have a tight, positive and precision closing.

All safety valves shall be provided with manual lifting lever.

Valves used for air and any other compressive fluid shall be of pop type.

Safety/Relief valves shall be constructed and adjusted to permit the fluid to escape without increasing the pressure beyond 10% above the set blow off pressure. Valve shall reset at a pressure not less than 2.5% and more than 5% of the set pressure.

Releasing capacity of the safety/relief valves shall be as per the applicable codes and standards and shall be subject to the approval of the Engineer.

The seat and disk of safety valves shall be of suitable material to resist erosion. The seat of valve shall be fastened to the body of the valve in such a way that there is no possibility of the seat lifting.

4.07.00 **Hosepipe and Accessories**

4.07.01 Hose valves for service water system shall be Gate valves and service air system shall be Globe valves.

4.07.02 Hose pipes with fittings for Service Water System:

- a) The water hose shall be as per IS-444 (Type-3).
- b) Length of each hose shall be 15 metres.
- c) For each hose, one end shall be fitted with M.S. female coupling with swiveling nuts and soft seating ring suitable for connection to male end of hose valve and other end shall be made threaded for joining with the swiveling nut of a second hose whereby two hose lengths may be joined.

4.07.03 Hose pipes with fittings for Compressed air System

- a) The compressed air hose shall be as per IS-911 (Type 2).

- b) The length and type of each end shall be similar to as specified in above clause no. (4.07.02) above.

5.00.00 DRAWINGS, DATA, INFORMATION & MANUALS

5.01.00 Drawings, data, Information to be furnished by the Bidder besides those already mentioned in volume : IIA with the offer.

5.01.01 A complete list of all piping and fittings of various sizes with their quantities and details e.g. nominal size, O.D., I.D. (as applicable) thickness, design pressure, design temperature, material of construction/code/standards etc.

5.01.02 A complete list of all valves with their type, quantities & ratings.

5.01.03 Manufacturer's catalogue indicating complete range of available size and rating of pipes & fittings.

5.01.04 Descriptive literature on the manufacturing process and quality control procedures highlighting the manufacturing, fabricating and testing facilities available in the shop.

5.02.00 After Award of Contract

Detail drawings including fabrication drawings of all shop fabricated piping system indicating design parameters and complete bill of material (Relevant Standards and grades to be indicated) and information/data pertaining to the hydrostatic and non-destructive test requirements to be submitted progressively.

5.02.01 Detail dimensioned drawing of each valve, specialties, indicating tag no., pressure rating, manufacturing standard, the bill of materials and hydrostatic test pressures. The drawing shall include the end preparation details and shall indicate the position of the hand wheel/operator. Technical particulars of motor operators wherever applicable shall also be indicated.

5.02.02 General arrangement drawing for each hanger/support/anchor etc. indicating identification number, auxiliary supporting structural details, other details & information as required in the specification.

5.02.03 Wiring diagram for all limit switches of motor operated valves.

5.02.04 The loading data required for design of structures shall be furnished well in advance to suit Purchaser's time schedule.

6.00.00 BROAD GUIDELINES FOR ERECTION AND INSTALLATION OF LP PIPING

6.01.00 All fittings like "T" pieces, flanges, reducers etc. shall be suitably matched with pipes for welding. The valves will have to be checked, cleaned or overhauled in full or in part before erection, after chemical cleaning and during commissioning.

6.02.00 Adjustments like removal of oval ties in pipes and opening or closing the fabricated bends of high pressure piping to suit the layout shall be considered

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- part of work and is required to carry out such work as per instruction of Owner, which shall include specified heat-treatment procedures, etc. also wherever required.
- 6.03.00 Certain adjustments in length may be necessary while erecting high pressure pipelines and the contractor should remove the extra lengths to suit the final layout after preparing edges afresh and adopting specified heat treatment procedures.
- 6.04.00 Suspension for piping, pressure parts, etc., will be supplied in running lengths, which shall be cut to suitable sizes and adjusted as required.
- 6.05.00 All the valves, lifting equipments, actuators, power cylinders, etc., shall be serviced and lubricated to the satisfaction of Engineer before erecting the same and also during pre-commissioning. Even after commissioning, the equipments, if there are problems in the operation, they have to be attended to by the Bidder during the tenure of the contract. Welding or jointing of extension spindle for valves to suit the site conditions and operational facility shall be part of erection work.
- 6.06.00 All tubes and pipes shall be cleaned and blown with compressed air and shown to the engineer before lifting. Bigger size pipes should be cleaned with flexible wire brush, wherever necessary. After cleaning is over the end caps shall be put back in tube openings till such time they are welded to other tubes.
- 6.07.00 Fine fittings, drain piping, oil systems & other small bore piping have to be routed according to site conditions and hence shall be done only in position. As such, layout of small-bore piping shall be done as per site requirement. There is a possibility of slight change in routing the above pipelines even after completion of erection, which shall be carried out by the Bidder without any extra cost to the Purchaser. Work shall also include fabrication of small bends at site from straight lengths to suit the site conditions.
- 6.08.00 No temporary supports shall be welded on the pressure parts. Welding of temporary supports, cleats, etc., on the building columns shall also be avoided. In case of absolute necessity, Contractor shall take prior approval from Engineer. Further, any cutting or alteration of member of the structure or platform or other equipments shall not be done without specific prior approval of Engineer.
- 6.9.00
- a) All piping shall be grouped wherever practicable and shall be routed to present a neat appearance.
 - b) The piping shall be arranged to provide clearance for the removal of equipment for maintenance and for easy access to valves, instruments and other piping accessories required for operational maintenance.
 - c) Piping shall be routed above ground unless otherwise specifically indicated/ approved by the Engineer. In such special case, the piping may be arranged in trenches, or buried and properly protected as per AWWA Standards.

- d) Overhead piping shall have a minimum overhead clearance of 4 meters above walkways and working areas and 7 meters above roadways unless otherwise approved by the Engineer.
- e) Drains shall be provided at all low points and vents at high points as per actual layout regardless of whether some have been shown in respective drawings or not. The pipelines shall be sloped towards the drain points.

6.10.00 All drips and drains for piping and equipment whether shown in the drawings or not shall terminate on the ground floor up to station drain unless otherwise specified. Leading such drains up to station drainage is also the responsibility of the Contractor.

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ANNEXURE-I
SPECIFICATION OF PIPES FOR DIFFERENT SERVICES

	A	B	C	D
Services	1. Clarified Water piping 2. DMCW piping	1. Drinking/ Potable Water Supply, piping (Clarified water, chlorinated)	1. Demineralised Water, Service and Instrument Piping less than and equal to 50 mm NB	1. Demineralised Water, Service and Instrument air piping for sizes equal to greater than 65 mm NB
1.00.00 Material of Pipe	Carbon Steel IS-1239 Heavy Grade upto 150 mm NB and IS-3589 for sizes above 150 mm with minimum pipe thickness of 6 mm.	Carbon Steel as per IS-1239 Heavy Grade for sizes upto 150 mm NB and IS-3589 for sizes above 150 mm NB with minimum pipe thickness of 6 mm. The pipes shall be galvanized as per IS-4736	Stainless Steel as per ASTM A-312 Gr. 304. Size- as per schedule 40 ANSI B36.10	Stainless steel as per ASTM A-312 Gr. 304. Size-upto 150 mm NB as per schedule 10S, ANSI B-36.10.
2.00.00 Construction	ERW / Seamless	ERW / Seamless	ERW	ERW
3.00.00 Joints	Slip-on Flange and butt weld for size 65 mm NB and above and Socket weld joint for size 50 mm NB and below.	Screwed flange for sizes 65 mm NB and above and screwed socket for size 50 mm NB and below.	Socket welded for size 50 NB and below	Slip-on flange and butt weld joint.
4.00.00 Fittings	Pipe Sizes > = 65 mm NB Pipe Sizes < = 50 mm NB	Pipe Sizes > = 65 mm NB Pipe Sizes < = 50 mm NB		

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	A		B		C		D	
Services	1. Clarified Water piping 2. DMCW piping		1. Drinking/ Potable Water Supply, piping (Clarified water, chlorinated)		1. Demineralised Water, Service and Instrument Piping less than and equal to 50 mm NB		1. Demineralised Water, Service and Instrument air piping for sizes equal to greater than 65 mm NB	
4.01.00 Materials	ASTM-A-234 Gr. WPB	ASTM-A-105	ASTM-A-234 Gr. WPB galvanized as per IS-4736	ASTM-A-105 galvanized as per IS-4736	ASTM-A-182 F304	ASTM-A-351-CF8		
4.02.00 Construction	Welded/ Seamless	Forged	Welded/ Seamless	Forged	Forged	Welded/Seamless		
4.03.00 Standard	ANSI-B-16.9 for fabricated fitting AWWA-C-208	ANSI-B-16.11	ANSI-B-16.9	ANSI-B-16.11	ANSI-B-16.11	MSS-SP-43		
4.04.00 End details	Pipe size >=65mm NB Butt welded as per ANSI-B-16.25	Pipe size <=50 mm NB Socket welded as per ANSI-B-16.11	Pipe size >=65 mm NB Screwed Flanged	Sizes <=50 mm Screwed socketed as per ANSI-B-16.11All fittings shall be galvanized.	Socket welded	Slip - on flanges		

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	A	B	C	D
Services	1. Clarified Water piping 2. DMCW piping	1. Drinking/ Potable Water Supply, piping (Clarified water, chlorinated)	1. Demineralised Water, Service and Instrument Piping less than and equal to 50 mm NB	1. Demineralised Water, Service and Instrument air piping for sizes equal to greater than 65 mm NB
5.00.00 Flanges	150 lb class as per ANSI-B-16.5 complete with nuts, bolts and gaskets	As per ANSI-B-16.5 pressure class 150lbs - galvanised-complete with nuts, bolts and gaskets.	As per ANSI-B-16.5 pressure class 150lb complete with nuts, bolts and gaskets. Material as per class 4.01.00.	150lb class, flat face, as per ANSI-B-16.5 complete with nuts, bolts and gaskets.
Pipes which fall under IS:1239 shall be hydrostatically tested according to the said code, for others refer Section-V, Vol.: II-A.				

ANNEXURE-II

SERVICES OF VARIOUS CATEGORIES OF VALVES

Valve Classification		Service		
A.	Cast iron body Gate/Globe/Check Valve	i)	Service Water	For sizes 65mm NB and above.
		ii)	Clarified Water	
		iii)	Drinking/ Potable Water	
		iv)	Inhibited Demineralised Water	
B.	Stainless steel body/ Gate/Globe /Check/Ball Valve	i)	For Demineralised water	For all sizes
		ii)	Potable/ Drinking Water	For sizes less than and equal to 50 mm NB
		iii)	Service and Instrument Air	For all sizes. Ball valves to be used in air line.
C.	Steel Body valves	i)	Clarified Water	For sizes less than and equal to 50 mm NB
		ii)	Inhibited Demineralised Water for DMCW system	
D.	Cast Iron body butterfly valve	i)	For Demineralised Water	For butterfly valve specification refer Annexure II, Sec.IV of Vol. III E. For DM water line rubber lining/ EPDM/equivalent protection to be provided
		ii)	Raw water	
		iii)	Clarified Water	
		iv)	Filtered Water	
		v)	Inhibited Demineralised Water for DMCW system	

ANNEXURE-III

SPECIFICATION OF VALVES

	A. Cast Iron Body Gate/ Globe/Check Valve	B. Stainless steel Body Gate/Globe/Check/Ball Valve	C. Steel Body Gate/ Globe/Check Valve/ Ball Valve
1.00.00	Valve Classification Code	CIGC	STGC
2.00.00	Basic Design Code		
	a) Gate	a, b, c) ANSI-B-16.34	i) API 600 for 50mm ii) API 602 for size
	b) Globe	IS 780 for 50 mm - 300 mm NB IS2906 for 350 mm NB and above or as per MSS-SP-70 MSS - SP - 85	b) BS-1873/ANSI-B-16.34 c) BS-1868/ANSI B16.34
	c) Check	IS-5312/MSS - SP -71	
	d) Ball	d) BS-5351	
3.00.00	Pressure Class	To be suitably chosen considering the pressure requirement. Refer Clause No. 4.01.08 in this regard.	
4.00.00	Construction	Forged body up to 50mm NB and Cast body above that	Same as Group-B
5.00.00	Material	ASTM-A-182 F304 for Ball Valves: A351 CF8M for cast body, A 182 F304 for forged body.	ASTM-A-216 Gr. WCB for cast body & ASTM-A-105 for forged body
5.01.00	Body & Bonnet/ cover	IS 210 Gr. FG 260	

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	A. Cast Iron Body Gate/ Globe/Check Valve	B. Stainless steel Body Gate/Globe/Check/Ball Valve	C. Steel Body Gate/ Globe/Check Valve/ Ball Valve
5.02.00	Trim / Disc.	ASTM-A-182 F304 for Gate, Globe, Check valves and 351CF 8M for Ball valves. For DKW system : ASTM-A-182 F6A (min. 250 HB)	13% Cr Steel as per ASTM-A-182 Gr. F6 heat treated and hardened(min 250 NB) for cast body and ASTM-A-105 Hard faced with Stellite (min 350 HB) for forged body
5.03.00	Seating surface	13% Cr steel as per IS 1570	13% Cr. Steel as per ASTM-A-182 Gr. F6
6.00.00	End Preparation	Socket welded for size equal to and below 50mm NB and flanged with counter flanges for 65mm NB and above.	
7.00.00	Testing		
	a) Gate	i) As per IS - 780 for 50 mm - 300 mm NB ii) IS-2906 for sizes equal to and above 350 mm NB	API-598
	b) Globe	Hydrostatic Test as per MSS-SP-85	BS-1873
	c) Check	IS-5312/MSS-SP-71	BS--1868



TITLE:

TECHNICAL SPECIFICATION FOR
CONDENSATE POLISHING UNIT
1X800 MW TSGENCO KOTHAGUDEM TPS
STAGE -VII, PALONCHA

SPEC NO: PE-TS-410-155A-A001

VOLUME: II-B

SECTION: D1

REV NO: 00

DATE:

**TECHNICAL SPECIFICATION FOR
PIPING, VALVES & FITTINGS
(CONT.)**



TITLE:

**TECHNICAL SPECIFICATION FOR
CONDENSATE POLISHING UNIT
1X800 MW TSGENCO KOTHAGUEM TPS
STAGE –VII, PALONCHA**

SPEC NO: PE-TS-410-155A-A001

VOLUME: II-B

SECTION: D1

REV NO: 00

DATE:

1.00.00**CODE & STANDARDS**

1.01.00

The Design, manufacture, shop testing, erection, testing and commissioning of piping and valves shall conform to the latest revisions of the following codes and Indian Standards, in addition to other standards mentioned elsewhere in the tender documents subject to any modification and requirement as specified hereinafter.

- IS : 778 - Gunmetal gate, globe and check valves for general purpose.
- IS : 1239 - Mild steel tubes and fittings - Part I & II.
- IS : 1536 - Centrifugally cast (spun) iron pipes for water, gas and sewage.
- IS : 1537 - Vertically cast iron pressure pipe for water, gas and sewage.
- IS : 1538 - Cast iron fittings for pressure pipes for water, gas and sewage.
- IS : 1703 - Ball valves (horizontal) plunger type including floats for water supply purposes.
- IS : 2379 - Colour for the identification of pipe line.
- IS : 2685 - Code of practice for erection, installation, and maintenance of sluice valves.
- IS : 14846 - Sluice valve for water works purposes (150 to 1200 mm).
- IS : 3042 - Single faced sluice gates (200 to 1200 mm).
- IS : 3589 - Electrically welded steel pipes for Water gas & sewage (200 to 2000 mm).
- IS : 4038 - Foot valve for water works purposes.
- IS : 4984 - High Density polyethylene pipes.
- IS : 4985 - Unplasticised PVC Pipes.
- IS : 5312 - Swing check type reflux (non-return) valve Part-I.
- IS : 458 - Concrete pipes (with and without reinforcement).
- IS : 3952 - Cast Iron butterfly valves for general purposes.
- ASTM-A 106 - Gr.C Seamless carbon steel pipe.
- ASTM - 53 - Seamless carbon steel.
- AWWA-C-504 - Standard for butterfly valve.
- BS : 5156 - Standard for Diaphragm valve.
- IS : 554 - Pipe thread for pressure tight joints.
- IS : 1363 - Black hexagon bolts, nuts and lock nuts.
- IS : 1364 - Precision and semi-precision hexagon bolts, screws, nuts and lock nuts.
- IS : 2062 - Structural steel fusion welding quality.
- IS : 4736 - Hot dip zinc coating on steel tubes.
- IS : 2825 - Code of unfired pressure vessels.
- IS : 2712 - Gaskets.
- IS : 4192 - Part-I Rubber lining.
- IS : 3006 - Acid resistant SWG Pipe.
- IS : 783 - Code of practice for laying RCC pipes.



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- IS : 3114 - Code of practice for CI Pipes.
- BS : 5142 - CI globe valve.
- ANSI:B 16.5 - Steel pipe flanges and flanged fittings.
- ANSI:B 31.1 - Power Piping code.

2.00.00 DESIGN, CONSTRUCTION AND ERECTION

2.01.00 Piping and Fittings (General)

2.01.01 Design

All piping systems shall be capable of withstanding the maximum pressure in the corresponding lines at the relevant temperatures. The minimum thickness for pipes and fittings shall be adhered to. Higher thickness in equivalent material is acceptable. However, no credit will be given for higher thickness.

2.01.02 All the piping systems, fittings and accessories supplied under this package shall be designed to operate without replacement and with normal maintenance for a plant service life of 25 years, and shall withstand the operating parameter fluctuations and cycling which can be normally expected during this period.

2.01.03 All piping systems shall be properly designed to take care of hydraulic shocks and pressure surges which may arise in the system during operation. Bidder should provide necessary protective arrangement like anchor blocks/anchor bolts, etc. for the safeguard of the piping systems under above mentioned conditions. External and internal attachments to piping shall be designed so as not to cause flattening of pipes, excessive localised bending stresses or harmful thermal gradients in pipe walls.

2.01.04 Piping and fittings shall be manufactured by an approved firm of repute. They should be truly cylindrical of clear internal diameter specified, of uniform thickness, smooth and strong, free from dents, cracks and holes and other defects. They shall allow ready cutting, chipping or drilling, welding etc.

2.01.05 All rubber lined pipes shall be seamless or bead removed ERW pipes.

2.01.06 Inspection holes shall be provided at suitable locations for pipes 800 mm NB and above as required for periodic observations and inspection purposes.

2.01.07 Material of construction for pipes carrying various fluids shall be as below: -

S.No.	Service	Material
1.	Raw water	Carbon Steel
2.	Clarified water/Filtered Water	Carbon steel
3.	Acidic Water	Rubber lined Steel
4.	Demineralised Water	Stainless Steel - 304
5.	Acid (hydrochloric)	Rubber lined Steel
6.	Alkali (Sodium Hydroxide)	
	a) Strong (5% and above)	Stainless Steel - 304
	b) Dilute (below 5%)	Stainless Steel - 304
7.	Lime Solution/Suspensions	Galvanized Steel
8.	Air	Galvanized Steel to IS 1239
9.	Waste effluent from N Pit	HDPE
10.	Resin water slurry	Stainless steel Type-304

2.01.08 The portion downstream of the isolation valves of pipe lines conveying flushing water shall be of the material &



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type as that of the chemical pipelines which is being flushed.

2.01.09

Pipelines carrying water, chemicals, air etc. shall be sized generally on the following velocities. However wherever minimum pipe sizes are defined in the tender drawing /data sheets the selected size shall not be less than the specified size. The velocity in the resin transfer line is specified elsewhere in the specification.

Pipe Size	Velocity in m/sec.		
	Below 50 mm above	50-150 mm	200 mm &
a) Pump suction	-	1.2 - 1.5	1.2 - 1.8
b) Pump discharge	1.2 - 1.8	1.8 - 2.4	2.1 - 2.5
c) Header	-	1.5 - 2.4	2.1 - 2.4
d) Compressed air below 2 Kg/cm ² (g)	15 - 20	20 - 30	25 - 35
e) Compressed air 2 Kg/cm ² & above	20 - 30	25 - 40	35 - 45
f) Suction to compressor/ Blowers	-	7 - 8	-

2.01.10

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

2.01.11

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

i) Carbon Steel pipe	-	100
ii) C.I Pipe / Ductile Iron	-	100
iii) Rubber lined steel pipe	-	120
iv) PVC / HDPE pipes	-	140
v) Resin Transfer Pipe	-	100

For calculating the pump head, at least 10% margin shall be taken over the pipe friction losses.

2.02.00

Material & Dimensional Standards for Piping

2.02.01

All piping system shall be capable of withstanding the maximum pressure and temperature in the corresponding line.

2.02.02

The Steel pipes (Welded type) for the services of raw water/clarified water/Filtered water shall conform to the following standard or codes.

- i) Pipes up to 150 NB
 - a) IS:1239 Part-I (Heavy grade-Black)
 - b) ASTM-A-53 Grade B (Welded), Sch 80 up to 2 inch nominal size.
Sch 40 above 2 inch nominal size.
- ii) Pipes 200 NB and above
 - a) IS:3589 - Grade 410
 - b) ASTM - A53, Type-E Grade B (Welded) - Sch. 40
- iii) Pipe 500 NB and above-In this case pipes shall be rolled and butt welded. These pipes may be



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fabricated by the bidder at site. The plates conforming to IS:2062 (Tested quality) or SA-285 Gr.C. or equivalent.

However, condenser polisher pipelines shall be of seamless carbon steel ASTM A 106 Gr.B all welded construction with minimum 300 lb flange connection.

2.02.03 Pipes for the Air Service shall conform to the above clause 2.02.02 and shall be galvanized to IS:4736.

2.02.04 Pipes to be used for the rubber-lined construction shall conform the above clause 2.02.02 and inside surface shall be completely de-beaded and made suitable for lining.

2.02.05 Other piping materials shall conform to the following standards.

- i) IS:4984 - Class-5-High density polyethylene pipes.
- ii) IS:4985 - Class-4 - PVC Pipes.
- iii) ASTM A-106, Gr. C, Schedule 80 - Seamless carbon steel pipe.
- iv) ASTM A-312 Grade TP-316 Schedule 40s - Stainless Steel pipes.
- v) ASTM A-312 - Grade TP-316 Schedule 40 - Stainless Steel pipes (ERW OR Seamless)

2.02.06 Fittings

- (a) Fittings to be used with carbon steel pipes shall conform to IS:1239 Part-II (Heavy grade) for sizes up to 150 NB.
- (b) For sizes 200 NB & above steel fittings shall conform to ASTM A 234 Gr. WPB. However for sizes above 350 NB fabricated fittings (meter bends etc) may be used. Forged elbows of long radius shall be used.
- (c) However inside surface of all the fittings used for the rubber lined application shall be de-beaded and made suitable for rubber lining.
- (d) For Galvanized pipe application all the fittings shall be galvanized as per IS:4736.
- (e) Fittings to be used in other type of piping shall conform to relevant IS/BS ANSI Standards and in conformity with the parent pipe standard.
- (f) Unless otherwise shown eccentric reducers shall be installed with straight side at the top of piping connection.

2.03.00 **Design of Piping Systems**

2.03.01 For water, air and other services where steel pipes are used, joints of this size range shall be screwed/flanged type.

2.03.02 All unlined steel pipes 65 NB and above (other than CI pipes and air service pipes) shall be joint by butt-welding.

2.03.03 All rubber lined pipes shall have flanged joints.

2.03.04 Steel pipe flanges shall be generally slip on flat face type. Weld neck flanges shall be used when flange follows immediately after a butt-welding or where it is required with respect to service conditions. When weld neck or socket weld flanges are used, their bore must be made the same as that of the pipe being welded to. Socket welded or threaded flanges may be used, with the appropriate piping system for connection of pipe to the flanged equipment.

2.03.05 All the piping flanges and counter flanges & their drilling shall conform to ANSI B 16.5 of relevant pressure & temperature class. However wherever the interferences is involved with the Owner's pipe, the flange/interconnection details shall be designed to match the piping and the details of which will be intimated later. Flanges shall conform to ANSI B.16.5 class 150 (min.) for service other than condensate polisher pipelines.

2.03.06 For easy handling & removal of equipments, valves etc. and for maintenance purpose, break up flanges for 65 NB and above sizes and suitable type of compression flexible coupling for flanged joints of 50 NB and below



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size shall be provided. The over ground piping wherever routed inside building, shall have a clear head room of minimum 2.1 meter from operating floor.

- 2.03.07 Pipes shall generally be routed above ground but where specifically indicated/specified the pipe may be laid in trenches or buried. Buried piping shall be generally installed so that the top of pipe is 1.0 metre below the ground level unless otherwise specifically mentioned. Full length of buried piping shall be provided with 100 mm thick sand bed.
- 2.03.08 Butt-welding edge preparation shall be done as per ANSI B 16.25.
- 2.03.09 Meter bends will not be accepted for steel pipes of 350 NB and below. For sizes above 350, the meter bends shall conform to BS:534. The bend radius shall be used for all pipes 1.5 times the nominal pipe diameter.
- 2.03.10 Hangers and supports shall be capable of carrying the sum of all concurrently acting loads. They shall be designed to provide the required supporting effects and allow pipeline movements as necessary. All guides, anchors, braces, dampener, expansion joint and structural steel to be attached to the building/structure, trenches etc. shall be provided. Type of hangers and components for all piping shall be selected and approval obtained from the ENGINEER.
- 2.03.11 For rubber lined pipe, lining should be applied in two (2) layers, giving a total thickness not less than 3 mm. Surface hardness of rubber lining shall be $65 \pm 5^\circ$ Shore A
- 2.03.12 Pipe coming under purview of IBR should meet its requirements and getting the IBR approval shall be under Vendors scope.

3.00.00 VALVES & GATES

- 3.01.00 Valves will be used to start/stop or control flow. Gates will be primarily used for isolation of flow in open channels although these should be capable of throttling the flow too. Sample valves will be used in sample collection lines.
- 3.02.00 (a) All valves, shall be suitable for service conditions i.e. flow, temperature and pressure under which they are required. All the valves shall be of standard pressure rating of the relevant design standard.
- (b) All the actuators of the valves shall be designed to handle the maximum expected pressure differential across the valves and to overcome friction forces and unbalance forces due to the flow through valve.
- 3.03.00 **Valves in Raw water, Clarified & Filtered water application**
- 3.03.01 Either Butterfly type or sluice/gate valves shall be used for isolation purposes.
- 3.03.02 Sluice/gate valve shall conform to IS 14846 of rating PN 1.6 (min.). Stem, seat ring and wedge facing ring shall be of stainless steel construction. Other parts shall be as per IS:780. Flanges shall be designed as per ANSI B 16.5 Cl. 300 (min.) to meet with the piping flanges. Valves shall be of outside screw and rising stem type.
- Sluice valves for sizes below 50 NB and below shall conform to IS:778 Class-2/ANSI B16.34 straight, rising stem; without side screw.
- 3.03.03 Sluice valves shall be provided with the following accessories in addition to the standard items.
- a) Hand wheel
- b) Manual Gear reduction unit operator for valves 250 NB and above.
- c) Bypass valve for valve of sizes 350 NB and above.
- d) Draining arrangement wherever required.
- e) Arrow indicating flow direction.



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f) Position indicator.

3.03.04 Sluice Valves shall be provided with back seating bush to facilitate gland renewal during full open condition.

3.03.05 Butterfly valves shall be of double flanged or lugged wafer type of low leakage rate confirming to AWWA-C-504 class 300 (min.) or BS:5155 PN 10 (min.)

3.03.06 The various components of butterfly valves shall be of the following

i) Body : Cast Iron - ASTM A 48 Cl.40; BS:1452 Gr.220 SG Iron - BS:2789. Cast Iron IS:210 Gr.FG260

Cast Steel - ASTM. A 216 GR. WCB; BS:1504 Eq.Gr.

Fabricated Steel as per ASTM A515 Gr.60/80 IS:2062, Gr.B/IS:2002.

ii) Disc. : Cast Iron IS:210, Gr.260; Cast Iron - ASTM A 48 Cl.40; BS:1452, Gr.220, SG Iron - BS:2789.

Cast Steel - ASTM A 216 Gr. WCB; BS:1504 Eq.Gr.

Fabricated Steel as per ASTM A515 Gr.60/80 IS:2062, Gr.B/IS:2002.

iii) Shaft : ASTM. A 296 Gr. CF8M/AISI 316: AISI 420; BS 970 Gr.316; BS:970 Gr.420 S45.

iv) Seat rings : Nitrile rubber, EPDM (Ethylene propylene rubber)

3.03.07 Butterfly valves shall be fitted with sleeve type bearing such as PTFE. Valves of size 350 NB and above shall be provided with one or two thrust bearings to hold the disc securely in the centre of valve seat without hydraulic or external axial shaft loads. Sleeve and other bearings fitted into the valves body shall be of self lubricated materials that do not have any effect on the fluid handled and other components of the valves.

3.03.08 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 hand wheel shall be provided. For lever/wrench operated valves, means shall be provided for positively holding the disc in not less than three intermediate positions.

Manually operated valves shall be provided with reduction gear unit for valves of size 250 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.

3.03.09 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 Cl.300 (min.)

3.03.10 Ball valves or Globe Valves may also be provided for the application of Raw/ Clarified / Filtered water services for sizes 40 NB and below conforming to the following specifications.

a) **Ball Valves**

i) Design Standard : BS:5351 Class 300 (min.)

ii) Type : Welded/Flanged ends; Full bore: Split Body & Seat supported construction.

iii) **Material of Construction**

Body : Carbon Steel/Cast Iron

Ball : Stainless steel ANSI 420

Seat ring : PTFE



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Stem : Stainless steel AISI 420

Seats : Nitrile rubber; PTFE.

- iv) Valves shall be designed to be directly operatable by a wrench / Hand lever.
- v) Suitable stops shall be provided for both the fully open & close condition.
- vi) All the valves shall be provided with an indicator for showing the position of the ball port.

b) Globe Valves 50 NB and Below

- i) Design Standard : IS:778 Class-2
- ii) Type : Straight, rising stem, with outside screw.

iii) Material of Construction

- i) Body, Bonnet, stuffing Box & seat rings : Leaded Tin Bronze conforming IS:318 Gr.2
- ii) Stem : Stainless Steel, AISI-316
- iii) Disc : IS:318 Gr. 2/AISI-316

For sizes above 50 NB

- i) Design Standard : IS:780/IS:2906 rating PN 1.0 min. or Equivalent/BS 5150 PN 10. (min.)
- ii) Type : Double Flanged or wafer body, outside screw and rising stem type.

iii) Material of construction

- Body : Cast iron : IS:210 Gr. FG 260/BS:1452 Gr.14.
- Stem : Stainless steel AISI 410/ 13% chrome steel.
- Disc : Cast iron IS:210 Gr.260/ BS:1452 Gr.14.
- Packing : PTFE
- Seat & seat rings : 13% chromium steel
- Gland & gland nut : AISI 420
- Hand wheel : Cast iron or Malleable iron.

- iv) Back seat shall be provided on the stem or on the disc.
 - v) Renewable disc assembly shall consist of disc holder, disc, disc guide, check nut and disc retaining nut with washer.
 - vi) Disc of globe valve may be provided with renewable rubber seating ring.
 - vii) Hand wheels shall be marked with the word. OPEN or SHUT with arrow to indicate direction of opening or closing.
- 3.03.11 However, valves in the flushing water lines shall be of type and material specified for the chemicals which is being flushed by the line.

3.04.00 Valves for Demineralised water application

- 3.04.01 Butterfly valves or Saunder's patented diaphragm valves shall be used for the services of demineralised water application for isolation purposes.



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3.04.02

The diaphragm valves shall conform to the following requirements.

- a) Design Standard : BS:5156 or equivalent of required rating/class. (minimum rating of valves should be PN 10).
- b) Type : Flanged and lined body ends, sealed bonnet, weir pattern, tight shut off type.
- c) **Material of Construction**
 - Body/Bonnet : I) Cast Iron IS:210 Gr.FG.260 or equivalent.
 II) Cast steel ASTM A-216 Gr. WCB.
 - Body lining : Soft Natural rubber, Ebonite polypropylene, PVDF.
 - Diaphragm : Reinforced rubber, hypalon/app. equal.
 - Hand wheel : Cast Iron
 - Compressor : Stainless Steel
 - Stem & Bush : Stainless Steel
- d) Flanges shall conform to ANSI B 16.5 Cl.300 and shall be cast/integral with the body.
- e) Hand wheels shall be marked with the direction of closure.
- f) Valves shall be provided with a position indicator to show the open and closed condition.
- g) Valves provided with pneumatic actuators shall be provided with a hand wheel for manual operation. The valves operators shall be designed as per relevant International Standard.

3.04.03

The butterfly valves shall conform to Cl.3.03.05 to Cl.3.03.09 above except to the following requirements.

- a) Body shall be lined (minimum 3 mm) with natural rubber, ebonite, polypropylene or PVDF.
- b) Disc shall be lined with PVDF, polypropylene, or natural rubber.
- c) Seat rings shall be of Nitrile rubber or Hypalon.

3.05.00

Valves for Acid & Alkali Services

Valves shall be saunder's patented diaphragm type. The valves shall conform to Cl. 3.04.02 above except to the following requirements.

- a) Diaphragm shall be of reinforced teflon, EPDM/Black Butile/appd. eqv. for acid services and reinforced Neoprene/Hypalon/app eqv for alkali services.

3.06.00

Valves for Lime Slurry / Solutions

3.06.01

Plug valves shall be used for the application of lime slurry /lime solutions.

3.06.02

The plug valves shall conform to the following requirements.

- a) Design Standard : BS:5353 Class 300 or Equivalent.
- b) Type : Flanged and non lubricated, regular pattern, plug valves.
- c) **Material of Construction**
 - i) Body : Cast Iron IS:210 Gr FG 260 or Equivalent
 - ii) Plug : Stainless Steel AISI 316
 - iii) Body Sleeve or Seat : PTFE
 - iv) Seat : PTFE



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- v) Gland : AISI 304 / AISI 316
- vi) Cover : Cast Steel ASTM A216 Gr WCB
- vii) Gland Nut : AISI :304 / AISI 316

- d) Valves shall be operated by permanently fitted wrench or Hand lever. Wrench shall be mounted so that they are parallel to the valve bore axis when the valve is in fully open condition.
- e) All valves shall be provided with an indicator for the position of the plug part.
- f) Suitable stops shall be provided for the fully open and fully closed positions of the valve.
- g) Valves of size of 250 NB and above shall be provided with a suitable reduction gear unit.

3.07.00 Resin Transfer Line

In resin transfer line in CPU two way eccentric plug valve as manufactured by De Zurik or approved equal shall be used. Ball valve may also be used for this application. The valves shall have type 316 stainless steel body and bearings, resilient faced plug and flanged ends. For service vessel area pressure rating should be in line with system requirement. All automatic valves shall be provided with double acting pneumatic cylinder actuators controlled by solenoid valves, manual over ride feature & local position indicators.

3.08.00 Butterfly valves in the condensate polisher service vessels.

3.08.01 They shall be lugged wafer type.

3.08.02 The material of construction shall be as below:

- i) Body : Cast Steel (Please refer note written below)
- ii) Disc : SS-316
- iii) Shaft : SS-316
- iv) Seal : Teflon
- v) Seat : Teflon with Titanium back-up rings

Note: - the body material shall be SS 316 for all the butterfly valves coming at the outlet of the service vessels.

3.08.03 Flanges shall correspond to ASA 300 lb class (min).

3.08.04 All automatic valves shall be provided with double acting pneumatic cylinder actuators controlled by solenoid valves, manual over ride feature & local position indicators.

3.09.00 Valves for Air pipe line application

3.09.01 For Air services, globe valves or Ball valves may be used for sizes 50 NB and below.

3.09.02 For sizes higher than 50 NB, either Butterfly valve or Ball valves shall be used.

3.09.03 Globe valves shall generally conform to Cl. 3.03.10 (b) above.

3.09.04 Ball valves shall conform to the requirements stipulated in Cl.4.03.10 (a) above. However, Body material shall be leaded Tin Bronze (IS:318 Gr.2) or stainless steel (AISI:304/316).

3.09.05 Butterfly valves shall conform to the Cl.3.03.05 to 3.03.09 of this section. However, the body & Disc shall be either cast iron lined with elastomer such as PVDF or PTFE or stainless steel construction (AISI 304/316).

3.10.00 Non-return valves (Check valves)

3.10.01 Non return valves shall be of swing check (reflux) type or dual plate type.

3.10.02 The valves shall conform to the following specifications.

- i) Design Standard : IS:5312, BS:1868, BS:5153 API 594/
API 60 or Eqvt.



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- ii) Type : Swing check Type and Flanged ends.
- iii) Material of Construction (For non corrosive application)
- a) Body & Cover : Cast iron IS:210 Gr.FG 260/or
Hinge Disk/Door Cast Iron BS:1452 Gr.220 or Eqvt.
- b) Hinge Pin and : Cast steel ASTM A 216 Gr.
Door/Disc Pin WCB.
High tensile Brass IS:320 HT 2 or BS:2872 eqvt.
- c) Disc facing ring : Stainless steel
- d) Body Seat ring : Stainless steel
- e) Bearing bushes : Leaded Tin Bronze IS:318 Gr.2
- f) Bolts : Carbon Steel
- iv) For the application of lime, corrosive water (DM water), and air, the body, cover & Disc shall be lined with natural Rubber, PTFE or Viton. The Hinge, Hinge Pin & Disc Pin shall be coated with PVDF, or suitable elastomer. The bearing bushes shall be PTFE or Eqvt. material. Bolting shall be of stainless steel. In the absence of lining/coating, the complete valve shall be of stainless steel construction (AISI 316) for the above application.
- v) For acid services, the valves shall be of lined construction as specified in (iv) above, or of Hastalloy 'B' construction and Body/Disc facing ring shall be of resilient materials such as natural rubber, PTFE or Viton.
- vi) For alkali services, the complete valve shall be stainless steel construction (AISI-316).
- 3.10.03 Flanges shall conform to ANSI B 16.5 Cl.300 to match with the piping flanges as specified elsewhere.
- 3.10.04 Body shall be permanently marked with an "arrow" inscription indicating the direction of motion of the fluid for all the check valves.
- 3.10.05 Check valves for Raw / Clarified / Filtered water may be offered in Gun metal construction & with threaded ends for sizes 50 NB and below conforming to IS:778 or Equivalent.
- 3.11.00 The safety valves / relief valves at the downstream of positive displacement type metering pumps shall be of the standard type manufactured by the pump manufacturer and the material of construction shall suit to the fluid handled.
- 3.12.00 **Gates**
- 3.12.01 Design standard for gates shall be IS:3042 or Eqv.
- 3.12.02 The gates shall be rectangular or square sluice, rising spindle type conforming to class-1 of IS:3042.
- 3.12.03 Material of Construction
- i) Frame and Door : Cast Iron IS:210 Gr. 20
- ii) Spindles, bolts & nuts : M.S. to IS:2062
- iii) Face & seat rings : Gun metal (as per IS:3042).
- 3.12.04 All the parts of gates shall be applied with the coats of heavy duty bitumastic paint.
- 3.12.05 Each of the gates shall be provided with hand wheel, and a position indicator.
- 3.12.06 The gates for DM plant drains shall be rubber lined to a minimum thickness of 4.5 mm.
- 3.13.00 **STRAINERS**



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3.13.01

Basket Strainers

- a) Basket strainers of simplex design shall have the following materials of construction for raw/clarified/filtered water application.
 - i) Body : Fabricated mild steel : IS:2062 (Tested quality)
 - ii) Strainers : Wire shall be stainless steel (AISI:316 18 BWG 30 mesh suitably reinforced. Reinforcement material shall also be of stainless steel construction.
 - iii) Drain Plug/Nuts : Gun metal
- b) Inside and outside of basket body shall be protected with one coat of high build zinc phosphate primer and three coats of Chlorinated rubber paint to a total thickness of 200 microns.
- c) Suitable Vent and drain valves shall be provided for the strainers.
- d) Screen (strainer) flow area shall be at least four times pipe sectional area. Flow area in any portion of Basket strainer assembly shall not be less than the pipe cross sectional area.
- e) Pressure drop in clean condition shall not be more than 1.0 MWC.
- f) Basket Strainer shall be provided with lifting lugs and suitable mounting arrangement.
- g) For DM water service, body shall be rubber lined to minimum 4.5 mm thickness (soft rubber of shore Hardness $65 \pm 5^{\circ}A$).

3.13.02

Y-Type Strainer

- a) Y-Type strainer for water application shall be constructed of following materials :
 - i) Body : Cast Iron IS:210 Gr. FG 260
 - ii) Strainers : Wires of stainless steel AISI-316, 18 BWG 30 mesh suitably reinforced. Reinforcement material shall also be of stainless steel construction.
 - iii) Drain Plug/Nuts : Gun metal (threaded construction)
- b) Y-Type strainers shall also conform to Cl. 3.14.01 (b), (d), (e) and (f).
- c) Body of the Y-type strainers of alkali, and demineralised water shall be of Cast Iron (IS:210, Gr.FG 260) and lined with soft or hard rubber to a thickness of 4.5 mm.
- d) For acid services, apart from the rubber lined body material, the screen material, shall be Polypropylene or HDPE wire cloth of suitable mesh and thickness.

3.14.00

General Requirements for Valves, Gates, Strainers

3.14.01

All the equipments shall be of proven design for the duty conditions and the contractor or manufacturer shall have sufficient experience in using the above equipments in water treatment application in the plants supplied earlier by them.

3.14.02

In case owner desires, the experience list/feedback from the users shall be made available to owner for any or all the equipments during the detailed engineering phase.

3.14.03

Valves coming under the purview of IBR if any shall meet its requirements and the approval of the same shall be obtained by the contractor.

3.14.04

Sizes of the valves shall be same as that of the interconnected pipe sizes except for the control valves.

3.14.05

The various equipments shall be installed so that they are easily approachable for the operating and maintenance personnel. Generally Valves shall be located about 1.2 meter to 1.5 meter from the operating platform and also they shall not be located below the ground level such as beneath the trenches etc. In such cases, extended spindle shall be provided with chain operating from operating floor. Valves which are installed below the ground floor shall be provided with a floor mounted pedestal at the top of the operating floor. The



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position indicator for such valves shall be also provided along with the stand.

3.14.06

However valves which are provided (in the burried pipe line) with a valves chamber shall have manual operator/Hand wheel inside the valve chamber. The valve chamber shall be provided with built in ladders/staircases and sufficient operating space within the chamber shall also be provided for easy operation of such valves.



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**TECHNICAL SPECIFICATION FOR
HORIZONTAL CENTRIFUGAL PUMPS(CONT.)**



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**TECHNICAL SPECIFICATION FOR
 CONDENSATE POLISHING UNIT
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1.00.0 SCOPE

1.01.0 This specification covers the design, material, construction features, manufacture, inspection, testing the performance at the Vendor's/Sub-Vendor's Works and delivery to site of Horizontal Centrifugal Pumps.

2.00.00 CODES AND STANDARDS

2.01.0 The design, material, construction, manufacture inspection and performance testing of Horizontal Centrifugal Pumps shall comply with all currently applicable statutes, regulations and safety codes in the locality where the Equipment will be installed. Nothing in these specifications shall be construed to relieve the Vendor of this responsibility. The Equipment supplied shall comply with the latest applicable Indian Standards listed below. Other National Standards are acceptable, if they are established to be equal or superior to the Indian Standards.

2.02.0 List of Applicable Standards.

1	IS : 1520	Horizontal Centrifugal Pumps for clear cold fresh water.
2	IS : 5120	Technical requirements of roto dynamic special purpose pumps.
3	API : 610	Centrifugal pumps for general refinery service.
4	IS : 5639	Pumps Handling Chemicals & corrosion liquids.
5	IS : 5659	Pumps for process water.
6	HIS	Hydraulic Institute Standards, USA
7	ASTM-1-165-65	Standards Methods for Liquid Penetration Inspection.

2.03.03 In case of any contradiction with aforesaid standards and the stipulations as per the technical specifications as specified hereinafter the stipulations of the technical specifications shall prevail.

3.00.00 DESIGN REQUIREMENTS

3.01.00 The Pump shall be capable of developing the required total head at rated capacity for continuous operation. Also the pumps shall be capable of being operated to give satisfactory performance at any point on the HQ characteristics curve over the operating range of 40% to 120% of the duty point. The maximum efficiency of pump shall be preferably be within +/- 10% of the rated design flow as indicated in the data sheets. The minimum efficiency of pumps shall be 40%.

3.02.00 The total head capacity curve shall be continuously rising from the operating point towards shut-off without any zone of instability and with a minimum shut-off head of 15% more than the design head.

3.03.00 Pumps of a particular category shall be identical and shall be suitable for parallel operation with equal load division. The head Vs capacity and BHP Vs capacity characteristics should match to ensure even load sharing and trouble free operation throughout the range. Components of identical pumps shall be interchangeable.

3.04.00 Pumps shall run smoothly without undue noise and vibration. Peak to peak vibration limits shall be restricted to the following values during operation:

SPEED	Antifriction Bearing	Sleeve Bearing
1500 rpm and below	75.0 micron	75.0 micron



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- 3.05.00 The noise level shall not exceed 85 dBA. Overall sound pressure level reference 0.0002 microbar (the standard pressure reference for air sound measurement) at a distance of 1 M from the equipment.
- 3.06.00 The pumps shall be capable of starting with discharge valve fully open and close condition. Motors shall be selected to suit to the above requirements. Continuous Motor rating (at 50 deg.C ambient) shall be atleast ten percent (10%) above the maximum load demand of the pump in the entire operating range to take care of the system frequency variation and no case less than the maximum power requirement at any condition of the entire characteristic curve of the pump.
- 3.07.00 The kW rating of the drive unit shall be based on continuously driving the connected equipment for the conditions specified. However, in cases where parallel operation of the pumps are specified, the actual motor rating is to be selected by the Bidder considering overloading of the pumps in the event of tripping of operating pump(s).
- 3.08.00 Pumps shall be so designed that pump impellers and other accessories of the pumps are not damaged due to flow reversal.
- 3.09.00 The Contractor under this specification shall assume full responsibility in the operation of pump and motor as a unit.

4.00.0 DESIGN CONSTRUCTION

- 4.01.00 DESIGN AND CONSTRUCTION OF VARIOUS COMPONENTS OF THE PUMPS SHALL CONFORM TO THE FOLLOWING GENERAL SPECIFICATIONS. FOR MATERIAL OF CONSTRUCTION OF THE COMPONENTS, DATA SHEETS SHALL BE REFERRED TO.

4.02.0 Pump Casing

- 4.02.01 Pump casing shall have axially or radially split type construction. The casing shall be designed to withstand the maximum shut-off pressure developed by the pump at the pumping temperature.
- 4.02.02 Pump casing shall be provided with a vent connection and piping with fittings & valves. Casing drain as required shall be provided complete with drain valves, piping and plugs. It shall be provided with a connection for suction and discharge pressure gauge as standard feature. It shall be structurally sound to provide housing for the pump assembly and shall be designed hydraulically to minimum radial load at part load operation.

4.03.00 Impeller

- 4.03.01 Impeller shall be closed, semi-closed or open type, and it shall be designed in conformance with the detailed analysis of the liquid being handled.
- 4.03.01 The impeller shall be secured to the shaft, and shall be retained against circumferential movement by keying, pinning or lock rings. On pumps with overhung shaft, impellers shall be secured to the shaft by a lockout or cap screw which tightness in the direction of normal rotation.

4.04.00 Impeller/Casing Wearing Rings

- 4.04.01 Replaceable type wearing rings shall be provided at suitable locations of pumps. Suitable method of locking the wearing ring shall be used. Wearing rings shall be provided in pump casing and/or impeller as per manufacturer's standard practice.

4.05.00 Shaft

- 4.05.01 The critical speed shall be well away from the operating speed and in no case less than 130% of the rated speed.
- 4.05.02 The shaft shall be ground and polished to final dimensions and shall be adequately sized to withstand all stresses from rotor weight, hydraulic loads, vibration and torques coming in during operation.



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4.06.00 Shaft Sleeves

- 4.06.01 Renewable type fine finished shaft sleeves shall be provided at the stuffing boxes/mechanical seals. Length of the shaft sleeves must extend beyond the outer faces of gland packing of seal end plates so as to distinguish between the leakage between shaft and shaft sleeve and that past the seals/gland.
- 4.06.02 Shaft sleeve shall be fastened to the shaft to prevent any leakage or loosening. Shaft and shaft sleeve assembly should ensure concentric rotation.

4.07.00 Bearings

- 4.07.01 Heavy duty bearings, adequately designed for the type of service specified in the enclosed pump data sheet and for long, trouble free operation shall be furnished
- 4.07.02 The bearings offered shall be capable of taking both the radial and axial thrust coming into play during operation. In case, sleeve bearings are offered additional thrust bearings shall be provided. Antifriction bearings of standard type, if provided, shall be selected for a minimum life 16,000 hrs. of continuous operation at maximum axial and radial loads and rated speed.
- 4.07.03 Proper lubricating arrangement for the bearings shall be provided. The design shall be such that the bearing lubricating element does not contaminate the liquid pumped. Where there is a possibility of liquid entering the bearings suitable arrangement in the form of deflectors or any other suitable arrangement must be provided ahead of bearings assembly.
- 4.07.04 Bearings shall be easily accessible without disturbing the pump assembly. A drain plug shall be provided at the bottom of each bearings housing.

4.08.00 Stuffing Boxes

- 4.08.01 Stuffing box design should permit replacement of packing without removing any part other than the gland.
- 4.08.02 Stuffing boxes of packed ring construction type shall be provided wherever specified. Packed ring stuffing boxes shall be properly lubricated and sealed as per service requirements and manufacturer's standards. If external gland sealing is required, it shall be done from the pump discharge. The Bidder shall provide the necessary piping valves, fittings etc. for the gland sealing connection.

4.09.00 Mechanical Seals

- 4.09.01 Wherever specified in pump data sheet, mechanical seals shall be provided. Unless otherwise recommended by the tenderer, mechanical seals shall be of single type with either sliding gasket or bellows between the axially moving face and shaft sleeves or any other suitable type. The sealing faces should be highly lapped surfaces of materials known for their low frictional coefficient and resistance to corrosion against the liquid being pumped.
- 4.09.02 The pump supplier shall coordinate with the seal maker in establishing the seal chamber of circulation rate for maintaining a stable film at the seal face. The seal piping system shall form an integral part of the pump assembly. For the seals under vacuum service, the seal design must ensure sealing against atmospheric pressure even when the pumps are not operating. Necessary provision for seal water supply along with complete piping fittings and valves as required shall form integral part of pump supply.

4.10.00 Pump Shaft Motor Shaft Coupling

- 4.10.01 The pump and motor shafts shall be connected with an adequately sized flexible coupling of proven design with a spacer to facilitate dismantling of the pump without disturbing the motor. Necessary coupling guards shall also be provided.

4.11.00 Base Plate

- 4.11.01 A common base plate mounting both for the pump and motor shall be provided. The base plate shall be fabricated steel and of rigid construction, suitably ribbed and reinforced. Base plate and pump supports shall be so constructed and the piping unit so mounted as to minimize misalignment caused by mechanical forces such as normal piping strain, internal differential thermal expansion and hydraulic piping thrust. Suitable drain troughs and drip lip shall be provided.



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4.12.00 Assembly and Dismantling

4.12.01 Assembly and dismantling of each pump with drive motor shall be possible without disturbing the grouting base plate or alignment.

4.13.00 Drive Motor (Prime Mover)

4.13.01 The kW rating of the drive shall be based on continuously driving the connected equipment for the conditions specified. In case, where parallel operation of the pumps are specified, the actual motor rating is to be selected by the tenderer considering overloading of the pumps in the event of tripping of operating pumps.

5.00.00 TESTING FOR HORIZONTAL CENTRIFUGAL PUMPS

The manufacturer shall conduct all tests required to ensure that the equipment furnished shall conform to the requirements of this specification and in compliance with the requirement of applicable Codes and Standards. The particulars of the proposed tests shall be submitted to the Owner for approval before conducting the tests.

5.01.00 Hydrostatic Tests

All pressure parts shall be hydraulically tested at 200% of pump rated head or at 150% shut off head whichever is higher. The test pressure shall be maintained for 1/2 hr. and no leakage shall be permitted. While arriving at the above pressure, the maximum suction head specified in Data Sheet shall be taken into account.

5.02.00 Performance Tests

5.02.01 All the pumps shall be tested in the Manufacture's Works at rated speed for capacity, efficiency and brake horse power. Pumps shall be given running test over the entire operating range covering from the shut off head to the maximum flow. The duration of test shall be minimum one (1) hour. A minimum of seven readings approximately equidistant shall be taken for plotting the curves with one point at design flow. Testing of pumps shall be in accordance with stipulations of Hydraulic Institute Standards or as applicable equivalent

5.02.02 The test shall be preferably conducted with the actual motor being furnished.

5.02.03 Only those pumps shall be subjected to strip down examination visually to check for mechanical damages after testing at shop in case abnormal noise level and excessive vibration is observed during the performance test. Otherwise strip down examination is limited to bearing inspection only.

5.02.04 The pump accessories e.g. the thrust bearing, couplings etc. shall be subjected to tests as per manufacturer's standards.

5.03.00 Mechanical Balancing

All rotating components of the pumps shall be statically balanced. In addition to static balancing, rotating components of the pumps shall be balanced dynamically at or near the operating speed. Tenderer shall furnish acceptance norm for this test.

5.04.00 Visual Inspection

Pumps shall be offered for visual inspection by the bidder before shipment. The components of the pumps shall not be painted before inspection.

5.05.00 NPSH Test

NPSH test shall be conducted with water as medium if required. NPSH shall not be mandatory in case type test certificates are furnished for the similar rating of pumps.

5.06.00 Noise and Vibration Measurement

Noise and vibration shall be measured during the performance testing at shop as well as during the site test.



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5.06.01 The noise level shall not exceed 85 dBA. Noise level measurement will be made as per applicable internationally acceptable standard. The measurement shall be carried out with calibrated integrating sound level meter meeting the requirement of IEC:651 or BS:5969 or IS:9779. Sound pressure level will be measured all round the pump and motor set at a distance of one meter from the nearest surface of the machine and at a height of 1.5 m from the floor level. A minimum of six (6) points should be covered for measurement. The measurement shall be done with a slow response on the A-weighted scale. The average of the A-Weighted sound pressure measurements expressed in decibels to a reference 0.0002 microbars shall not exceed the specified value.

The tests shall be carried out on the machine operating at rated speed and as near as possible to the rated power. Corrections for background noise and correction on account of test environment will be considered in line with applicable standard. For this purpose all the additional data required should necessarily be collected during the test.

5.06.2 Vibration check will also be done as per HIS. Vibration would be checked at thrust bearing locations on horizontal, radial and vertical direction. The acceptance limits would be as per HIS. The instrument used would be IRD 308 or equivalent with velocity pick-up. Vibration limits to be specified as per the speed of the pump.

5.07.00 Material Test Certificate

5.07.01 Material of the various pump components shall be tested in accordance with the relevant standards. Test certificates for these shall be furnished for the Owner's approval.

5.07.02 Where stage inspection is desired by BHEL/customer all material test certificates shall be correlated and verified with the actual material used for construction before starting fabrication by BHEL/customer's inspector who will stamp the material. In case mill test certificate for the material are not available, the supplier shall carry out physical and chemical tests at his own cost from a testing agency, approved by BHEL/Customer, as per the requirement of specified material standard. The sample for physical and chemical testing shall be drawn up in presence of BHEL/Customer's inspector who shall also witness the testing.

5.08.00 Non Destructive Testing

- (a) UT shall be carried out on shafts of diameter more than 50 mm.
- (b) DP tests shall be carried out on shaft and impeller.
- (c) No weld repair shall be allowed on cast iron.

5.09.00 Field Testing

5.09.01 After installation, the pumps offered shall be operated to prove satisfactory performance as individual equipment as well as a system run. If the performance at site is found not to the requirements then the equipment shall be rectified or replaced by the Vendor, at no extra cost to the Owner. The procedure of the above testing will be mutually agreed between the Owner and the contractor. Noise and vibration tests shall also be repeated at site.

5.09.02 Based on observation of the trial operation, if modifications and repairs are necessary, the same shall be carried out by the contractor to the full satisfaction of the engineer and then the performance and guarantee tests to be repeated at site as per relevant clauses of the specification.



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**TECHNICAL SPECIFICATION FOR
METERING PUMPS (CONT.)**



TITLE:

TECHNICAL SPECIFICATION FOR
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1.00.0 GENERAL

1.01.01 Specification cover the design, material, construction features, manufacture, inspection, testing the performance at the vendor's/sub-vendor's works, delivery to site, erection, commissioning and testing of metering pumps.

2.00.0 GENERAL DESIGN FEATURES

2.00.01 Pumps shall be simplex positive displacement hydraulically operated diaphragm design, driven by squirrel cage induction motor through suitable speed reduction unit. Maximum pump stroke speed shall not exceed 100 per minute.

2.00.02 The stroke shall be continuously adjustable to give a capacity variation 0-100% range while the pump is running or stopped. Adjustment of capacity shall be done by manual control facility (micrometric adjusting type) to be provided locally for each of the pump.

2.00.03 The stroke shall be continuously adjustable to give a capacity variation 0-100% range while the pump is running or stopped. Adjustment of capacity shall be done by manual control facility (micrometric adjusting type) to be provided locally for each of the pump.

2.00.04 Capacity variation may be effected by changing eccentricity of the driving crank or by suitable hydraulic circuit. Pump accuracy shall be industry standard $\pm 1\%$ of capacity setting.

2.00.05 Pumps shall be provided with an integral relief valve, spring operated to release pressure when delivery line blockage occurs.

2.00.06 Crankcase shall be constructed of high quality cast iron, which will also house the gearbox and guides of cross head.

2.00.07 Guided, controlled travel, double-ball check valves or equivalent, shall be provided both on the suction and discharge side.

2.00.08 Material of construction of the various parts shall be as per the details furnished elsewhere in the specification. However all parts coming in contact with acid shall be of Haste alloy 'B' and for alkali it should be of SS-316 only.

2.00.09 Suitable gland seal shall be provided to prevent leakage.

2.00.10 Electric drive motor particulars should follow enclosed electrical chapters.

3.00.00 TESTING

3.01.00 Testing and Inspection at Manufacturer's Works

3.01.01 The manufacturer shall conduct all tests required to ensure that the equipment furnished conforms to the requirements of this Specification and is in compliance with requirements of the applicable codes. The particulars of the proposed tests and the procedures for the tests shall be submitted to Owner for approval before conducting the tests.

3.01.02 The Owner's representatives shall be given full access to all tests for which the Manufacturer shall inform the Owner allowing adequate time so that if the Owner so desires, his representatives can witness the test.

3.01.03 All materials and castings used for the equipment shall be of tested quality. The test certificates shall be made available to Owner.

3.01.04 The pump casing shall be hydraulically tested at 200% pump operating pressure or 150% of design pressure whichever is higher. The test pressure shall be maintained at least for $\frac{1}{2}$ an hour.

3.01.05 The rotating parts of pump drive shall be subjected to static balancing.



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- 3.01.06 All pumps shall be tested at the shop for capacity, volumetric accuracy, repetitive accuracy, power and volumetric efficiency. The tests are to be done according to the requirements of the "Hydraulic Institute" of U.S.A. and Indian Standards as applicable.
- 3.01.07 The pump accessories e.g. gear box, speed reduction unit etc. will be subjected to tests as per manufacturer's standards. The test results shall be furnished to the Owner.
- 3.01.08 The combined variation of the pump and motor should be restricted within limits specified by Hydraulic Institute Standard, USA when the pump operated singly or in parallel.
- 3.01.09 All pumps shall be subject to strip down examination visually to check for mechanical damages after performance testing at shop.
- 3.01.10 Diaphragm of the metering pump shall be type tested as per applicable code/standard.
- 3.01.11 Performance test shall be carried out for the setting of pressure relief valve.
- 3.01.12 Test reports and certificates of all the above-mentioned tests to ensure satisfactory operation of the system shall be submitted to the Owner for approval before dispatch.

3.02.00 Test at Site

After erection at site pumps as detailed under different groups shall be operated to prove satisfactory performance as individual equipment as well as a system. If the performance at site is found to be not to the requirements, then the equipment shall be rectified or replaced by the Vendor at no extra cost to the Owner.



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THIS IS A PART OF TENDER TECHNICAL SPECIFICATION PE-TS-410-155A-A001

SCHEDULE OF DEVIATIONS WITH COST OF WITHDRAWAL



PROJECT:-1X800 MW TSGENCO KOTHAGUDEM TPS
STAGE -VII, PALONCHA

PACKAGE:-CONDENSATE POLISHING UNIT

TENDER ENQUIRY REFERENCE:-

NAME OF VENDOR:-

SL NO	VOULME/ SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATION/ TENDER DOCUMENT	COMPLETE DESCRIPTION OF DEVIATION	COST OF WITHDRAWAL OF DEVIATION	REFERENCE OF PRICE SCHEDULE ON WHICH COST OF WITHDRAWAL OF DEVIATION IS APPLICABLE	NATURE OF COST OF WITHDRAWAL OF DEVIATION (POSITIVE/ NEGATIVE)	REASON FOR QUOTING DEVIATION
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TECHNICAL DEVIATIONS

COMMERCIAL DEVIATIONS

PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE

NAME	DESIGNATIONS	SIGN & DATE

NOTES:

- For self manufactured items of bidder, cost of withdrawal of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.
- For directly dispatchable items, cost of withdrawal of deviation will be applicable on the basic price including taxes, duties & freight.
- All the bidders have to list out all their Technical & Commercial Deviations (if any) in detail in the above format.
- Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of.
- Bidder shall submit duly filled unpriced copy of above format indicating "quoted" in "cost of withdrawal of deviation" column of the schedule above along with their Techno-commercial offer, wherever applicable.
- Bidder shall furnish price copy of above format along with price bid.
- The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.
- Bidders to note that any deviation (technical/commercial) not listed in above and asked after Part-I opening shall not be considered.
- For deviations w.r.t. Payment terms, Liquidated damages, Firm prices and submission of E1/ E2 forms before claiming 10% payment, if a bidder chooses not to give any cost of withdrawal of deviation loading as per Annexure-VIII of GCC, Rev-06 will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of this format submitted with Priced bid, the cost of withdrawal of deviation shall be taken as NIL.
- Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not be accepted.
- All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in unpriced copy of this format.
- Cost of withdrawal is to be given separately for each deviation. In no event bidder should club cost of withdrawal of more than one deviation else cost of withdrawal of such deviations which have been clubbed together shall be considered as NIL.
- In case nature of cost of withdrawal (positive/negative) is not specified it shall be assumed as positive.
- In case of discrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.



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SCHEDULE OF PRE-BID CLARIFICATION

All clarification from the Technical Specification shall be filled in by the BIDDER clause by clause in this format only.

VOLUME	SECTION	CLAUSE NO.	PAGE NO.	SPECIFICATION REQUIREMENT	CLARIFICATION	REASONS FOR CLARIFICATION

PARTICULARS OF BIDDER / AUTHORISED REPRESENTATIVE				
NAME	DESIGNATION	SIGNATURE	DATE	COMPANY SEAL



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COMPLIANCE CERTIFICATE

The bidder shall confirm compliance with following by signing/ stamping this compliance certificate and furnishing same with the offer:

1. The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions/ deviations with regard to same.
2. QP/ test procedures shall be submitted in the event of order based on the guidelines given in the specification & QP enclosed therein.
3. QP will be subject to BHEL/Customer approval in the event of order & customer hold points for inspection/ testing shall be marked in the QP at the contract stage. Inspection/ testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc.
The charges for 3rd party inspection (Lloyds, TUV or equivalent) for imported components shall be included in the base price of the equipment by the bidder.
4. All drawings/data – sheets etc. to be submitted during contract shall be subject to BHEL/Customer review/ approval. GA drawings, as submitted with offer at tender stage are for reference purpose only and shall be subject to approval during contract stage.
5. There are no other deviations with respect to specification other than those furnished in the 'Schedule of Deviations'.
6. The offered materials shall be either equivalent or superior to those specified. Also for components where material is not specified it shall be suitable for intended duty, materials shall be subject to approval in the event of order.
7. The commissioning spares (if any) are supplied on 'As Required Basis' & prices for same included in the base price (If bidders reply to this is "No commissioning spares are required" and if some spares are actually required during commissioning same shall be supplied by bidder without any cost to BHEL).
8. All sub vendors shall be subject to BHEL/CUSTOMER approval.
9. Any special tools & tackles, if required, shall be in bidder's scope.
10. Performance guarantee test parameters shall stand valid till the satisfactory completion of Performance guarantee test and its acceptance by BHEL/Customer.
11. Prices for recommended spares (if any) for three year operation shall be furnished separately and not to be included in the base price.

PARTICULARS OF BIDDER / AUTHORISED REPRESENTATIVE				
NAME	DESIGNATION	SIGNATURE	DATE	COMPANY SEAL



TITLE:
**TECHNICAL SPECIFICATION FOR
 CONDENSATE POLISHING UNIT
 1X800 MW TSGENCO KOTHAGUDEM TPS
 STAGE –VII, PALONCHA**

SPEC NO: PE-TS-410-155A-A001	
VOLUME: III	
SECTION:	
REV NO: 00	DATE:

SCHEDULE OF DECLARATIONS

Icertify that all the technical data and information pertaining to this specification are correct and are true representation of the equipment/system covered by our format proposal number Dated and there is no deviation to the specification.

I hereby certify that I am duly authorized representative of the Bidder's company whose name appears above my signature.

Bidders Company Name

Authorized representative's
Signature

Name

Bidder's Name

The bidder hereby agrees to fully comply with the requirements and intent of this specification for the price indicated.

PARTICULARS OF BIDDER / AUTHORISED REPRESENTATIVE				COMPANY SEAL
NAME	DESIGNATION	SIGNATURE	DATE	

ANNEXURE -A				
1	Total lump sum firm price on FOR site basis for design, engineering, manufacture, fabrication, assembly, inspection / testing at vendor's & sub-vendor's works, painting,mandatory spares alongwith spares for erection,startup and commissioning as required, forwarding, proper packing, shipment and delivery at site,unloading, handling,transportation & storage at site , in site transportation, assembly, erection & commissioning, trial run on FOR site basis preparation and submission of "As Built" drawings and carrying out performance guarantee tests at site etc. inclusive of all prevailing taxes, duties and other levies and handover in flawless condition of CONDENSATE POLISHING UNIT and external regeneration system to the end customer complete with all accessories for the total scope defined as per BHEL tender technical specification (PE-TS-410-155A-A001) for project 1X800 MW TSGENCO KOTHAGUEM TPS,STAGE -VII, PALONCHA			
a)	Bidder to note that total price indicated above at 1 shall be considered for evaluation and hence should be complete in all respect for the full scope defined and considering all terms and conditions agreed.			
b)	In case, price indicated above does not match with item wise break-up given at 2, the highest price so calculated shall be considered for evaluation but in case of order, the same shall be placed at the lowest price.			
2	MAJOR BREAK-UP OF PRICES GIVEN IN 1 ABOVE			
2.1	Total lumpsum firm price for EQUIPMENT (SUPPLY, DESIGN & ENGINEERING) i.e.manufacture, fabrication, assembly, inspection / testing at vendor's & sub-vendor's works, painting,mandatory spares alongwith spares for erection,startup and commissioning as required, forwarding, proper packing, shipment and delivery at site, inclusive of all taxes & duties for the complete scope of supply of CONDENSATE POLISHING UNIT and external regeneration system to the end customer complete with all accessories for the total scope defined as per tender technical specification (PE-TS-410-155A-A001).			
2.2	Total lump sum firm price for all services including unloading, handling,transportation & storage at site , in site transportation, assembly, erection & commissioning, trial run on FOR site basis preparation and submission of "As Built" drawings, etc, required for completion of CONDENSATE POLISHING UNIT as per tender technical specification (PE-TS-410-155A-A001).			
2.3	Price for performance guarantee test and handing over the plant to the customer.			
3.0	Break-up (%) of prices given at SI No-2.1 above (To be used during contract execution for payment).			
3.1	Lumpsum firm price for supply of Service vessels inclusive of all taxes, duties and other levies as applicable.	15% of sl no 2.1 above.		
3.2	Lumpsum firm price for supply of Pressure vessels other than Service vessels inclusive of all taxes, duties and other levies as applicable.	10% of sl no 2.1 above.		
3.3	Lumpsum firm price for supply of Resin inclusive of all taxes, duties and other levies as applicable.	12% of sl no 2.1 above.		
3.4	Lumpsum firm price for supply of Atmospheric tank inclusive of all taxes, duties and other levies as applicable.	6% of sl no 2.1 above.		
3.5	Lumpsum firm price for supply of Low Pressure Valves inclusive of all taxes, duties and other levies as applicable.	7% of sl no 2.1 above.		
3.6	Lumpsum firm price for supply of High Pressure Valves inclusive of all taxes, duties and other levies as applicable.	10% of sl no 2.1 above.		
3.7	Lumpsum firm price for supply of Instruments & Analyser inclusive of all taxes, duties and other levies as applicable.	8% of sl no 2.1 above.		
3.8	Lumpsum firm price for supply of Rotary Equipments (Pumps,Blowers,Agitators etc.) inclusive of all taxes, duties and other levies as applicable.	5% of sl no 2.1 above.		
3.9	Lumpsum firm price for supply of Piping & Fittings inclusive of all taxes, duties and other levies as applicable.	10% of sl no 2.1 above.		
3.10	Lumpsum firm price for supply of Balance items inclusive of all taxes, duties and other levies as applicable.	7% of sl no 2.1 above.		
3.11	Submission & approval of all documents including DCS engineering inputs comprising of following documents as minimum requirement (i.e. O&M Manual, PG test procedure, Recommended control scheme & write-up, Input/output list, Drive List, List of alarm & SOE with set points, Grouping of Instruments, JB details, Graphics/Mimic, Power supply requirement for instruments) & Deputation of vendors Engineer during FAT (at Bangalore) to certify correctness & complete implementation of Control Logic.	10% of sl no 2.1 above.		
Bidder shall furnish this price schedule in his price offer only				
Particulars of bidder / authorised representative				
Name	Designation	Signature	Date	Company seal

ANNEXURE-B			
LIST OF CIF CONTENTS FOR CONDENSATE POLISHING UNIT FOR 1X800 MW TSGENCO KOTHAGUDEM TPS STAGE -VII, PALONCHA			
S.NO.	DESCRIPTIONS	UNIT	TOTAL CIF CONTENT
1)	Resins		