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1x660 MW Unit No. 5, Phase - III

- a) All valves shall be of approved make and type and shall have cast/ forged steel bodies with covers and glands of proven design. 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 Owner.
- 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) **Integral Bypass Valves:**
 - i) The requirement of integral bypass valves shown in P&IDs, is the minimum required. The final requirement shall be worked out, as per process requirement, during detailed engineering.





- ii) If integral bypass valve selected is of size 50 mm Nb and below, then gate or globe type of forged construction with socket weld end as per ANSI B-16.11 shall be provided. For integral bypass valves of size 65 mm Nb and above, only cast steel gate valves with butt weld ends as per ANSI B 16.25 shall be provided.
 - iii) Bypass pipe shall be of seamless construction and thickness corresponding to minimum of schedule 80 and shall be of the same material class as the main pipe.
 - iv) Integral bypass shall be motor operated if main valve is motor operated.
- 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 Owner.
- 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 by Owner.
- 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.

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- 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.



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- 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.
- kk) The control valves and accessories equipment furnished by the Bidder shall be designed, constructed and tested in accordance with the latest applicable requirements of code for pressure piping ANSI B 31.1, the ASME Boiler & pressure vessel code, Indian Boiler Regulation (IBR), ISA and other standards specified elsewhere as well as in accordance with all applicable requirements of the Federal Occupational Safety and Health Standards, USA or acceptable equal standards.

Seat tightness of the HP and LP bypass valves shall be equivalent to block valve tightness conforming to MSS SP61.

The Contractor shall furnish all the control valves under this package as finalized during detailed engineering stage depending on the process requirements. All the control valves provided by the Bidder shall meet the specifications requirements specified herein.





The start-up system control valves and HP & LP bypass control valves shall be proven in same application and shall be as per Owner's approval.

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-III and Annexure-IV of this Section. Valves and Specialties are to be supplied conforming to specified pressure rating.
- b) Carbon steel gate / globe / check valves in size 100 mm and below shall be in accordance with API-602 or any other approved international standards. 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.
- 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.

For L.P. valves the body seat for swing check valves shall be inclined at such an angle as to minimise chatter. For H.P. valves, the seat is straight to take advantage of high fluid pressure for closing.

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-I/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





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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 Owner 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 central control room.
- 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 shall 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





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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 Contractor 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 Contractor 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 Tender drawings. 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





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suitable for direct mounting on condensate Transfer pump suction 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 from Owner.
- 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) **Desuperheaters**

Desuperheaters along with spray water supply and control system shall be provided on the auxiliary steam lines, etc. as required. A desuperheater 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-superheated 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.

l) **CONTROL VALVES**

HP & LP Bypass valves, BFP recirculation valves, Reheater attemperation valve, soot blower control valve and High capacity





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PRDS valve shall be of multi step design. For detail specification of control valves, refer Volume II-E.

6.08.00 Flash Tank

6.08.01 The flash tanks shall be adequately sized to take care of the total drains in the complete power cycle piping system. There shall be sufficient margin to accommodate the possible variation in drain quantities as well as flash steam. Flash tanks shall be designed as per the requirement of ASME Boiler and Pressure Vessels (B&PV) codes, & ANSI standard. The Bidder shall submit design calculation for flash tanks and basis of design parameter selection for Owner's review.

6.08.02 Flash tanks shall be provided into which all recoverable drains from turbine casing, extraction lines, valves, strainers, main steam, CRH and HRH line drains, cascaded drains from heaters etc. shall be led. Number of flash tanks shall as per tender drawings. Requirement /details of various flash tanks are given below:

- i) High pressure (HP) flash tank for accommodating high pressure (above and including hot reheat design pressure) steam drains and HP heater emergency drains, as indicated in the tender drawing.
- ii) Low pressure (LP) flash tank for accommodating low pressure (below hot reheat design pressure) steam drains and LP heater emergency drains as indicated in the tender drawing.
- iii) Atmospheric flash tank to accommodate alternate drains of steam lines, feed water safety valve discharge and aux. steam line drains, as indicated in the tender drawing.

Schedule of materials

Shell and Head - ASTM A 285 Gr.C
Wear Plate/Baffle - ASTM A 285 Gr.C
Nozzle Neck- ASTM A 106 Gr.B
Manhole nozzle flange and cover- ASTM A 285 Gr.C
Couplings - ASTM A 105
Bolts and studs - ASTM A 193 Gr. B7
Nuts - ASTM A 194 Gr. 2 H
Gaskets - Spiral wound SS 316 with graphite

6.08.03 Minimum design pressure and temperature for the flash tanks shall be 3.5 Kg/cm² (g) and 210 deg. C respectively. Flash tanks shall also be designed for full vacuum condition.

6.08.04 Corrosion allowance of 3.0 mm shall be added to the design thickness of the shell and head of the vessels. The minimum thickness of the vessels including corrosion allowance shall not be less than 8 mm.



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- 6.08.05 The flash tanks and manifolds shall be designed to take care of the impact forces due to incoming drains.
- 6.08.06 In case the spray is in manifold, the material for the flash tank manifolds shall conform to ASTM A335 Gr. P22 or better and its thickness shall not be less than SCH 100 of ANSI B36.10 irrespective of temperature of the fluid handled.
- 6.08.07 The temperature in the flash tanks shall be maintained by using condensate/Feed water spray, as the case may be and in whichever case applicable. The spray shall be automatically controlled. However, for flash tanks open to atmosphere continuous spray through an orifice shall also be acceptable.
- 6.08.08 All design parameters shall be subject to Owner's approval.
- 6.09.00 **Metallic Expansion Joints**
- 6.09.01 The expansion joints shall be of metallic multi-bellows construction and shall be used to reduce the reactions (forces and moments) at the connected equipment terminals due to thermal expansion/connection and/or vibration of connected equipment and piping.
- 6.09.02 The design, material, construction, manufacture, inspection, testing and performance of the expansion joints shall comply with the currently applicable requirement of EJMA, Boiler and Pressure Vessel Code Section III, ANSI B-31.1 and all statutes, regulations and safety codes.

a) Material of bellow :

Based on material of bellow, bellows shall be categorized into three category namely Carbon steel, stainless steel (eg. SS304, 316, 321 etc.) & High alloy steel (eg. Inconel).

b) Profile of convolutions:

Each profile shall be considered as separate category (e.g. U profile, V profile & Lyra profile etc.).

c) Dimension of bellows:

Based on the size, the categories shall be as under:

- i) Nominal diameter of metallic expansion joint up to and including 800mm NB.
- ii) Nominal diameter of metallic expansion joint greater than 800mm NB up to & including 1600 NB.
- iii) Each size above 1600mm NB shall be a separate category.





d) Design pressure:

Based on the design pressure, bellows shall be categorized as under:

- i) Design pressure from full vacuum up to 5 kg / sq.cm (g).
- ii) Design pressure above 5 kg / sq.cm(g) and up to 10 kg / sq.cm (g) with or without vacuum.

e) Number of Cycles:

For the life cycle test, the number of test cycles shall be minimum 10,000 cycles.

Other tests for metallic expansion joints shall be carried out as per the approved QP/QA procedure. Further, other terms and conditions for type test shall be as specified elsewhere in the specification.

f) Construction details:

Bel lows:

The bellow shall be hydraulically or roll formed from perfect cylinders of single ply. The number of longitudinal weld seams shall be minimum and there shall be no circumferential weld seam. Cold formed stainless steel bellows shall not be heat treated. All bellow elements shall be pickled after forming. Equalizing rings, where required, shall be either from high quality casting or from fabrication metal. Flanged expansion joints shall be provided with adequate pipe stubs. Butt welded expansion joints shall have adequate length of pipe so that site welding does not impair or reduce the joints efficiency.

Sleeves

Expansion joints will be furnished with internal sleeves of the same material as the bellows and installed with sufficient clearance to allow full rated deflection. The sleeves shall be welded on the flow inlet end of the joint only. Bellow shall have external sleeves with an arrow including the direction of flow on the outside. The external steel covers provided to protect bellows from physical damages, shall be suitable for supporting insulation where necessary and shall be detachable.

Tie bars:

Joints shall be shipped at neutral length. They shall be provided with suitable erection and knock-off type temporary tie bars to prevent damage and misalignment during transit and also with permanent tie bars along with necessary nuts, bolts, etc. The rod on pressure balanced type expansion joints shall be adequately sized to prevent buckling in vacuum services or services other than external loads.

6.09.03 All design parameters shall be subject to Owner's approval.

7.00.00 INSPECTION, TESTING AND INSTALLATION





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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 before the final shop inspection.

7.01.02 Hydrostatic Test

All piping shall be subjected to the hydrostatic test pressure at shop for a duration of 30 minutes (min) as required by the IBR or any other applicable standards. Test pressure shall however be not less than the following :

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 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

All materials shall be of tested quality and the Contractor shall submit the relevant material test certificate for the approval of Owner/Consultant.





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| 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. |
| 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. |
| 7.03.07 | All Control valves shall be tested in accordance with the quality assurance programme agreed between the Owner and Contractor which shall meet the requirements of IBR and other applicable codes mentioned elsewhere in the specifications. The tests shall include but not be limited to the following: |
| | Non destructive test as per ANSI B-16.34. Hydrostatic shell test in accordance with ANSI B 16.34 prior to seat leakage test. |
| | Valve closure test and seat leakage test in accordance with ANSI- B 16.34 and as per the leakage class. |
| | Functional test: The fully assembled valves including actuators control devices and accessories shall be functionally tested to demonstrate times from open to close position. |
| | CV test: CV test shall be carried out as type test on each size, type and design of the valves as per ISA 75.02 standard and test report shall be furnished for Owner's approval. |

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.





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| 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 Contract 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 tests 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 and a half times that of the maximum design/working pressure in the system for a minimum duration of thirty (30) minutes 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 Owner.



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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 Contractor 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 non-destructive testing (NDT) methods shall be employed as per ASME or equivalent standards. 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 Owner. Regarding acceptance of the joints, decision of the Owner 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

Hydro testing 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.





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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 Owner. 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 Owner.

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 Owner.

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/Consultant to meet the guarantee and other technical particulars.

7.08.05 **Testing Requirements**

The detailed testing requirements for power cycle piping and its components are given in the subsection for Quality Assurance(QA) .The requirements pertaining to testing given in this subsection if in variance with that given in QA subsection, then the more stringent of the two shall be followed.

7.09.00 **Installation**

7.09.01 For all steam blowing 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 Owner. 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 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 so that vibrations will be minimised. The Contractor shall



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be responsible for the expansion provisions and flexibility of all field run piping. No piping shall be cold-sprung or cold-pulled.

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.

When C-clamps are tack welded to the pipe for the purpose of alignments of a joint, preheating for the tack welding shall be performed if the main joint adjacent to it to be preheated as per the requirements of this specification, otherwise preheating for the tack weld may be omitted. After the joint is completed, all tack welds shall be removed flushed with the adjacent surface of pipe by chipping and/or grinding. The areas where C-clamps were attached shall be subjected to stress relieving as required.

The hydrostatic testing of the piping system shall be done after proper installation of all permanent hangers supports. Spring hangers shall be locked during hydrostatic test. Prior to steam blowing all hangers which had been locked for the hydrostatic testing shall be unlocked.

The setting and logging of all supports, restraints/limit stop, spring hangers, etc. is the responsibility of the Bidder. The initial setting on all hangers and supports and clearance on restraints and limit stops shall correspond to the design cold values. The Bidder shall check all readings after completion of erection of piping system and application of insulation and carry out readjustment as necessary to be in line with the design cold values. After satisfactory setting of all hangers/restraints, hanger readings/clearances shall be logged by the Bidder in proper format and a joint protocol to be made.

The Bidder shall monitor the behavior of all hangers, supports, restraints etc. during the initial stages of plant operation. When the piping system(s) have attained their rated temperature the Bidder shall log, hanger readings, snubber deflections, restraints / limits stop clearances, as specified elsewhere. All gaskets shall be asbestos free material and suitable for the service application.

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.



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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 and 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 Contractor. 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 Drain pipe 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.

No part of any drain line may be below its terminal point at the condenser, drain collection header or other drain vessel. All drain manifold connections to the condenser or flash tank must be above the maximum water level in the tank.

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 back flow of flashed steam.

Drain line should be connected at a 45 degree angle to the manifold axial centerline with the drain line discharge pointing towards the condenser.

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/Consultant during detailed engineering stage.

Drain pockets of an approved size and construction shall be provided for all steam lines.





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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.

All design parameters shall be subject to Owner's approval.

7.10.00 **Steam Blowing of Piping**

- 7.10.01 Steam blowing shall include engineering, supply and installation of all temporary piping, valves, fittings including quick actuating valves (for puffing purposes), supports, blanking plates, spools, target plates, instruments, controls and all other accessories and services required to complete the cleaning process as specified herein.

- 7.10.02 The detailed schemes and procedure for steam blowing operations shall be prepared and furnished by the Bidder and discussed and finalized during the detailed engineering stage the bidder shall make an estimate based on his experience for the piping system defined below, taking into consideration all temporary piping, consumables etc. required.

- 7.10.03 Steam blowing shall also include reinstatement of cleaned piping systems; and dismantling/removal of all temporary piping, equipment and materials from site. All temporary piping, valves, equipment and materials shall be taken back by the Bidder upon satisfactory completion of cleaning, and shall be removed from the Owner's premises.

- 7.10.04 Engineering involved regarding temporary piping shall include the following:

- i) Selection of temporary piping including disturbance factor calculation.
- ii) Preparation of layout of temporary piping and performing stress analysis as per ASME B 31.1.
- iii) Selection of temporary hangers and supports as required.

- 7.10.05 The following piping systems shall be cleaned through steam blowing operation :

- i) Main steam.
- ii) Hot reheat.
- iii) Cold reheat.
- iv) HP Bypass & LP bypass.
- v) Complete Auxiliary steam system including TG gland sealing lines.





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vi) Steam lines feeding turbines of boiler feed pumps and their exhausts to condenser.

- 7.10.06 Steam blowing shall be carried out for removal of particles (rust, scales, weld splatter etc.) from various piping systems to avoid damage to turbine blade's. Cleanliness of system shall be checked by means of test plates made of steel which will be installed in the centre line of the piping system.
- 7.10.07 Cleaning shall be achieved by steam purging i.e. by blowing of steam through the piping such that the momentum of flow is greater than that of steam flow during normal operation of unit (at MCR).
- 7.10.08 The blow off shall be done with steam which is exhausted through adequately sized, open ended temporary piping. Temporary piping and motor operated valves shall be installed for steam blowing operation. Pressure shall be built up in the boiler and the piping warmed before release of steam by quick opening of motor operated valve located on temporary piping. The cycle shall be repeated until steam from the blow out pipe is determined to be clean.
- 7.10.09 If erected already flow nozzles and control valves etc. shall be removed and replaced by spool pieces before steam blowing. The removed flow nozzle and control valves etc. shall be put back after steam blowing.
- 7.10.10 The motor operated valves used for steam blowing shall have special characteristics like minimum loss of pressure, resistance to wear during grave working conditions (high velocity and carryover of water and solid particles), quick opening time, minimum effort on electric actuator etc.
- 7.10.11 The steam blowing termination criteria will be:
- i) Acceptable target plate condition
 - ii) Measured D.F. (disturbance factor) more than 1.4

The required values to calculate actual D.F. will be measured at site. The criteria for acceptable target plate condition shall be finalized during detailed engineering.

7.11.00 Chemical Cleaning of Piping Systems and Equipments

- 7.11.01 It is intended to chemically clean the following piping system
- i) Boiler feed piping
 - ii) Heater drains piping
 - iii) Main condensate piping



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- iv) Extraction steam piping
- v) The following equipment which form a part of the above system shall also be included in the cleaning operation :
 - a) H.P. Heaters
 - b) L.P. Heaters
 - c) Deaerator
 - d) Gland steam cooler
 - e) Drain cooler

7.11.02 Before introducing chemicals, all the piping systems and equipment listed above shall be water flushed. Water flushing will be followed by alkaline cleaning acid cleaning and passivation.

7.11.03 However, the Bidder shall submit along with the offer his usual procedures and practices for chemical cleaning of the piping and equipment specified. The Bidder shall submit all schematics, write up, details of chemicals to be used etc. and detailed procedures he intends to follow. These schematics and procedures shall be subject to the approval of the Owner.

7.11.04 Pre-Cleaning Procedure: Prior to starting any phase of cleaning operation the following procedures shall be ensured.

- i) Installation of all temporary piping, valves, pumps and equipments as required for the flushing and chemical cleaning operations.
- ii) Temporary piping shall be routed at floor level as far as possible and secured in place to prevent movement vibration beyond acceptable limits.
- iii) Installation of the instruments as required to ensure satisfactory monitoring and control of the cleaning process. The Bidder shall also determine and arrange locations for sampling of the cleaning solution during cleaning.
- iv) Bypassing all regulation/control valves coming in the cleaning circuit or installation of temporary spool pieces.
- v) Installation of special end covers and temporary suction strainers, for boiler feed pumps and condensate pumps. Pump internals shall not be installed.
- vi) Installation of plastic seal in the condenser neck to protect the turbine from alkaline fumes.
- vii) Blocking and securing of all spring hangers in the steam lines which may be flooded during the cleaning operation.

7.12.00 **Surface Preparation & Painting**



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- 7.12.01 Surface preparation methods and paint/primer materials shall be of the type specified herein. If the Bidder desires to use any paint/primer materials other than that specified, specific approval shall be obtained by the Bidder in writing from the Owner for using the substitute material.
- 7.12.02 All paints shall be delivered to job site in manufacturers sealed containers. Each container shall be labeled by the manufacturer with the manufacturer's name, type of paint, batch number and Color.
- 7.12.03 Unless specified otherwise, paint shall not be applied to surfaces of insulation, surfaces of stainless steel/nickel/ copper/brass/ monel/ aluminum/ hostelry/lead/ galvanized steel items, valve stem, pump rods, shafts, gauges, bearing and contact surfaces, lined or clad surfaces.
- 7.12.04 All pipelines shall be Color coded for identification as per the agreed Colour coding scheme, which will be furnished to the Bidder during detailed engineering.
- 7.12.05 Surface Preparation:
- i) All surfaces to be painted shall be thoroughly cleaned of oil, grease and other foreign matter. Surfaces shall be free of moisture and contamination from chemicals and solvents.
 - ii) The following surface schemes are envisaged here. Depending upon requirement any one or a combination of these schemes may be used for surface preparation before application of primer.
 - SP1 Solvent cleaning.
 - SP2 Application of rust converter (Ruskil or equivalent grade).
 - SP3 Power tool cleaning.
 - SP4 Shot blasting (shot blasting shall be used as surface preparation method for hot worked pipes prior to application of primer).
 - SP4* Shot blast cleaning/ abrasive blast cleaning to SA21/2 (near white metal) 35-50 microns.
 - SP5 Phosphating.
 - SP6 Emery sheet cleaning/Manual wire brush cleaning.

Application of Primer/Paint

1. The paint/primer manufacturer's instructions covering thinning, mixing, method of application, handling and drying time shall be strictly followed and considered as part of this specification.





The Dry film thickness (DFT) of primer/paint shall be as specified herein.

2. Surfaces prepared as per the surface preparation scheme indicated herein shall be applied with primer paint within 6 hours after preparation of surfaces.
3. Where primer coat has been applied in the shop, the primer coat shall be carefully examined, cleaned and spot primed with one coat of the primer before applying intermediate and finish coats. When the primer coat has not been applied in the shop, primer coat shall be applied by brushing, rolling or spraying on the same day as the surface is prepared. Primer coat shall be applied prior to intermediate and finish coats.
4. Steel surfaces that will be concealed by building walls shall be primed and finish painted before the floor is erected. Tops of structural steel members that will be covered by grating shall be primed and finish painted before the grating is permanently secured.
5. Following are the Primer/painting schemes envisaged herein:

PS3 Zinc Chrome Primer (Alkyd base) by brush/Spray to IS104.

PS3* Zinc Chrome primer (Alkyd base) by dip coat.

PS4 Synthetic Enamel (long oil alkyd) to IS2932.

PS5 Red oxide zinc phosphate to IS-12744. PS9- Aluminum paint to IS 2339.

PS9* Heat resistant Aluminum paint to IS-13183 Gr.-I (for temperature above 400°C) and to IS-13183 Gr.-II (for temperature 200°C - 400°C)

PS13 Rust preventive fluid by spray, dip or brush.

PS14 Weldable primer-Deoxaluminate or equivalent.

PS16 High Build Epoxy CDC mastic.

PS17 Aliphatic Acrylic Polyurethane CDE134, %V=40.0(min.)

PS18 Epoxy based TiO2 pigmented coat PS19- Epoxy based
Zinc phosphate primer (92% zinc in dry film (min.)),

%VS=40.0(min.). PS20- Epoxy based finish paint.





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6. All weld edge preparation for site welding shall be applied with one coat of weldable primer.

7. For internal protection of pipes/tubes, VCI pellets shall be used at both ends after sponge testing and ends capped. VCI pellets shall not be used for SS components and composite assemblies.

7.13.00 **Broad Guidelines for Erection and Installation of LP Piping**

7.13.01 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.

7.13.02 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 part of work and the Erection contractor is required to carry out such work as per instruction of Bidder/Owner, which shall include specified heat-treatment procedures, etc. also wherever required.

7.13.03 Certain adjustments in length may be necessary while erecting high pressure pipelines and the Erection contractor should remove the extra lengths to suit the final layout after preparing edges afresh and adopting specified heat treatment procedures.

7.13.04 Suspension for piping, pressure parts, etc., will be supplied in running lengths, which shall be cut to suitable sizes and adjusted as required.

7.13.05 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.

7.13.06 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.

7.13.07 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 Owner. Work shall also include fabrication of small bends at site from straight lengths to suit the site conditions.

7.13.08 No temporary supports shall be welded on the pressure parts. Welding of temporary supports, cleats, etc., on the building columns shall also be



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avoided. In case of absolute necessity, Erection contractor shall take prior approval from Owner. Further, any cutting or alteration of member of the structure or platform or other equipments shall not be done without specific prior approval of Owner.

- 7.13.09 Wherever piping erected by the Erection Contractor is connected to piping or equipment erected by some other agencies the joint at the connecting point shall be considered under this specification.
- 7.13.10
- 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 6 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.
- 7.13.11 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.

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**





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- 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 Owner/Consultant 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 Owner/Consultant 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 Owner/Consultant 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



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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.





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Annexure-I

LIST OF POWER CYCLE PIPING

The following list of power cycle piping is an indicative one and is provided for the guidance of the Bidder only. Items not mentioned but deemed necessary by the Bidder for making the system complete, reliable and efficient shall also be included. This shall be read in conjunction with Clause No. 4.00.00 of this section and tender drawings.

Sl. No.	Name	Description
1.	Main Steam lines :	From Superheater outlet to inlet of turbine.
2.	Main steam Equalising line :	Between RHS and LHS main steam lines.
3.	HP By-pass line :	Between Main steam equalising line and Cold reheat line.
4.	Cold Reheat line :	Between HP turbine outlet and Reheater.
5.	Extraction line from CRH :	Between CRH and Deaerator.
6.	Extraction line from CRH :	Between CRH and H.P. heater.
7.	Extraction line from MS equalising line :	From MS equalising line to turbine auxiliary header.
8.	Steam supply to BFP Turbine :	From the main and alternative steam source point to BFP Turbine inlet. Alternative Source of Steam shall be CRH Line and HT Steam Header.
9.	Extraction from BFP discharge :	Between BFP discharge and H.P. By-pass PRDS.
10.	Warm up line for HP By-pass :	Between MS line and H.P. By-pass line.
11.	Hot Reheat lines :	Between Reheater and I.P turbine.
12.	HR equalising line :	Between LHS and RHS Hot Reheat lines.
13.	LP By-pass line :	Between HR line and condenser.
14.	Warm up line for LP By-pass :	Between LP By-pass line and HR line.
15.	CEP Suction line :	Between condenser hot well and CEP.
16.	Main condensate line :	Between CEP outlet and Deaerator, through GSC, CPU, DC, L.P. heaters.
17.	CEP Minimum Recirculation :	Between main condensate line after CEP to



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	line		condenser.
18.	GSC Minimum Recirculation line	:	Between main condensate line after GSC to condenser.
19.	Deaerator filling line	:	Between Condensate Transfer pump discharge and deaerator.
20.	Boiler filling line	:	Between Condensate Transfer pump discharge and Boiler bottom ring header / economiser inlet.
21.	Fill up and Emergency	:	From Condensate Transfer pump discharge to make-up to condenser.
22.	DMCW make-up tank	:	From Cycle make-up pump discharge to DMCW make-up tank.
23.	Gravity Make-up to condenser	:	From condensate storage tank to condenser.
24.	Condensate Dump Line	:	Between M.C. line after GSC and condensate storage tank.
25.	Cycle make-up (DMSW) Pump Recirculation	:	Between Cycle make-up pump discharge header and suction header.
26.	Cycle make-up (DMSW) Pump Suction Line	:	From condensate storage tanks to Cycle make-up pump suction header.
27.	By-pass line	:	For all control valves
28.	By-pass lines for heaters	:	GSC, LP Heaters and HP Heaters.
29.	CEP sealing line	:	Bidder's choice.
30.	All extractions from main condensate line	:	For : <ul style="list-style-type: none"> a) Exhaust Hood spray. b) Turbine Flash Tank spray. c) L.P. By-pass spray. d) Water sealing of valves. e) Vacuum breaker line sealing. f) CEP sealing. g) Analytical measurements.





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- h) Alkali flushing.
 - i) Spray water to GSC desuperheater.
 - j) Sampling.
 - k) Instrument seal pot.
 - l) Water sealing of valves & water Washing of BFP Turbine.
 - m) Make up to Vacuum Pumps.
 - n) Spares.
31. Turbine flash tank drain and vent line : From turbine Flash Tank drains to condenser hot well.
From flash vessels vent to condenser steam space.
32. BFP Suction line : Between Deaerator and BFP suction.
33. Main Feed Water Feed Line : From BFP discharge through HP heaters, control station up to economiser inlet header.
34. Steam turbine drive for BFP : Associated piping.
35. Inlet line to attemperation water header : From main feed water line to attemperation water header.
36. Extraction from BFP : From BFP suction to sample cooler suction, BFP worm up and balance Leak-off line.
37. All extraction from Main Feed Water line :
 - a) To Auxiliary Steam pressure reducing desuperheating station.
 - b) Stub for alkali flushing.
 - c) HP By-pass spray.
 - d) Blind Stub.
 - e) Minimum recirculation lines.
38. Extraction lines : From various stage of turbine / CRH to L.P. Heaters, H.P. heaters, Deaerator and BFP Turbines.
39. All vents of H.P and L.P. heaters :
 - a) L.P. Heater vents to Condenser.





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|-----|--|----|---|
| | | b) | H.P. Heater vents to Deaerator / condenser. |
| 40. | All cascade drain connection between heaters : | a) | From each HP Heater to next lower pressure HP Heater. |
| | | b) | The lowest pressure H.P. Heater to Dearator. |
| | | c) | From each L.P. Heater to next lower pressure L.P. heater |
| | | d) | The lowest pressure L.P. heater to flash vessel through drain cooler. |
| 41. | All Drip connections to Flash Tanks : | a) | From all HP heaters. |
| | | b) | All LP Heaters (except the Lowest Pressure LP Heater) |
| | | c) | From Gland Steam Condenser (GSC). |
| 42. | Air Steam mixture line from turbine Glands : | a) | To GSC. |
| | | b) | To Atmosphere. |
| 43. | Vapour extraction line for GSC : | | From GSC through vapour extractors to atmosphere. |
| 44. | By pass Line to GSC : | | Through desuperheater to atmosphere. |
| 45. | Air steam mixture line from condenser : | | To vacuum pumps. |
| 46. | Drip connections to Deaerator: | | From H.P. Heaters. |
| 47. | Connections for air outlet from vacuum pump : | | For vacuum pumps to atmosphere. |
| 48. | Steam connection to Auxiliary steam header : | | From final superheater outlet. |
| 49. | High Temperature Auxiliary Steam Header : | | One for the unit with interconnection to phase - II. |
| 50. | Auxiliary Steam from High Temperature Header : | a) | To Gland steam pressure reducing unit |
| | | b) | For mill inerting (if required). |





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- c) For soot blowing.
- d) For BFP drive turbine.
- 51. Low Temperature Auxiliary Steam Header : One for the unit with interconnection to Phase – II
- 52. Auxiliary Steam from Low Temperature Header :
 - a) For Deaerator pegging
 - b) For atomising
- 53. Extraction line from CRH line : From CRH line to auxiliary steam header.
- 54. Condensate surge tank outlet : From condensate surge tank to line condenser hotwell.

- Note :**
1. Steam Blowing pipelines including target plates for MS, HR and CR lines etc. shall be included.
 2. Chemical cleaning pipelines shall be included.
 3. For scope of auxiliary steam line to new HFO heater, HFO pressurizing suction and discharge piping within Fuel oil Pressurizing pump house, please refer tender drawing no. 12A05-DWG-M-001N. Similarly, for scope of HFO & LDO piping in boiler island, the same drawing can be referred.





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Annexure-II

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°C	Carbon Steel, ASTM A-106, Gr. B or C Seamless. ASTM A-105/ A-234 WPB/WPC.
ii) Temp. Above 410 °C to 510 °C	Alloy Steel, ASTM A-335,P11. ASTM A-182 F11; A-234 WP11.
iii) Temp. Above 510°C to 540°C	Alloy Steel, ASTM A-335, P22/P91, ASTM A-182 F22/F91; A-234 WP22/91.
iv) Temp. Above 540 °C to 600°C	Alloy Steel, ASTM A-335, P91/ P92 or ASTM A-182 F91/F-92; A-234 WP91/92.
v) Temperature above 600°C	Austenitic stainless steel, Super 304H, TP 347H. For Corrosive application – Rubber-lined Stainless Steel / Stainless Steel to 304L, 316L or approved equivalent.





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Annexure-III

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	ASTM A-182, Gr. F6a - min. hardness 200 HB
ii) Temp. Above 410 °C to 510°C	65 mm & above	ASTM A-217, Gr. WC6	- Do -
	50 mm & below	ASTM A-182, Gr. F11	- Do --
iii) Temp. Above 510 °C to 540 °C	65 mm & above	ASTM A-217, Gr. WC9	
	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	
	50 mm & below	ASTM A-182, Gr. F91/F92	

Note : Non-return valves in corrosion service shall be swing check type, suitably lined.





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Annexure-IV

MATERIALS OF CONSTRUCTION FOR CONTROL VALVES

Materials for Control Valves shall be equivalent/superior to the following:

Sl. No.	Service	Body Material	Trim Material
1	Non-corrosive, non-flashing and non-cavitation service below 275°C. like Aux. steam flow to deaerator, Condensate flow to deaerator, CRH flow to deaerator etc.	Compatible with piping material	SS-316 with stellite faced guide posts and bushings.
2	Severe flashing/ cavitation services like HP Heaters and LP Heaters, emergency drain, Deaerator overflow drain to hotwell etc.	Alloy steel as per ASTM A 217 Gr. WC9	400 series SS or equivalent to suit the specific requirement
3	Low flashing/ cavitation service like HP Heater/ LP Heater normal drains level control, GSC minimum flow, Gland seal steam pressure control valve etc.	Alloy steel as per ASTM A 217 Gr. WC6	400 series SS or equivalent to suit the specific requirement
4	Condensate service below 300°C. like condensate normal and emergency make-up control, DMCW DP control	SS-316	SS-316

Note : Valve body rating shall meet the process pressure and temperature requirements as per ANSI B16.34.





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**TECHNICAL SPECIFICATION
FOR
LOW PRESSURE PIPING, VALVES AND SPECIALTIES**



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SECTION-VI

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 terminated at hose valves for general house-keeping on the different floors of Power House Building, boiler floors, mill reject system and other auxiliary buildings of Main Plant. Distribution scheme shall also include some continuous and intermittent requirement of boiler and Turbine-generator islands and other BOP area buildings such as CW-ACW pump house, Vacuum pump house, CW treatment building, FGD & SCR areas. Both service air and instrument air will be supplied from the existing compressor house, where new compressors of Phase-III shall be installed.
- 1.02.00 Instrument Air System - shall comprise of distribution of instrument quality air to pneumatically operated instruments/ valves/dampers of the Main Power House Building, boiler, mill reject system and other auxiliary buildings inside plant area.
- 1.03.00 Demineralised Water -supply system including hot well make-up water piping from condensate storage tank, suction to different pumps and distribution to different consumption points.
- 1.04.00 Demineralised Water closed cycle cooling system.
- 1.05.00 Service water (clarified quality) - including supply to overhead Service Water (SW) tank in Power house from Tie-in-Point near unit#4 power house building and from tank to different distribution points of the Main Power house and other auxiliary buildings.
- 1.06.00 Potable water system (filtered & chlorinated water) including supply to overhead potable tank of Power House building, from Tie-in-Point near unit#4 power house building and from tank to different distribution points of the Power House Building and other auxiliary buildings.
- 1.07.00 Air Preheater wash water system including supply of Clarified water from Tie-in-Point near unit #4 to APH wash point of Unit #5, Phase-III and one pipe line (250 NB) from existing APH wash pump discharge header in clarified water pump house in PT area of Phase-I to enable operation of both existing APH wash pumps. This pipe shall be run on existing pipe rack.



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- 1.08.00 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) |
| 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. |



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- 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.





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- 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 as per approved P &ID during detail engineering stage.

3.04.00 **Tie-in Points with Phase-II**

Tie-in points for different systems will be as indicated below:

i) DM Water Transfer System

DM Water Transfer pump discharge line, capable of feeding both Phase-II & Phase-III is extended upto Condensate Storage tanks (CST) of unit #3 & #4 of Phase-II. The discharge line is terminated with an isolation valve. Suitable extension of piping from this tie-in point to inlet of CST of Phase-III will be done.

ii) Potable Water System

Potable water pump discharge line, capable of feeding both Phase-II & Phase-III is extended upto Potable water storage tanks on power house of unit #4 of Phase-II. The discharge line is terminated with an isolation valve. Suitable extension of piping from this tie-in point to the inlet of potable water storage tank of Phase-III will be done.

iii) Service Water System

Service water pump discharge line, capable of feeding both Phase-II & Phase-III is extended upto Service water storage tanks on power house of unit #4 of Phase-II. The discharge line is terminated with an isolation valve. Suitable extension of piping from this tie-in point to the inlet of service water storage tank of Phase-III will be done.

iv) APH wash System

APH Wash pump discharge line, is extended upto Air pre-heater of unit #4. The discharge line is terminated with an isolation valve. Suitable extension of piping from this tie-in point to be done upto APH of Phase-III. Another extension pipe line (250 NB) from existing APH



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wash pump discharge header in clarified water pump house in PT area of Phase-I to APH of Phase-III to be implemented.

v) Instrument Air System

Instrument air line of Phase-III shall be interconnected with instrument air header of Phase-II near existing plant air compressor house. Further, IA ring header of Phase-III power house shall have interconnection with that of power house Phase-II.

vi) Service Air System

Service air line of Phase-III shall be interconnected with service air header of Phase-II near existing plant air compressor house. Further, SA ring header of Phase-III power house shall have interconnection with that of power house Phase-II.

vii) Cooling water supply & return lines

DMCCW supply and return header of Phase-II inside compressor house shall be extended to cater the cooling water requirement of IA & SA compressors and dryers of phase-III.

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 respect and in accordance with the highest standard of workmanship. Any item of the section on which the bidder is in doubt shall be referred to the Owner for clarification.
- 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.



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- 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**
- All pipes above 50 NB shall have butt-welded connections as per ANSI B 16.25 with a minimum of flanged joints necessary for maintenance. Piping of sizes 50 NB and below shall have socket welded connections as per ANSI B 16.11. 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,



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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 bidder 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 Beveling**
- a) Carbon steel piping - End preparation for butt welding shall be done by machining/flame 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



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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. The valves shall be provided with electric motors/solenoids and actuators as required.
- 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 bidder'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.



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- 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 valves of 300 mm size and above.
 - 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.



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- 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.



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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 **BROAD GUIDELINES FOR ERECTION AND INSTALLATION OF LP PIPING**

5.01.00 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.

5.02.00 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 part of work and is required to carry out such work as per instruction of Owner,



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which shall include specified heat-treatment procedures, etc. also wherever required.

- 5.03.00 Certain adjustments in length may be necessary while erecting high pressure pipelines and the bidder should remove the extra lengths to suit the final layout after preparing edges afresh and adopting specified heat treatment procedures.
- 5.04.00 Suspension for piping, pressure parts, etc., will be supplied in running lengths, which shall be cut to suitable sizes and adjusted as required.
- 5.05.00 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.
- 5.06.00 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.
- 5.07.00 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.
- 5.08.00 Welding of temporary supports, cleats, etc., on the building columns shall also be avoided. In case of absolute necessity, Erection bidder shall take prior approval from Bidder/Owner. Further, any cutting or alteration of member of the structure or platform or other equipments shall not be done without specific prior approval of Owner.
- 5.09.00 Wherever piping erected by the Erection Bidder is connected to piping or equipment erected by some other agencies the joint at the connecting point shall be considered under this specification.
- 5.10.00 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.



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- c) Piping shall be routed above ground unless otherwise specifically indicated/ approved by the Owner. 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 6 meters above roadways unless otherwise approved by the Owner.
- 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 Tenders drawings or not. The pipelines shall be sloped towards the drain points.

5.11.00 All drips and drains for piping and equipment whether shown in the Tender 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 Bidder.

6.00.00 **DRAWINGS, DATA, INFORMATION & MANUALS**

6.01.00 Drawings, data, Information to be furnished by the Bidder besides those already mentioned in volume : IIA with the offer.

6.01.01 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.

6.01.02 A complete list of all valves with their type, quantities & ratings.

6.01.03 Manufacturer's catalogue indicating complete range of available size and rating of pipes & fittings.

6.01.04 Descriptive literature on the manufacturing process and quality control procedures highlighting the manufacturing, fabricating and testing facilities available in the shop.

6.02.00 **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.

6.02.01 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.



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- 6.02.02 General arrangement drawing for each hanger/support/anchor etc. indicating identification number, auxiliary supporting structural details, other details & information as required in the specification.
- 6.02.03 Wiring diagram for all limit switches of motor operated valves.
- 6.02.04 The loading data required for design of structures shall be furnished well in advance to suit Purchaser's time schedule.



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ANNEXURE-I**SPECIFICATION OF PIPES FOR DIFFERENT SERVICES**

	A		B		C	D
Services	1. Clarified Water piping		1. Drinking/ Potable Water Supply, piping (Clarified water, chlorinated)		1. Demineralised Water, DMCW piping, Service and Instrument Air Piping less than and equal to 50 NB	1. Demineralised Water, 2. DMCW piping, Service and Instrument air piping for sizes equal to greater than 65 NB
1.00.00 Material of Pipe	Carbon Steel IS-1239 Heavy Grade upto 150 NB and IS-3589 for sizes above 150 NB with minimum pipe thickness of 6 mm.		Carbon Steel as per IS-1239 Heavy Grade for sizes upto 150 NB and IS-3589 for sizes above 150 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. Thickness- as per schedule 40S, ANSI B36.19	Stainless Steel as per ASTM A-312 Gr. 304. Thickness- as per schedule 10S, as per ANSI B36.19
2.00.00 Construction	ERW / Seamless		ERW / Seamless		Seamless	ERW
3.00.00 Joints	Slip-on Flange and butt weld for size 65 NB and above and Socket weld joint for size 50 NB and below.		Screwed flange for sizes 65 NB and above and screwed for size 50 NB and below. Pipe to pipe joint shall be with union as per IS:1239, Part-II.		Socket welded for size 50 NB and below	Slip-on flange and butt weld joint.
4.00.00 Fittings	Pipe Sizes > = 65 NB	Pipe Sizes < = 50 NB	Pipe Sizes > = 65 NB	Pipe Sizes < = 50 NB		



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	A		B		C	D
Services	1. Clarified Water piping		1. Drinking/ Potable Water Supply, piping (Clarified water, chlorinated)		1. Demineralised Water, DMCW piping, Service and Instrument Air Piping less than and equal to 50 NB	1. Demineralised Water, 2. DMCW piping, Service and Instrument air piping for sizes equal to greater than 65 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 galvanised as per IS-4736	ASTM-A-182 F304	ASTM-A-351-CF8 or ASTM-A-403 WP304
4.02.00 Construction	Welded/ Seamless	Forged	Welded/ Seamless	Forged	Forged	Welded/Seamless
4.03.00 Standard	ANSI-B-16.9 for Butt welding fittings and fabricated fitting AWWA-C-208	ANSI-B-16.11 or IS:1239, Part-II	ANSI-B-16.9	ANSI-B-16.11 or IS:1239, Part-II	ANSI-B-16.11	ANSI-B-16.9
4.04.00 End details	Pipe size >=65 NB Bevel ended as per ANSI-	Pipe size <=50 NB Socket welded as per ANSI-B-	Pipe size >=65 NB Screwed Flanged	Sizes <=50 NB Screwed socketed as per ANSI-B-16.11.	Socket welded as per ANSI-B-16.11	Bevel ended as per ANSI- B-16.25



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	A		B		C	D
Services	1. Clarified Water piping		1. Drinking/ Potable Water Supply, piping (Clarified water, chlorinated)		1. Demineralised Water, DMCW piping, Service and Instrument Air Piping less than and equal to 50 NB	1. Demineralised Water, 2. DMCW piping, Service and Instrument air piping for sizes equal to greater than 65 NB
	B-16.25	16.11				
5.00.00 Flanges	150 lb (min) class as per ANSI-B-16.5 complete with nuts, bolts and gaskets		As per ANSI-B-16.5 pressure class 150lbs (min) - galvanised-complete with nuts, bolts and gaskets.		As per ANSI-B-16.5 pressure class 150lb (min) complete with nuts, bolts and gaskets. Material as per class 4.01.00.	150lb (min) 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 Vol.: II-A.						



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ANNEXURE-II

SERVICES OF VARIOUS CATEGORIES OF VALVES

Valve Classification		Service	
A.	Cast iron body Gate/Globe/Check Valve	i) Service Water ii) Clarified Water iii) Drinking/ Potable Water	For sizes 65 NB and above.
B.	Stainless steel body/ Gate/Globe /Check/Ball Valve	i) For Demineralised water ii) Service and Instrument Air iii) Inhibited Demineralised Water	For all sizes For all sizes. Ball valves to be used in air line. For all sizes
C.	Steel Body valves	i) Service Water ii) Clarified Water iii) Drinking/ Potable Water	For sizes less than and equal to 50 NB
D.	Cast Iron body butterfly valve	i) Service Water ii) Clarified Water iii) Filtered Water	For butterfly valve specification refer Annexure II, Sec.V of Vol. II-J1.



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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	SSGC	STGC
2.00.00	Basic Design Code			
	a) Gate	a) i) IS 780 for 50 mm - 300 mm NB ii) IS2906 for 350 mm NB and above or as per MSS-SP-70	a, b, c) ANSI-B-16.34	i) API 600 for 50mm ii) API 602 for size
	b) Globe	b) MSS - SP - 85		b) BS-1873/ANSI-B-16.34
	c) Check	c) IS-5312/MSS - SP -71		c) BS-1868/ANSI B16.34
	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	Cast body and bonnet / cover	Forged body up to 50 NB	Forged body up to 50 NB and



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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
5.00.00	Material		and Cast body above that	Cast body above that
5.01.00	Body & Bonnet/ cover	IS 210 Gr. FG 260 or ASTM A216 Class B.	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
5.02.00	Trim / Disc.	IS-210 Gr. FG 260 or ASTM A216 Class B.	ASTM-A-182 F304 for Gate, Globe, Check valves and 351CF8M 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	For Ball valves PTFE seats and seals.	13% Cr. Steel as per ASTM-A-182 Gr. F6
6.00.00	End Preparation	Socket welded for size equal to and below 50 NB and flanged with counter flanges for 65 NB and above.		



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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
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	As per ANSI B-16.34	API-598
	b) Globe	Hydrostatic Test as per MSS-SP-85		BS-1873
	c) Check	IS-5312/MSS-SP-71		BS--1868



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TITLE:

**1 X 660 MW SAGARDIGHI TPS UNIT NO. 5
PHASE III**

**TECHNICAL SPECIFICATION FOR
CONDENSATE POLISHING UNIT**

SPECIFICATION NO. PE-TS-445-155A-A001

SECTION : II

SUB-SECTION: IIA

REV. NO. 00

DATE : 10.05.2021

**TECHNICAL SPECIFICATION FOR
HORIZONTAL CENTRIFUGAL PUMPS**



TITLE:
1 X 660 MW SAGARDIGHI TPS UNIT NO. 5
PHASE III

SPECIFICATION NO. PE-TS-445-155A-A001

SECTION : II

TECHNICAL SPECIFICATION FOR
CONDENSATE POLISHING UNIT

SUB-SECTION: IIA

REV. NO. 00

DATE : 10.05.2021

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.

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.



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1 X 660 MW SAGARDIGHI TPS UNIT NO. 5
PHASE III

SPECIFICATION NO. PE-TS-445-155A-A001

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- 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

- 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 at least 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.

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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.

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

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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.


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

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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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TITLE:

**1 X 660 MW SAGARDIGHI TPS UNIT NO. 5
PHASE III**

**TECHNICAL SPECIFICATION FOR
CONDENSATE POLISHING UNIT**

SPECIFICATION NO. PE-TS-445-155A-A001

SECTION : II


SUB-SECTION: IIA

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TECHNICAL SPECIFICATION FOR METERING PUMPS

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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

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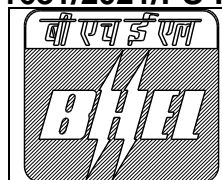
codes. The particulars of the proposed tests and the procedures for the tests shall be submitted to Owner for approval before conducting the tests.

- 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 ½ 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, 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 BHEL/ Owner.

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TECHNICAL SPECIFICATION FOR PRESSURE & STORAGE VESSEL

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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 vessels.
2. Condensate Polisher Resin Separation and Cation Regeneration vessel.
3. Condensate Polisher anion regeneration vessel.
4. Condensate Polisher 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 Hopper
10. Acid Measuring Tank.
11. Acid Storage Tank
12. DM storage tank.
13. Alkali storage tank

1.01.00

Of these, the items specified from Sr. no. 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) minimum or as per system design whichever is higher.


2.01.02

Design of all vertical cylindrical atmospheric storage tanks containing water, acid, alkali and

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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.
- 2.01.06 The design of Demineralised water storage tanks (Vertical type) shall conform to IS: 803. Supporting frame where required shall be in accordance with IS: 800. The tank shall be "Non-pressure" fixed roof type with atmospheric vents.
- 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 / tanks ends shall be of dished design and 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 30 cm or 10% of vessel height above the "Level High"/"Normal Level" for all the tanks except for the DM tanks for which a minimum height of 300 mm shall be provided over the "High Level". Further, a minimum 300 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 All pressure vessels shall be fabricated from carbon steel plates as specified in datasheet A

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of this specification and lined internally. All atmospheric tanks shall be fabricated of material as specified in datasheet A and lined internally.

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 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.

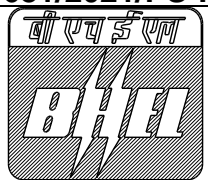
4.04.00 **Vessel Internals**

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.

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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 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, 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)**

Hot water tank for heating of alkali diluent water with (2X60%) electric heating coil, of MOC as specified in sub section –IA of this specification shall be provided by bidder. 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 heaters shall be sized for heating the water from a temperature of 15 to 50 deg. C in 5 hours at the outlet of ejector.

All tank internals, including the inlet water tail pipe, shall be fabricated of type 304 stainless steel.

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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.

b) **Material**

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

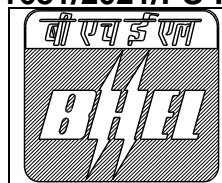
5.05.00 **LINING**

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 or 65 on the A scale, or semi-hard rubber having a durometer reading of 65 on the A 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**



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The lining material shall be suitable for prolonged service in the chemical environment described below:

- Hydrochloric acid, 2 to 8% concentration, at temperature from 10 deg C to 50 deg C.
- Sodium hydroxide, 1 to 4% concentration, at temperature from 30 deg C to 50 deg 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.
- 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.

- Degrease surface prior to blasting.
- The surface is to be blasted with steel grit or sharp silica sand to a white and bright metal surface.
- 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.
- 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**

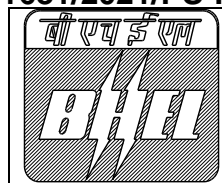
After the lining is completed the vessels shall not be subjected to any prolonged exposure to direct sunlight in course of its transportation erection, etc. They shall not also be stored in direct sunlight. No further welding or burning shall be carried out on the vessel, after application of the lining.

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.

Example:

“Warning – Tank is lined”



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“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

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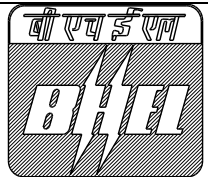
7.01.00

The vessel ends for storage tanks of vertical type shall have flat 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

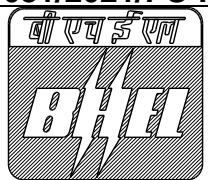
The plates to be used for fabrication shall preferably have a minimum width of 1500 mm.

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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. Contractor shall indicate in his drawing the sequence of welding proposed by him which should meet prior approval of the engineers. 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 (DM) water 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 Owner 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 Contractor shall provide these fittings to match with the Owner'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 conforms to 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.

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- 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.
- 7.08.04 Various instrumentation and the fittings required for the same shall be supplied as elaborated in data sheets.
- 7.08.05 Water seal shall be provided for the overflow line of DM and degassed water storage tanks. 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.
- 7.08.06 Conservation vent valves shall be provided in the vent line of DM storage tanks so that, at a vacuum to the extent of 65 mm water column, the valve shall open to relieve the vacuum. Body and trim of the valve shall be Die Cast Aluminum.

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TECHNICAL SPECIFICATION FOR VERTICAL CENTRIFUGAL PUMPS

1.00.00

GENERAL INFORMATION

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1.01.00 The general guidelines as illustrated in the subsequent clauses of this section shall be applicable for vertical pumps to be procured under the scope of this package.

2.00.00 CODES AND STANDARDS

2.01.00 In addition to the requirements spelt out elsewhere in the specification, the equipment to be provided under this section shall specifically conform to the following codes, standards, specifications and regulations, as applicable, including all the latest amendments subsequent to the year of publication as mentioned below.

2.01.01 IS 1710/1989: Vertical Turbine Pumps for Clear, Cold and Fresh Water.

2.01.02 IS 5120/1977: Technical requirements - Rotodynamic special purpose pumps.

2.01.03 IS 5639/1970: Pumps for handling chemical and corrosive liquids.

2.01.04 IS 5659/1970: Pumps for process water.

2.01.05 IS 6536/1972: Pumps handling volatile liquids.

2.01.06 IS 9137/1978: Code for acceptance for centrifugal, mixed flow and axial
Flow pumps - Class 'C'

2.01.07 BS 5316: Acceptance tests for Centrifugal, mixed flow Part-I/1976 And axial flow pumps - Class 'C' Tests (ISO 2548/1973)

2.01.08 BS 5316: Acceptance tests for Centrifugal, mixed flow Part- II/1977 And axial flow pumps - Class 'B' Tests (ISO 3555/1977)

2.01.09 ANSI B 73.2M : Vertical inline centrifugal pumps for chemical process 1984

2.01.10 API 610/1989: Centrifugal pumps general refinery services.

2.01.11 Hydraulic Institute Standards of USA (1983).


2.01.12 PTC 8.2/1965: Power Test Codes - Centrifugal pumps.

3.00.00 Accessories:

All the pumps under this specification shall be complete with following standard/special accessories.

3.01.00 Standard accessories:

- a) Pump motor coupling along with coupling guard
- b) Common base plates for pump and motor.
- c) Lubrication system along with all internal piping, valves, fittings, specialties etc. as required.
- d) Counter flanges for suction/ discharge nozzles along with fixing nuts, bolts and gaskets.
- e) Anchor bolts, nuts, seating steel works, etc. as necessary for mounting the pump-motor unit on Civil foundations.
- f) Suitable vent (with valves)/ lifting/ handling attachments for the pump/ motor/ Accessories.
- g) Suitable drain connections with isolating valves as applicable.
- h) Set of "Special" Tools & Tackles for Pumps and motors, if any.
- i) Erection and commissioning spares, "on as required" basis.

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- j) Bidder shall provide various drawings, data, calculations, test reports/ certificates, Operation and maintenance manuals, As-built drawings, etc. as specified and as necessary.

3.02.00 Services included in Bidder's Scope:

3.02.01 The pumps shall be guaranteed to meet the performance requirements as specified vide datasheet – A and also for trouble free operation after commissioning.

4.00.00 TECHNICAL REQUIREMENTS:

4.01.00 The pumps shall be Electric motor driven.

4.02.00 The Pumps shall conform to HIS

4.03.00 Vertical type pumps with 1500rpm.

4.04.00 Minimum efficiency of vertical pump will be 40%.

4.05.00 No negative tolerance shall be permitted in rated capacity & TDH.

4.06.00 No negative tolerance shall be permitted in efficiency at rated capacity.

4.07.00 The shut off head of pumps shall be at least 115% of pump rated TDH.

4.08.00 The pumps shall be capable of developing the required total head at rated capacity for Continuous operation. The pumps shall operate satisfactorily at any point on the Q-H Characteristic curve over a range of 0% to 130% capacity and shall be suitable for Continuous operation between 30% to 130% capacity.

4.09.00 Selection of the pumps shall be such that the design point shall be met even with negative manufacturing tolerance.

4.10.00 The total head capacity curve shall be continuously rising towards the shut off, the pumps shall preferably be non-overloading type and stable.

4.11.00 The pumps shall be capable of running over the entire range of NPSH conditions required without any noise, vibration or cavitation.


4.12.00 The pumps shall be of stiff shaft design. The minimum internal clearances should be sufficiently more than the max. Static deflection of the shaft. Shaft size selected must take into consideration the critical speed as specified in API-610.

4.13.00 Pumps and motors shall run smooth without undue noise and vibration. The vibration shall be within 75 microns for pump - motor set. The noise level shall be limited to 85 dB at distance of 1.0M.

4.14.00 High reliability of the pumps is an essential requirement and therefore it gets weight age over its efficiency. It is therefore essential that the bidder choose a standard proven model from the range of pumps manufactured.

4.15.00 If water handled by pump is dirty/ not suitable for lubrication/ cooling, the bidder shall provide requisite strainer/ filters, tanks, motorized valves, etc. after the tap off for the required service, the arrangement provided shall be subject to Purchaser's approval.

5.00.00 OTHER REQUIREMENTS:

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5.01.00 The materials of construction for various components specified are the minimum Requirements indicated in datasheet – A section C and materials of construction for other components not specified shall be similarly selected by the bidder for the intended duty.

6.00.00 PAINTING FOR PUMPS:

- a) The surface of SS, Gun metal, brass, bronze and non-metallic component shall not be applied with any painting.
- b) The Steel surface to be applied with painting shall be thoroughly cleaned before applying painting by brushing, shop blasting etc. as per the agreed procedure.

For all the steel surfaces inside the (indoor installation) building, a coat of red oxide primes of min. thickness of 50 microns followed up with under coat of Synthetic Enamel paint of min. thickness of 50 microns shall be applied. the top coat shall consist of two coats each of min. thickness of 50 microns of synthetic enamel paint and thus total thickness shall be min. 200 microns.

7.00.00 PERFORMANCE REQUIREMENTS

- 7.01.00 Pump (s) shall preferably be designed to have the best efficiency at the specified duty point. Further, the pumps (s) shall be suitable for continuous operation at any point within its 'range of operation'.
- 7.02.00 Under all circumstances, the 'range of operation' of the pump (s) shall exclude any Unstable operating zone of the head-capacity curve.

8.00.00 DESIGN AND CONSTRUCTION

Pumps shall be of vertical shaft, complete with bowl, column pipe, discharge head and base plate with all accessories. General design and constructional features of the pumps shall be as follows:

8.01.00 BOWL ASSEMBLY

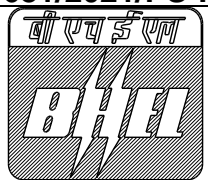
- 8.01.01 This will be either a single, mixed flow or axial flow type with discharge co-axial with shaft. Type of impeller shall be chosen on the basis of the pump specific speed and the characteristics of handling fluid.

8.02.00 IMPELLER SHAFT, LINE SHAFT AND HEAD SHAFT

- 8.02.01 Shaft size shall be selected on the basis of maximum torque to be applied on the pump shaft. Critical speed of the shaft shall be sufficiently away from the pump operating speed and in no case shall lie between 90% and 110% of the rated speed.
- 8.02.02 Impeller shaft shall be guided by bearings provided in each bowl or above and below the impeller shaft assembly. The butting faces of the shaft shall be machined square to the assembly and the shaft shall chamfer at the edges.
- 8.02.03 Line shaft may be single or multiple pieces as required. In case of multiple pieces, line shaft shall be coupled as per the standard practice of the manufacture. For screwed coupling, directions shall permit tightening of the joint during pump operation.
- 8.02.04 Replaceable shaft sleeves shall be furnished at applicable location, particularly under stuffing box and at other locations, as considered necessary.

8.03.00 BEARINGS

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8.03.01 **SHAFT BEARINGS**

Adequate number of properly designed bearings shall be provided for smooth and trouble free operation of the pump. Number of bearings shall consider the number of shaft pieces used and the critical speed of the shaft. Bearings shall be either lubricated by external clear water/oil/grease or self-lubricated. In case of external water/oil lubrication, complete lubrication arrangement shall be furnished with the pump.

8.03.02 **THRUST BEARING**

Thrust bearing of adequate size and capacity shall be provided to take the vertical thrust of the impeller arising out of the pump operation and dead weight of the rotating Components. Life of the thrust bearing shall be guided by the design standard of the pump. Thrust bearing shall be capable of running continuously at maximum load. Thrust bearing shall be either grease or oil lubricated. Lubrication arrangement shall be such that the lubricant does not contaminate the handling fluid. The arrangement shall also be adequate to protect the bearing, while the pump coast down to stop in case of power failure of the station. Pre-lubrication of the thrust bearing, if recommended by the pump manufacturer, shall be taken care of in designing the lubrication system. Cooling of the thrust bearing, if necessary, shall be done by the handling fluid/external Water, depending on the fluid handled. Location of the thrust bearing may be at the pump body or at the driver, or at both depending on the requirement.



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SECTION-III

MISCELLANEOUS HOISTS

1.00.00 GENERAL INFORMATION

- 1.01.00 The hoists will be used for erection and maintenance of various equipment in different buildings under the scope of Entire Package, except FGD and Coal Handling Plant, of 1 x 660 MW Sagardighi Thermal Power Project Unit 5, Phase-III. Hoists for FGD and CHP area are mentioned in Section-V of Volume-IIB and Volume II H1 respectively.
- 1.02.00 Hoists are divided into two separate groups - (a) Hand operated and (b) Electric operated.

2.00.00 CODES AND STANDARDS

The design, manufacture and testing of the equipment covered under this specification shall conform to the latest editions of the following Indian Standards:

- | | | | |
|---------|---------------------|---|---|
| 2.01.00 | IS : 3832 | : | Specification for Hand Operated Chain Pulley-blocks. |
| 2.02.00 | IS : 807 | : | Code of Practice for Design, Manufacture, Erection and Testing (Structural Portion) of Cranes and Hoists. |
| 2.03.00 | IS : 6216 | : | Short link Chain, Grade T(8) for Pulley-blocks & other Lifting Appliances. |
| 2.04.00 | IS : 2429 (part -I) | : | Non-calibrated Load Chain for Lifting Purposes. |
| 2.05.00 | IS : 15560 | : | Point Hook with Shank up to 160 tones - Specification |
| 2.06.00 | IS : 3938 | : | Specification for Electric Wire Rope Hoists. |

and other Indian Standards referred to in the above standards.

3.00.00 SCOPE OF WORK

- 3.01.00 Hoists shall be provided in all areas under the scope of this specification (except the areas covered by E.O.T. cranes) where any equipment/component weighing above 100 kg is installed and needs to be handled for maintenance purposes. Number of monorail beams shall be such that the centre line of the hoist and the centre line of equipment to be handled shall be not more than 500 mm.



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- 3.01.01 The location and no. of hoists is to be finalised during detailed engineering. Final arrangement is subject to approval of Owner/Consultant.
- 3.01.02 Monorail hoists shall at least be provided in the areas mentioned in Annexure-I. The list is indicative only and not an exhaustive one.
- 3.01.03 Besides monorail hoists, fixed Chain Pulley blocks of following capacities shall be provided:

Capacity (T)	Nos.
1	10
3	10
5	8
10	3

- 3.02.00 All drive motors and driving gears as necessary.
- 3.03.00 Limit switches for electrical hoist as necessary.
- 3.04.00 Trailing cable with all supporting fixtures as necessary for electric hoists.
- 3.05.00 Pendant control station with all accessories for electric hoists.
- 3.06.00 Lifting lug, eye bolts etc., for handling hoist parts.
- 3.07.00 Protection guard as specified.
- 3.08.00 Lifting hook block assembly for hoists.

4.00.00 SPECIFIC DESIGN REQUIREMENTS

- 4.01.00 Lifting capacity
- 4.01.01 Capacity of each hoist shall be 1.2 times the maximum working load.
- 4.01.02 Hoists of capacity below 3 tones shall be manual hoists.
- 4.01.03 Hoists of capacity equal and above 3 tones shall be electric hoists.
- 4.02.00 Effort for Mechanical Hoists
- 4.02.01 Hoisting
- Hoisting effort for hoists up to 3 tones capacity shall not be more than 20 kg.



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4.02.02 Trolley Motion

Effort for trolley motion for hoists upto 3 tones capacity shall not be more than 43 Kg.

4.02.03 For Electric operated hoist both hoisting and trolley motion shall be motor operated.

4.03.00 Lift

4.03.01 Lift above operating floor

Highest position of the hook shall be such that during operation of hoists, the vertical distance between bottom of any equipment handled and top of any permanent structure or equipment in the operating area shall be at least one metre.

4.03.02 Approach below operating floor

To be decided by the Bidder for safe and reliable handling of any equipment above half ton below the operating floor.

4.04.00 Length of monorail hoist

To be decided by the Bidder depending on the floor and machine layout. The horizontal distance between the centre line of the hoist and centre line of any installed equipment in its operating shall not be more than half metre.

5.00.00 DESIGN AND CONSTRUCTION

5.01.00 All parts requiring replacement or lubrication shall be easily accessible without the need for dismantling of other equipment and structures.

Robust construction and ample rating merging which experience has shown to be necessary shall be ensured throughout manufacture.

5.02.00 All components of hoists of identical capacity and duty shall be interchangeable. The hoists of identical capacity and duty shall be identical in all respects unless otherwise required. The hoist design shall be such that these can be quickly removed from one monorail beam and fixed on another beam without disassembling major components.

5.03.00 All machinery and equipment included under this specification must be equipped with safety devices and clearances to comply with recognized standards and specification requirements.

5.04.00 Cast iron parts wherever used, shall conform to IS:210 - FG 260. Also no wood or other combustible materials shall be used.

5.05.00 Defects in material like fractures, cracks, blowholes, laminations, pitting etc. are not allowed. Rectifications of any such flaw is permissible only with the approval of the Owner.



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- 5.06.00 Each hoist shall be permanently and legibly stamped with the tag number, manufacturer's name, safe working load, grade of load chain (where applicable), range of lift etc.
- 5.07.00 Load chain (where applicable) shall be of grade T(8) as per IS:6216 and Hand chain shall be as per IS:2429 (Part-I) grade 30.
- 5.08.00 Wheels in trolley unit travel shall be single flanged with straight/tapper/barrel shaped tread to suit the monorail. Wheels should be preferably of forged steel construction. Material of construction for wheels of traversing block and hoist gear for hoist used in hazardous areas shall be of non-ferrous material to avoid spark during operation.
- 5.09.00 All gears shall be hardened and tempered steel with machine cut teeth.
- 5.10.00 Hoist (Manually Operated)
- 5.10.01 Manually operated hoists shall be of spur gear chain pulley block type. It shall be suspended from the trolley by a hook. The design of the hoist shall conform to IS:3832 (Specification for hand operated chain pulley blocks).
- The hooks and brakes of hoist shall conform to the requirements stipulated in (a) and (b) below
- a) Hooks shall conform to IS:3832. The load hook shall be swiveling type fitted with a locking device.
 - b) The pulley blocks shall be fitted with an automatic mechanical load brake to prevent self-lowering of load in all working positions. The load brake shall also allow smooth lowering of load without serious overheating.
 - c) All manually operated hoists, unless stated otherwise, shall be trolley suspended type.
- 5.10.02 The trolley of hoists shall be manually operated.
- 5.10.03 The hoists shall be of Mechanism class 2 as per IS:3832.
- 5.11.00 Electric Hoist
- 5.11.01 Electric hoist shall be electric wire rope trolley suspended type. The design, operation, testing of electric hoist shall conform to IS:3938 (Specification for electric wire rope hoist).
- Minimum speed for hoisting shall be 3 m/min. and that of for trolley motion shall be 15 m/min.
- 5.11.02 Lifting hook shall conform to IS 15560 as applicable.
- 5.11.03 Wire rope for hoists shall conform to IS-2266.

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- 5.11.04 Electro-mechanical brakes of fail to safety type shall be provided for hoist motion as well as per trolley motion for electrically driven trolley. Load brake shall allow smooth lowering of load and arrangement shall be such as it can not be released accidentally. Capacity of brake and other relevant data shall conform to IS:3938.
- 5.11.05 The trolley of the hoists shall be electrically driven.
- 5.11.06 For other components of hoist such as rope, sheave, drum, bearings, gears etc. stipulations of IS: 3938 shall be followed.
- 5.11.07 Motor shall be rated for duty S4, CDF 40% and 150 starts per hour. Service class of motor shall be "4" as per IS:3938. Conditions given in IS:3938 for hoist motor shall be followed over and above the specification of electric motor in Volume II-F1/F2.
- In case of any contradiction of the aforesaid standard and the motor specification, the conditions, which are more stringent, shall be considered. All the motors shall be suitable for reversing, frequent starting and braking. Motors shall be provided with suitable space heating arrangement.
- 5.11.08 Hoist shall be designed so that remote control can be effected by means of pendant push button switch from the operating floor. Operation, arrangement etc. of pendant push button switch shall conform to IS:3938.
- 5.11.09 Micro-speed attachment in hoist shall be provided if considered necessary by the Bidder.
- 5.11.10 The hoists shall be of mechanism class 2 as per IS-3938.
- 5.12.00 Ball and roller bearings of reputed make shall be used throughout.
- 5.13.00 Suitable lubrication system shall be provided for all gear drives.
- 5.14.00 Other Electrical Items
- 5.14.01 The cross conductor on monorail for power supply to the hoist shall be of festoon type flexible insulated cable conductors. All fixtures and accessories shall be provided by the Bidder for this purpose.
- 5.14.02 Necessary insulators, supports, clamps and all other accessories shall be provided as per standard design.
- 5.14.03 Each hoist shall be provided with a starter panel with protective relays.
- 5.14.04 One main isolating switch shall be used to cut-off the supply to the hoist assembly.
- 5.14.05 One main electro-magnetic contactor together with magnetic overload relay (hand reset) for each motor circuit shall be housed in the protection panel.



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- 5.14.06 The operation of overload relay shall interrupt the main magnetic contactor.
- 5.14.07 Adequate short circuit protection shall be provided for main and individual circuits.
- 5.14.08 415V \pm 10%, 3 Phase, 4 Wire, 50 Hz \pm 5%, power supply for the hoist shall be arranged through switch fuse unit mounted at standing height at a convenient location near each hoist. The above switch fuse unit and the connecting cables between switch fuse unit and the cross conductor are included within the scope of this specification.
- 5.14.09 Transformers to step down the voltage and rectifiers as necessary shall be provided by the Bidder.
- 5.14.10 All external and internal power, control and auxiliary circuit wiring of the electrical drive and accessories and panels shall be provided. The wiring shall be done with 1100 V grade PVC insulated stranded aluminium conductor cable of suitable size not less than 2.5 sq.mm nominal equivalent copper area of cross-section. All control and auxiliary circuit wiring shall be done with 1100 V grade PVC insulated, 2.5 sq.mm. stranded copper conductor. Control wire terminations to the panels shall be made with compression type connectors. Multiway terminal blocks shall be furnished for terminating panel wiring and outgoing cable.
- 5.14.11 The hoist structure, motor frame and metal cases of all electrical equipment including metal conduit shall be effectively connected to earth. All grounding materials shall be supplied under this specification to grounding risers.
- 5.14.12 Single speed control shall be used for both hoist and trolley travel in each direction of motion.
- 5.15.00 Final painting at manufacturer's works shall be provided by the Bidder.

6.00.00 INSPECTION AND TESTING

- 6.01.00 The manufacturer shall conduct all tests required to ensure that the equipment furnished shall conform to the requirements of the specification and in compliance with the requirements of the latest edition of IS:3832 or equivalent standards for manually operated hoists and shall be as per IS:3938 for electrically operated hoist.
- 6.02.00 All hoists performance test shall be duly certified by govt. approved agency.

7.00.00 DRAWINGS, DATA AND INFORMATION

- 7.01.00 General arrangement drawings incorporating all dimensions information on head rooms, lift, wheel loads, hook suspension arrangement and other relevant data for all the hoists.



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- 7.02.00 Design calculation for selection of electric motor capacities for electric hoist.
- 7.03.00 Complete list of location, number and capacity of hoists provided.





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ANNEXURE-I

LIST OF LOCATION FOR MONORAIL HOISTS

Hoists shall be provided for equipment/component weighing 100 kg and above where mobile equipment is not accessible to those areas.

1. Power House
 - a) For all equipment above 500 Kg in ground floor and mezzanine floor in AB bay, which do not have suitable openings in upper floors for approach of E.O.T. crane hooks.
 - b) A/C Plant Equipment Room Area.
2. Boiler Area
 - a) I.D. fan, motor.
 - b) F.D. fan, motor.
 - c) P.A. fan, motor.
 - d) Mills & gear boxes.
 - e) Air heater areas.
3. For SCR, at least 2 (two) nos. hoists each of 3 ton capacity (minimum) along with monorail to be provided for each SCR reactor.
4. E.S.P. Transformer Rectifier Sets
5. All Electrical Switch Gear Rooms
6. CW Treatment Building
7. CPU regeneration building
8. Machine room of all elevators (Power House building, boiler and mill areas, ESP & FGD absorber tower etc).
9. Chlorine ton container storage room of CW Treatment Plant.
10. For AHP area hoists, refer Vol.-II-H2, Section-I.
11. For FGD area hoists, refer Vol.-II-B, Section-V.
12. For CHP area hoists, refer Vol.-II-H1.



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TITLE:

**1 X 660 MW SAGARDIGHI TPS UNIT NO. 5
PHASE III**

**TECHNICAL SPECIFICATION FOR
CONDENSATE POLISHING UNIT**

SPECIFICATION NO. PE-TS-445-155A-A001

SECTION : II

SUB-SECTION: IIB


REV. NO. 00

DATE : 10.05.2021

SECTION – II

SUB-SECTION IIB: GENERAL TECHNICAL REQUIREMENTS (ELECTRICAL)


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2021/PS-PEM-MAX		TYPE	
	LV MOTOR		SPECIFICATION NO.
	DATA SHEET – C		VOLUME II B
			SECTION D
			REV NO. 00 DATE
			SHEET 1 OF 2
SAGARDIGHI THERMAL POWER PROJECT			
1 x 660 MW UNIT NO. 5, PHASE – III			

S. No.	Description		Data to be filled by successful bidder
A.	General		
1	Manufacturer & country of origin		
2	Motor type		
3	Type of starting		
4	Name of the equipment driven by motor & Quantity		
5	Maximum Power requirement of driven equipment		
6	Rated speed of Driven Equipment		
7	Design ambient temperature		
B.	Design and Performance Data		
1	Frame size & type designation		
2	Type of duty		
3	Rated Voltage		
4	Permissible variation for		
5	a	Voltage	
6	b	Frequency	
7	c)	Combined voltage & frequency	
8	Rated output at design ambient temp (by resistance method)		
9	Synchronous speed & Rated slip		
10	Minimum permissible starting voltage		
11	Starting time in sec with mechanism coupled		
12	a) At rated voltage		
13	b) At min starting voltage		
14	Locked rotor current as percentage of FLC (including IS tolerance)		
15	Torque		
	a) Starting		
	b) Maximum		
16	Permissible temp rise at rated output over ambient temp & method		
17	Noise level at 1.0 m (dB)		
18	Amplitude of vibration		
19	Efficiency & P.F. at rated voltage & frequency		
	a) At 100% load		
	c) At 75% load		

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

291681/2021/PS-PEM-MAX

2021/PS-PEM-MAX		TYPE	
	LV MOTOR		SPECIFICATION NO.
	DATA SHEET – C		VOLUME II B
			SECTION D
			REV NO. 00 DATE
			SHEET 2 OF 2
SAGARDIGHI THERMAL POWER PROJECT			
1 x 660 MW UNIT NO. 5, PHASE – III			

S. No.	Description	Data to be filled by successful bidder
	c) At starting	
C.	Constructional Features	
1	Method of connection of motor driven equipment	
2	Applicable Standard	
3	DOP of Enclosure	
4	Method of cooling	
5	Class of insulation	
6	Main terminal box	
	a) Type	
	b) Power Cable details (Conductor, size, armour/unarmour)	
	c) Cable Gland & lugs details (Size, type & material)	
	d) Permissible Fault level (kArms & duration in sec)	
7	Space heater details (Voltage & watts)	
8	Flame proof motor details (if applicable)	
	a) Enclosure	
	b) suitability for hazardous area	
	i Zone	O / I / II
	ii Group	IIA / IIB / IIC
9	No. of Stator winding	
10	Winding connection	
11	Kind of rotor winding	
12	Kind of bearings	
13	Direction of rotation when viewed from NDE	
14	Paint Shade & type	
15	Net weight of motor	
16	Outline mounting drawing No (To be enclosed as annexure)	
D.	Characteristic curves/ drawings (To be enclosed for motors of rating $\geq 55\text{KW}$)	
	a) Torque speed characteristic	
	b) Thermal withstand characteristic	
	c) Current vs time	
	d) Speed vs time	

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

291681/2021/PS-PEM-MAX:



GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO.	PE-SS-999-506-E101
VOLUME NO. :	II-B
SECTION :	D
REV NO. : 00	DATE : 29/08/2005
SHEET :	1 OF 1


GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO.: PE-SS-999-506-E101 Rev 00

291681/2021/PS-PEM-MAX:

2021/PS-PEM-MAX : 07/07/2021		SPECIFICATION NO. PE-SS-999-506-E101	
 GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS		VOLUME NO. : II-B	
		SECTION : D	
		REV NO. : 00 DATE : 29/08/2005	
		SHEET : 1 OF 4	

1.0

INTENT OF SPECIFICATION

The specification covers the design, materials, constructional features, manufacture, inspection and testing at manufacturer’s work, and packing of Low voltage (LV) squirrel cage induction motors along with all accessories for driving auxiliaries in thermal power station.

Motors having a voltage rating of below 1000V are referred to as low voltage (LV) motors.

2.0

CODES AND STANDARDS

Motors shall fully comply with latest edition, including all amendments and revision, of following codes and standards:

IS:325	Three phase Induction motors
IS : 900	Code of practice for installation and maintenance of induction motors
IS: 996	Single phase small AC and universal motors
IS: 4722	Rotating Electrical machines
IS: 4691	Degree of Protection provided by enclosures for rotating electrical machines
IS: 4728	Terminal marking and direction of rotation rotating electrical machines
IS: 1231	Dimensions of three phase foot mounted induction motors
IS: 8789	Values of performance characteristics for three phase induction motors
IS: 13555	Guide for selection and application of 3-phase A.C. induction motors for different types of driven equipment
IS: 2148	Flame proof enclosures for electrical appliance
IS: 5571	Guide for selection of electrical equipment for hazardous areas
IS: 12824	Type of duty and classes of rating assigned
IS: 12802	Temperature rise measurement for rotating electrical machines
IS: 12065	Permissible limits of noise level for rotating electrical machines
IS: 12075	Mechanical vibration of rotating electrical machines

In case of imported motors, motors as per IEC-34 shall also be acceptable.

3.0

DESIGN REQUIREMENTS

3.1

Motors and accessories shall be designed to operate satisfactorily under conditions specified in data sheet-A and Project Information, including voltage & frequency variation of supply system as defined in Data sheet-A

3.2

Motors shall be continuously rated at the design ambient temperature specified in Data Sheet-A and other site conditions specified under Project Information
Motor ratings shall have at least a 15% margin over the continuous maximum demand of the driven equipment, under entire operating range including voltage & frequency variation specified above.

3.3

Starting Requirements


3.3.1

Motor characteristics such as speed, starting torque, break away torque and starting time shall be properly co-ordinated with the requirements of driven equipment. The accelerating torque at any speed with the minimum starting voltage shall be at least 10% higher than that of the driven equipment.


3.3.2

Motors shall be capable of starting and accelerating the load with direct on line starting without exceeding acceptable winding temperature.

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<div>2021/PS-PEM-MAX</div> <div>07/07/2021</div> <div></div>	<div>GENERAL TECHNICAL REQUIREMENTS</div> <div>FOR</div> <div>LV MOTORS</div>	SPECIFICATION NO.
		PE-SS-999-506-E101
		VOLUME NO. : II-B
		SECTION : D
		REV NO. : 00 DATE : 29/08/2005
		SHEET : 2 OF 4
<div>The limiting value of voltage at rated frequency under which a motor will successfully start and accelerate to rated speed with load shall be taken to be a constant value as per Data Sheet - A during the starting period of motors.</div>		
<div>3.3.3 The following frequency of starts shall apply</div> <div><div>i) Two starts in succession with the motor being initially at a temperature not exceeding the rated load temperature.</div><div>ii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature. (not to be repeated in the second successive hour)</div><div>iii) Motors for coal conveyor and coal crusher application shall be suitable for three consecutive hot starts followed by one hour interval with maximum twenty starts per day and shall be suitable for minimum 20,000 starts during the life time of the motor</div></div>		
<div>3.4 Running Requirements</div>		
<div>3.4.1 Motors shall run satisfactorily at a supply voltage of 75% of rated voltage for 5 minutes with full load without injurious heating to the motor.</div>		
<div>3.4.2 Motor shall not stall due to voltage dip in the system causing momentary drop in voltage upto 70% of the rated voltage for duration of 2 secs.</div>		
<div>3.5 Stress During bus Transfer</div>		
<div>3.5.1 Motors shall withstand the voltage, heavy inrush transient current, mechanical and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.</div>		
<div>3.5.2 Motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.</div>		
<div>3.6 Maximum noise level measured at distance of 1.0 metres from the outline of motor shall not exceed the values specified in IS 12065.</div>		
<div>3.7 The max. vibration velocity or double amplitude of motors vibration as measured at motor bearings shall be within the limits specified in IS: 12075.</div>		
<div>4.0 CONSTRUCTIONAL FEATURES</div>		
<div>4.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor or semi-indoor motors shall conform to degree of protection IP: 55 as per IS: 4691 and shall be of weather-proof construction. Outdoor motors shall be installed under a suitable canopy</div>		
<div>4.2 Motors upto 160KW shall have Totally Enclosed Fan Cooled (TEFC) enclosures, the method of cooling conforming to IC-0141 or IC-0151 of IS: 6362.</div>		
<div>Motors rated above 160 KW shall be Closed Air Circuit Air (CACA) cooled</div>		
<div>4.3 Motors shall be designed with cooling fans suitable for both directions of rotation.</div>		

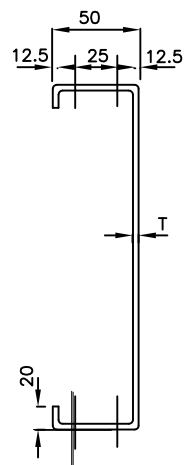
291681/2021/PS-PEM-MAX

2021/PS-PEM-MAX : 07/15 (7)		SPECIFICATION NO. PE-SS-999-506-E101	
	GENERAL TECHNICAL REQUIREMENTS FOR LV MOTORS	VOLUME NO. : II-B	
		SECTION : D	
		REV NO. : 00 DATE : 29/08/2005	
		SHEET : 3 OF 4	
<p>4.4. Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.</p> <p>4.5 Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.</p> <p>4.6 In case Class ‘F’ insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class ‘B’ insulation. In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10°C.</p> <p>4.7 Terminals and Terminal Boxes</p> <p>4.7.1 Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet-A.</p> <p>Unless otherwise stated in Data Sheet-A, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current mentioned in data sheet “A”.</p> <p>4.7.2 unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.</p> <p>4.7.3 Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or U W & V respectively.</p> <p>4.7.4 Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.</p> <p>4.7.5 Motor terminals and terminal leads shall be fully insulated with no bar live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A.</p> <p>4.7.6 Degree of protection for terminal boxes shall be IP 55 as per IS 4691.</p> <p>4.7.7 Separate terminal boxes shall be provided for space heaters.. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes.</p> <p>4.7.8. Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.</p> <p>4.7.9 Cable glands and cable lugs as per cable sizes specified in Data Sheet-A shall be included. Cable lugs shall be of tinned Copper, crimping type.</p> <p>4.8 Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size given in Data Sheet-A shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.</p> <p>4.9 General</p>			

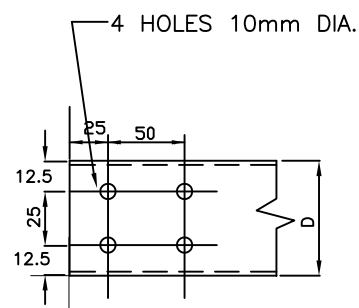
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291681/2021/PS-PEM-MAX:

	<p align="center">GENERAL TECHNICAL REQUIREMENTS</p> <p align="center">FOR</p> <p align="center">LV MOTORS</p>	<p>SPECIFICATION NO. PE-SS-999-506-E101</p> <p>VOLUME NO. : II-B</p> <p>SECTION : D</p> <p>REV NO. : 00 DATE : 29/08/2005</p> <p>SHEET : 4 OF 4</p>
	<p>4.9.1 Motors provided for similar drives shall be interchangeable.</p> <p>4.9.2 Suitable foundation bolts are to be supplied alongwith the motors.</p> <p>4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above.</p> <p>4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956.</p> <p>4.9.5 All motors rated above 30 kW shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Unless otherwise specified, space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz.</p> <p>4.9.6 Name plate with all particulars as per IS: 325 shall be provided</p> <p>4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions.</p> <p>5.0 INSPECTION AND TESTING</p> <p>5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied.</p> <p>5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser.</p> <p>5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan.</p> <p>5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A.</p> <p>6.0 DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT</p> <p>a) OGA drawing showing the position of terminal boxes, earthing connections etc.</p> <p>b) Arrangement drawing of terminal boxes.</p> <p>c) Characteristic curves: (To be given for motor above 55 kW unless otherwise specified in Data Sheet).</p> <p>i) Current vs. time at rated voltage and minimum starting voltage.</p> <p>ii) Speed vs. time at rated voltage and minimum starting voltage.</p> <p>iii) Torque vs. speed at rated voltage and minimum voltage. For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling.</p> <p>iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.</p>	



-4 HOLES 10mm DIA.



ARRANGEMENT OF PERFORMATIONS

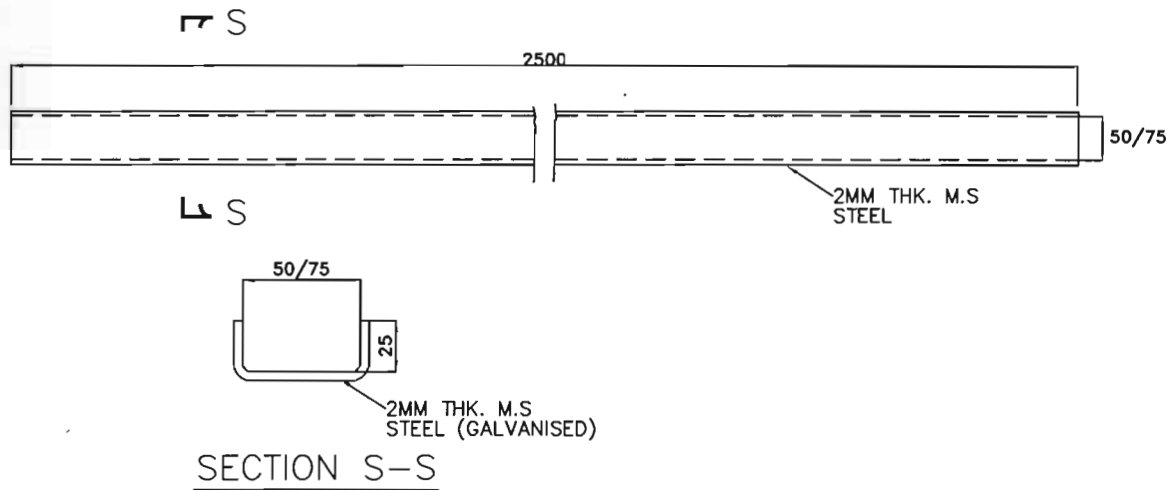
TRAY WIDTH W (mm)	100	50
TRAY DEPTH D (mm)	50	50
T (mm)	2	2

PERFORATED TYPE TRAY



TYPICAL DETAILS OF CABLE TRAYS AND ACCESSORIES

291681/2021/PS-PEM-MAX

CABLE TROUGHS

TYPICAL DETAILS OF
CABLE TRAY AND ACCESSORIES

291681/2021/PS-PEM-MAX



TITLE:

**1 X 660 MW SAGARDIGHI TPS UNIT NO. 5
PHASE III**

**TECHNICAL SPECIFICATION FOR
CONDENSATE POLISHING UNIT**

SPECIFICATION NO. PE-TS-445-155A-A001

SECTION : II

SUB-SECTION: IIC


REV. NO. 00

DATE : 10.05.2021

SECTION – II

SUB-SECTION IIC: GENERAL TECHNICAL REQUIREMENTS (C&I)

FORM NO. PEM-666-Q

	<p align="center">SPECIFICATION FOR CONTROL & INSTRUMENTATION FOR AUX PACKAGES</p>	SPECIFICATION NO.:	
		VOLUME	
		SUB SECTION	
		REV. NO.	DATE :
		SHEET	OF

GENERAL REQUIREMENT


1.0 Bidder shall provide complete and independent control & instrumentation system with all accessories, auxiliaries and associated equipments for the safe, efficient and reliable operation of auxiliary systems.

2.0 The quantity of instruments for auxiliary system shall be as per tender P & ID wherever provided of the respective system as a minimum, for bidding purpose. However, Bidder shall also include in his proposal all the instruments and devices that are needed for the completeness of the plant auxiliary system/ equipment supplied by the bidder, even if the same is not specifically appearing in the P & ID. During detail engineering if any additional instruments are required for safe & reliable operation of plant, bidder shall supply the same without any price implication.

3.0 Measuring instruments/equipment and subsystems offered by the bidder shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Further all the instruments shall be of proven reliability, accuracy, and acceptable international standards and shall be subject to employer's approval. All instrumentation equipment and accessories under this specification shall be furnished as per technical specification, ranges, makes/ numbers as approved by the employer' during detail engineering.

4.0 The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifold and all the other accessories required for mounting/ erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments; sensors, switches etc for external connection including spare contacts shall be wired out to suitably located junction boxes.

5.0 The customer specification attached as Specific Technical Requirement will supercede the Data sheets, if there is any mismatch.

	C&I SPECIFICATION FOR CONDENSATE POLISHING UNIT	SECTION: C SUB SECTION: C&I
<div>LIST OF DOCUMENTS/DELIVERABLES</div>		


**C&I SPECIFICATION FOR
CONDENSATE POLISHING UNIT**SECTION: C
SUB SECTION: C&I**LIST OF DELIVERABLES OF PEM - C&I DEPARTMENT**

Sl. No.	DRAWING NO.	DRAWING/DOCUMENT TITLE	CATEGORY
1	PE-V0-445-145-I901	CONTROL & OPERATIONAL WRITE-UP FOR THE SYSTEM WITH SET POINTS	A
2	PE-V0-445-145-I902	CONTROL SCHEME/LOGIC DIAGRAM (TO BE IMPLEMENTED IN DDCMIS)	A
3	PE-V0-445-145-I903	HMI PICTURES/PLANT SCHEMATICS	A
4	PE-V0-445-145-I904	INSTRUMENT SCHEDULE WITH SET POINTS	A
5	PE-V0-445-145-I905	I/O LIST (ANALOG & BINARY)	A
6	PE-V0-445-145-I906	DRIVE LIST/SOLENOID/ACTUATOR VALVE LIST WITH LOCATION DATA	A
7	PE-V0-445-145-I907	FIELD JB/LIE/LIR,DRIVES TERMINATIONS	A
8	PE-V0-445-145-I908	DATASHEETS FOR INSTRUMENTS, JBs, etc.	A
9	PE-V0-445-145-I909	QUALITY PLANS (INSTRUMENTS, VMS, etc.)	A
10	PE-V0-445-145-I910	INSTRUMENT HOOK-UP DRAWING	A
11	PE-V0-445-145-I911	THERMOWELL SIZING CALCULATION	A
12	PE-V0-445-145-I913	CABLE SCHEDULE & INTERCONNECTION	A
13	PE-V0-445-145-I914	ANNUNCIATION & SOE LIST	A


NOTES:


ANY OTHER DOCUMENT DECIDED DURING DETAILED ENGINEERING SHALL BE PROVIDED BY BIDDER WITHOUT ANY COMMERCIAL/TECHNICAL IMPLICATION.

CONTRACTOR TO SUBMIT REUSABLE DATABASE FORMATS IN BHEL/CUSTOMER APPROVED FORMATS LIKE MS EXCEL, MS ACCESS OF DOCUMENTS LIKE INSTRUMENT SCHEDULE, I/O LIST, DRIVE LIST, FIELD JB TERMINATIONS, CABLE SCHEDULE & INTERCONNECTION, etc.
SOFT COPY OF FORMATS SHALL BE PROVIDED TO SUCCESSFUL BIDDERS.

	C&I SPECIFICATION FOR CONDENSATE POLISHING UNIT	SECTION: C SUB SECTION: C&I
<div>MOTORISED VALVE ACTUATOR</div>		

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR		DOCUMENT NO.: PE-ID-445-145-I902	
			VOLUME II B	
			SECTION D	
			REV. NO. 01	DATE:27/03/2020
			SHEET 1	OF 5
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 660 MW SAGARDIGHI STPP		
	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 -20 to 70 DEG C AND RELATIVE HUMIDITY OF 0-95% IN HOT HUMID AND TROPICAL ATMOSPHERE AND HIGHLY POLLUTED AT PLACES OF COAL DUST AND FLY DUST		
	VALVE SEAT TEST PRESS	BIDDER TO SPECIFY		
	REQUIRED VALVE TORQUE	BIDDER TO SPECIFY		
	ACTUATOR RATED TORQUE	BIDDER TO SPECIFY		
	CONSTRUCTION AND SIZING	CONSTRUCTION	TOTALLY ENCLOSED, WEATHER PROOF, DUST TIGHT SUITABLE FOR OUTDOOR USE WITHOUT CANOPY, NEMA6/IP:68	
MECHANICAL POSITION INDICATOR		TO BE PROVIDED FOR 0-100% TRAVEL		
BEARINGS		DOUBLE SHIELDED, GREASE LUBRICATED ANTI-FRICTION.		
GEAR TRAIN FOR LIMIT SWITCH/TORQUE SWITCH OPERATION		METAL (NOT FIBRE GEARS). SELF-LOCKING TO PREVENT DRIFT UNDER TORQUE SWITCH SPRING PRESSURE WHEN MOTOR IS DE-ENERGIZED.		
SIZING		OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 85% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER. FOR INCHING SERVICE - 150 STARTS/HR MINIMUM & FOR REGULATING SERVICE - 600 STARTS/HR MINIMUM as per IEC60034-1		
HANDWHEEL as per standard EN 12570:2000	* 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) (REFER NOTE NO. 6 & 7)	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 (BIDDER TO CONFIRM) A: <input checked="" type="checkbox"/> DRG. NO. 3-V-MISC-24227 R00 B: <input type="checkbox"/> DRG. NO. 3-V-MISC-24550 R00 C: <input type="checkbox"/> DRG. NO. 3-V-MISC-24283 R00 D: <input type="checkbox"/> DRG. NO. 4-V-MISC-90271 R11 E: <input type="checkbox"/> For Thyristor based Integral starter, Bidder/Vendor to furnish wiring diagram		
	COLOUR SHADE	<input type="checkbox"/> BLUE (RAL 5012) <input type="checkbox"/> <input checked="" type="checkbox"/> TO BE DECIDED DURING DETAILED ENGINEERING		
	PAINT TYPE	<input type="checkbox"/> ENAMEL <input checked="" type="checkbox"/> EPOXY CONFIRMING TO CORROSION CATEGORY C5-I		
	SHAFT RPM	BIDDER TO SPECIFY		
	OLR SET VALUE	BIDDER TO SPECIFY		

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR		DOCUMENT NO.: PE-ID-445-145-I902		
			VOLUME II B		
			SECTION D		
			REV. NO. 01	DATE:27/03/2020	
			SHEET 2	OF 5	
Data Sheet A & B					
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)		
	@ STARTING / FULL LOAD CURRENT	BIDDER TO SPECIFY			
	NO. OF REV FOR FULL TRAVEL	BIDDER TO SPECIFY			
	@ PWR SUPP TO MTR / STARTER	415V, 3PH, AC			
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER <input type="checkbox"/> 230 V <input type="checkbox"/> 110 V			
	@ ENCLOSURE CLASS OF MOTOR	<input type="checkbox"/> IP 67 <input checked="" type="checkbox"/> IP 68 <input type="checkbox"/> FLAME PROOF			
	@MOTOR BEARING WITH 2 EARTH TERMINALS	DOUBLE SHIELDED; GREASE LUBRICATED ANTI FRICTION			
	@ INSULATION CLASS	CLASS-F TEMP. RISE LIMITED TO CLASS-B			
	@ WINDING TEMP PROTECTION	<input checked="" type="checkbox"/> THERMOSTAT (3 Nos.,1 IN EACH PHASE)			
	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED (THERMISTOR PTC)			
	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 (REFER BELOW POINT a – h)			
		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(Refer Note 14)	REQUIRED MOTOR THERMOSTTTRIP O/L RELAY OPTD, CONT./POWER SUPPLY FAILED, S/S IN LOCAL/REMOTE/OFF MODE, TORQUE SWITCH OPEN/CLOSE CUT OFF/STOP PB OPTD, VALVE JAMMED ETC)				
ACTION ON LOSS OF EXTERNAL ELECTRIC POWER	<input checked="" type="checkbox"/> STAYPUT <input checked="" type="checkbox"/> FAIL SAFE TO BE DECIDED DURING DETAILED ENGINEERING				
INTERPOSING RELAY/OPTO COUPLER (Applicable for integral Starter) DATASHEET & WIRING DIAGRAM OF ISOLATION DEVICE TO BE PROVIDED	TYPE OF ISOLATING DEVICE	<input checked="" type="checkbox"/> INTERPOSING RELAY <input type="checkbox"/> OPTO COUPLER TO BE DECIDED DURING DETAILED ENGINEERING			
	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			

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Data Sheet A & B				
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
TORQUE SWITCH (Not Applicable for Smart Actuator) (\$\$ Refer Notes)	MFR & MODEL NO.	BIDDER TO SPECIFY		
	OPEN / CLOSE	<input type="checkbox"/> 1 No. <input type="checkbox"/> 2Nos. / <input 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. <input type="checkbox"/> 2 Nos.	2 Nos. (ADJ.)	<input type="checkbox"/> 1 No. <input type="checkbox"/> 2Nos.
	CONTACT TYPE	2 NO + 2 NC		
	RATING (AC / DC)	5A 240V AC AND 0.5A 220V DC		
	ACCURACY	2% OF SET VALUE		
POSITION TRANSMITTER	POSITION TRANSMITTER (For inching duty & other specific applications**)	<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)	230V AC,1 PH.,50 Hz		
	@ POWER SUPPLY (INTEGRAL)	BIDDER TO SPECIFY		
	@ RATING			
TERMINAL BOX	ACTUATOR/MOTOR TERMINAL BOX	REQUIRED		
	ENCL CLASS ACTUATOR/MOTOR T.B.	<input checked="" type="checkbox"/> IP 68 <input type="checkbox"/>		
	@ EARTHING TERMINAL	REQUIRED		
	PLUG & SOCKET	<input type="checkbox"/> REQUIRED <input checked="" type="checkbox"/> NOT REQUIRED		
	NO. OF PINS REQUIRED(TO BE CHECKED AS PER SIGNALS IN DRIVE CONTROL PHILOSOPHY)			
	NOS. OF PLUG & SOCKET	<input type="checkbox"/> 1 Nos. for ON/OFF <input type="checkbox"/> 2 NOS.(for inching duty) <input type="checkbox"/> OTHER (TO BE SPECIFIED INLINE WITH DRIVE CONTROL PHILOSOPHY)		
CABLE GLANDS	@ POWER CABLE GLAND	SIZE:-----		
	@ SPACE HEATER CABLE GLAND	SIZE:-----		
	CONTROL CABLE GLANDS-1	CABLE GLAND SUITABLE FOR INSTRUMENTATION CABLE SIZE OF 4P X 1.5 SQMM		
	CONTROL CABLE GLANDS-2	CABLE GLAND SUITABLE FOR INSTRUMENTATION CABLE SIZE OF 8P X 0.5 SQMM		
	CONTROL CABLE GLANDS-3 (Additional for inching duty)	CABLE GLAND SUITABLE FOR INSTRUMENTATION CABLE SIZE OF 2P X 0.5 SQMM		
WEIGHT	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY _____ Kg.		

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Data Sheet A & B				
DATA SHEET-A (TO BE FILLED BY PURCHASER)		DATA SHEET-B (TO BE FILLED-UP BY BIDDER)		

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, IS-4722, IEC 60947-5-1 AND EN 15714-3 :2010 OR LATEST VERSION.
- TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C.
- CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL SHALL BE PROVIDED.
- THE TORQUE SWITCHES SHALL BE PROVIDED WITH MECHANICAL LATCHING DEVICE TO PREVENT OPERATION WHEN UNSEATING FROM THE END POSITIONS. THE LATCHING DEVICE SHALL UNLATCH AS SOON AS THE VALVE LEAVES THE END POSITION. IF SUCH PROVISION IS NOT POSSIBLE, THE TORQUE SWITCHES SHALL BE BYPASSED BY END-POSITION LIMIT SWITCHES WHICH OPENS ON VALVE LEAVING END POSITION. THESE LIMIT SWITCHES ARE ADDITIONAL TO THE NUMBER OF LIMIT SWITCHES SPECIFIED ELSEWHERE.
- THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING.
- THE MOTOR SHALL BE CAPABLE OF STARTING AT 85 PERCENT OF RATED VOLTAGE 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.
- IN ADDITION TO ABOVE REQUIREMENTS FOR LIMIT/TORQUE SWITCH, **MECHANICAL END STOP** WITH ACCURACY OF 2% SHALL BE SUPPLIED.
- IT SHOULD BE POSSIBLE TO OPERATE THE ACTUATOR LOCALLY. LOCKABLE LOCAL/REMOTE SELECTION SHALL BE PROVIDED ON THE ACTUATOR.
- LOCAL POSITION INDICATOR SHALL BE PROVIDED FOR 0 TO 100 % TRAVEL.
- CONTROL WIRING SHALL BE SUITABLE VOLTAGE GRADE COPPER WIRE 1.5 SQ. MM.
- ENDURANCE: RATED TORQUE RANGE SHOULD BE BASED ON ISO 5211, ISO5210.
- TAG PLATE SHALL BE CONFIRMING TO STANDARD BS-15714.
- THE ACTUATORS SHALL BE DESIGNED TO BE SELF-LOCKING UPON LOSS OF POWER. MOTOR SHALL BE DESIGNED TO CLOSE IN 30 SECS. FROM FULL OPEN POSITION AND SHALL HAVE ADEQUATE CAPACITY TO OPEN AND CLOSE UNDER FULL UNBALANCED DESIGN PRESSURE.
- AUTOMATIC PHASE CORRECTION FACILITY AND POTENTIAL FREE CONTACT FOR ANNUNCIATION OF POWER FAILURE SHALL BE PROVIDED.
- LIMIT SWITCHES SHALL BE SILVER PLATED WITH HIGH CONDUCTIVITY AND NON-CORROSIVE TYPE. CONTACT RATING SHALL BE SUFFICIENT TO MEET THE REQUIREMENT OF CONTROL SYSTEM SUBJECT TO A MINIMUM OF 60 V, 6 VA RATING. PROTECTION CLASS SHALL BE IP67.
- THE TERMINAL BOX SHALL BE WEATHER PROOF WITH REMOVABLE FRONT COVER & CABLE GLANDS FOR CABLE CONNECTION. IT SHALL BE SUITABLE FOR 2.5 SQ MM COPPER CONDUCTOR.
- ACTUATOR SHALL ATTAIN FULL SPEED OPERATIONS BEFORE VALVE LOAD IS ENCOUNTERED AND IMPART AN UNSEATING BLOW TO START THE VALVE IN MOTION (HAMMER BLOW EFFECT).
- ** VALVES WITH 10 DEGREE/20DEGREE FEEDBACK REQUIREMENT FOR APPLICATIONS SUCH AS CW/ACW/PLANT WATER SYSTEM SHALL BE CONSIDERED AS INCHING DUTY VALVES. ACCORDINGLY, POSITION FEED BACK TRANSMITTER, PLUG & SOCKET REQUIREMENT SHALL BE CONSIDERED.**

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

	PREPARED BY	CHECKED BY	APPROVED BY	VENDOR COMPANY SEAL
NAME	ANJALI RAMAN	VIPUL KUMAR VERMA	SURESH CHAND SHARMA	NAME
SIGNATURE				SIGNATURE
DATE	27.03.2020	27.03.2020	27.03.2020	DATE

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

@ BE FILLED BY ES

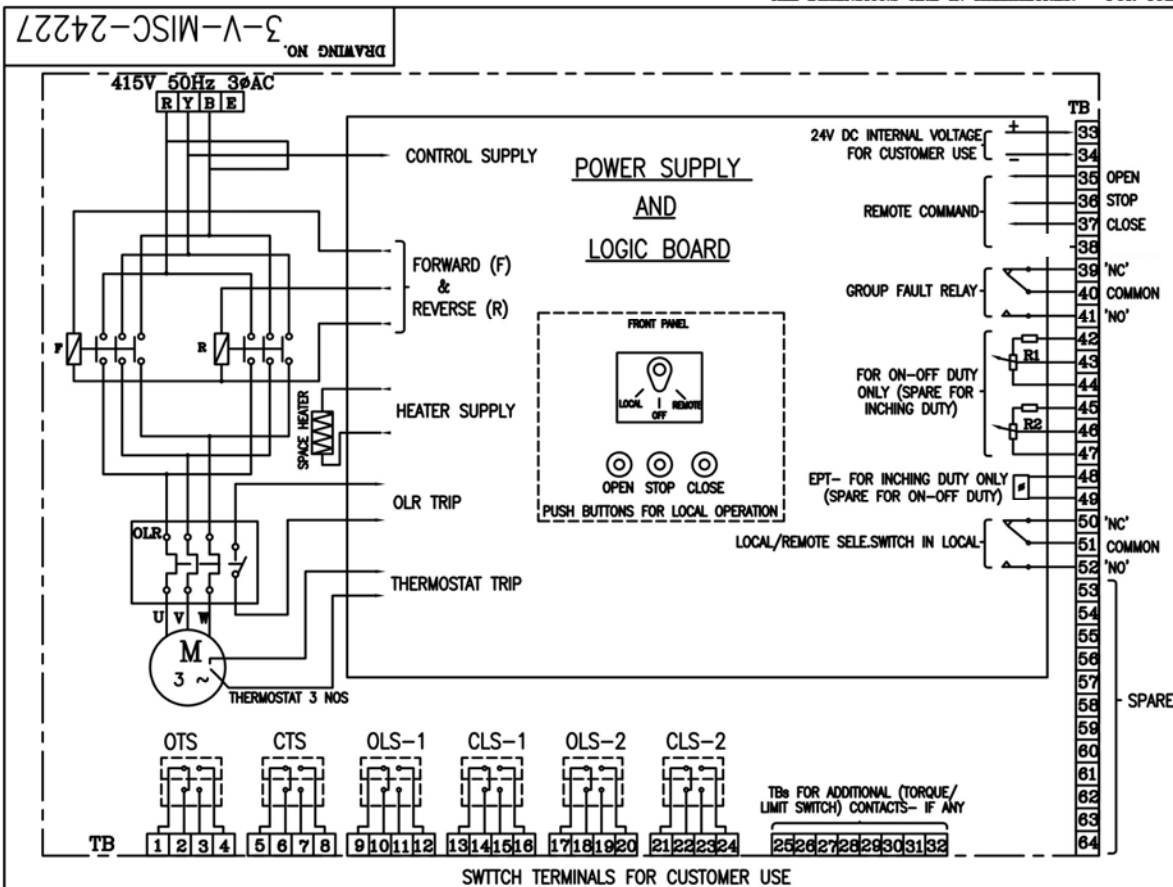
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ADDITIONAL NOTES FOR SAGARDIGHI PROJECT:

- TEST WITNESS: TESTS SHALL BE PERFORMED IN THE PRESENCE OF OWNER/PURCHASER'S REPRESENTATIVE SO DESIRED BY THE OWNER/ PURCHASER. THE CONTRACTOR SHALL GIVE AT LEAST FIFTEEN (15) DAYS ADVANCE NOTICE OF THE DATE WHEN THE TESTS ARE TO BE CARRIED OUT.
- 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 SUCCESSFUL BIDDER MAY PROCEED WITH MANUFACTURE HAVING FORWARDED TO THE OWNER DULY CERTIFIED COPIES OF HIS OWN INSPECTION AND TEST RESULTS.
- ACTUATOR SHALL ATTAIN FULL SPEED OPERATIONS BEFORE VALVE LOAD IS ENCOUNTERED AND IMPART AN UNSEATING BLOW TO START THE VALVE IN MOTION (HAMMER BLOW EFFECT).
- A SPACE HEATER SHALL BE INCLUDED IN THE LIMIT SWITCH COMPARTMENT SUITABLE FOR 240V, 1 PHASE, 50 HZ SUPPLY.

291681/2021/PS-PFM-MAX

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



Separate wire (no common wire) to be used for signal exchange between DCS and actuator. Additionally, separate TBs are to be used at actuator end. Please refer attached dwg 12A05-DWG-I0021 for the same.

CONTACT DEVELOPMENT DIAGRAM				
OTS	1-2	OPEN AT OVER TORQUE DURING OPENING TRAVEL		
	3-4	CLOSE AT OVER TORQUE DURING OPENING TRAVEL		
CTS	5-6	OPEN AT OVER TORQUE DURING CLOSING TRAVEL		
	7-8	CLOSE AT OVER TORQUE DURING CLOSING TRAVEL		
OLS-1	9-10			
	11-12			
CLS-1	13-14			
	15-16			
OLS-2	17-18			
	19-20			
CLS-2	21-22			
	23-24			
SWITCH	TERMINAL NO.			
	FULL OPEN	a	INTERMEDIATE	b FULL CLOSE
VALVE POSITION				
—————		INDICATES CONTACT CLOSED		
-----		INDICATES CONTACT OPEN		
CONTACT RATING: 5A AT 250V AC & 0.5A AT 220V DC				



SETTING PROCEDURE OF POSITION LIMIT AND TORQUE SWITCH				
VALVES	OPEN		CLOSE	
	MAIN	BACK UP	MAIN	BACK UP
GATE VALVE OF 100 mm AND ABOVE IN 1500 CL AND ABOVE RATINGS	OLS	OTS *	CLS	CTS
ALL OTHER GATE & GLOBE VALVES	OLS	OTS *	CTS	#
# - CLS NOT TO BE CONNECTED IN TRIP CIRCUIT				
* - BYPASS OTS FOR INITIAL 5% OF TRAVEL (FOR GATE VALVES ONLY)				

NOTE:-

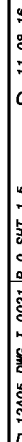
- ALL TORQUE AND LIMIT SWITCHES (OTS, CTS, OLS1&2, CLS1&2) ARE WITH 2NO+2NC CONTACTS '1NO+1NC' IS TERMINATED IN TBS 1-24, REMAINING CONTACTS ARE FOR INTERNAL USE.
- ANY SPARE CONTACTS WHICH ARE NOT USED INTERNALLY ARE TO BE TERMINATED IN TBS 25-32
- CTS - TORQUE SWITCHES FOR CW ROTATION (CLOSE)
- OTS - 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 (POTENTIOMETRIC TYPE, 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

REV	DATE	ALTERED
		CHD & APPD

CAUTION: The information on this document is the property of BHARAT HEAVY ELECTRICALS LTD. It must not be used directly or indirectly in any way detrimental to the interest of the company.

TYPE OF PRODUCT OR NAME OF CUSTOMER/PROJECT		ELECTRICAL VALVE ACTUATORS (AC) WITH INTEGRAL STARTERS (DRAWN FOR INTERMEDIATE POSITION OF VALVES)						
 365-121		BHARAT HEAVY ELECTRICALS LTD., UNIT: HIGH PRESSURE BOILER PLANT. TIRUCHIRAPALLI-620014.		DRN	NAME N.P.ESWAR	SIGN N.P	DATE 07.10.04	NO.OF VAR.
				CHD	D.DINAKARAN	D.D	07.10.04	
				APPD	K.ARUNACHALAM	K.A	07.10.04	
DEPT VL		SCALE	WEIGHT (KG).	REFERENCE INFORMATION				NO. OF ITEMS
CODE								
TITLE WIRING DIAGRAM (TERMINAL PLAN) FOR ACTUATOR WITH INTEGRAL STARTER				CARD CODE U 01	DRAWING NO. 3-V-MISC-24227			REV 0

Size A3





SECTION – III

ELECTRIC MOTOR ACTUATORS

1.00.00 SCOPE

1.01.00 This Section covers the general requirements of Electric Motor Actuators for valves, dampers and gates.

1.02.00 All electric motor actuators shall be furnished in accordance with this general specification and the accompanying driven equipment specification.

2.00.00 CODES & STANDARDS

2.01.00 All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian standards (IS), IEC, ANSI & NEMA. Standards except when otherwise stated herein or in the driven equipment specification.

2.02.00 Equipment and material conforming to any other standard, which ensures equal or better quality, may be accepted. In such case the seller shall provide details of how his standards comply with the Buyer's requirement and duly certified copies of the English version of the standard adopted shall be submitted.

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 annexure to this specification.

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 minimum S2-15 minutes as per IEC-60034-1, 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 operations before valve load is encountered and impart 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, self locking features, 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.

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.

6.01.05 All motorized actuators shall be Smart Type and shall be furnished with Integral Starter mounted on the actuator and compatible with DCS/PLC. The Integral Starter shall be complete with:

1. One (1) triple pole breaker
2. One (1) no. reversing starter with mechanically interlocked contactors, 3 thermal overload relays, 2 NO + 2 NC aux. contacts for each contactor.
3. One (1) no. Remote- Local selector switch
4. CLOSE-STOP-OPEN oil tight push buttons with indication lights. STOP push button shall be latchable type.
5. 415 / 240 V control transformer with primary and secondary fuses.

These actuators shall have diagnostic feature with valve checking facility from remote.

6.02.00 **Motor**

6.02.01 The drive motor shall be three phase, squirrel cage, induction machine with minimum class F insulation and weatherproof IPW-55 enclosure, designed for high torque and reversing 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 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 Open / Close command termination logic with position and torque limit switch positioner circuitry shall be suitably built in a PCB inside the actuator.

a) For binary drive, open/close/stop command and status thereof and disturbance monitoring signal (common contact for overload, thermostat, control supply failure, L/R selector switch at local, other protections operated) shall be provided.

Interface with the control system shall be through hardwired signal only. Interposing relays provided (with coil burden 2.5 VA) in the actuator shall be energized to initiate opening and closing, by 24V DC signal from the external control system.

b) For modulating drive, the command to actuator shall be in form of 4-20mA signal. The necessary positioning circuit and motor protection shall be provided

c) Open/close command termination logic shall be suitably built inside actuator.

6.03.04 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.

6.03.05 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 (applicable for inching services only)**

The actuator shall have:

6.05.01 One (1) built-in local position indicator for 0-100% travel.



6.05.02 One (1) no. transducer (4-20 ma) for remote position indicator for 0-100 % travel

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. The internal wiring shall be of sufficient size for the power rating involved but in no case less than 1.5 Sq.mm copper. All wiring shall be identified at both ends with ferrules.


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 2X2.5 Sq.mm copper conductors.

7.00.00 **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.



	C&I SPECIFICATION FOR CONDENSATE POLISHING UNIT	SECTION: C SUB SECTION: C&I
<div>FIELD & MEASURING INSTRUMENTS</div>		



WBPDCCL

EPC Bid Document
Sagardighi Thermal Power Project
1x660 MW Unit No. 5, Phase - III

SECTION-VI

TECHNICAL SPECIFICATION

CONTROL AND INSTRUMENTATION SYSTEMS

1.00.00 FIELD INSTRUMENTS

This section provides general guidelines for field instruments and equipment to be supplied under this specification. All measuring instruments/equipment and subsystems offered by Bidder shall be from reputed experienced manufacturer of specified type and range of equipment, whose guaranteed and trouble free operation has been established. All instruments/equipment shall be of proven reliability, accuracy, repeatability requiring a minimum of maintenance and comply with the acceptable international standards. All instruments/equipment and accessories shall be supplied as per technical specifications, ranges, make as approved by Owner.

- i) HART management system shall be integral feature of the DDCMIS and shall be provided for centralised configuration, maintenance, diagnostics & record-keeping for all electronic transmitters.
- ii) Bidder shall provide following facilities as a minimum through software:
 - a) Constant scanning to monitor faults of changes to instrument configuration.
 - b) Owner-defined and standard calibration and configuration procedures for all transmitters.
 - c) Constant signal data collection facilities to maintain continuously updated records.
 - d) Automatic tracking of configuration changes made in the field, such as may be introduced by hand-held communicator. All configuration function associated with hand-held communicators shall be available in the system.
 - e) Event and log reports on screen as well as on printer.
 - f) Any addition/deletion of transmitter will be reported on printer and logged in hard disk.

1.01.00 PRESSURE TRANSMITTER

01. Type : Microprocessor based Smart, HART protocol compatible
02. Transmission : 2 - Wire



Development Consultants Pvt. Ltd.

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Control & Instrumentation
Systems



WBPDC

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- | | | | |
|------|---------------------|---|--|
| 03. | Output Signal | : | Simultaneous transmission of digital and 4-20 mA DC signal. |
| 04. | Signal Processing | : | Silicon solid state electronic circuitry |
| 05. | Sensor type | : | Capsule / Diaphragm |
| 06. | Element material | : | AISI-316 or better |
| 07. | Static Pressure | : | 150 % of maximum span continuously, without affecting the calibration. |
| 08. | Turn-down ratio | : | 10 : 1 for vacuum/very low pressure application ; 30 : 1 minimum for other applications. |
| 09. | Span and Zero | : | Locally adjustable non-interacting. Facility for elevation and suppression by 100% of span |
| 10. | Enclosure Class | : | Weather proof as per IP-65 with durable corrosion resistant epoxy coating (Explosion proof for NEC Class-1, Division 1 area wherever required) |
| 11. | Output Indicator | : | Backlit LCD type |
| 12. | Nameplate | : | Tag number, service engraved in stainless steel tag plate |
| 13. | Body | : | Forged Carbon Steel (SS for DM Water & corrosive service). |
| 14. | Power supply | : | 16 - 48 Volts D.C. |
| 15. | Load | : | 500 Ohms (min.) at 24 Volts D.C. |
| 16. | Ambient Temperature | : | 0 - 50°C |
| 17. | Performance : | | |
| i) | Accuracy | : | ± 0.075% of Span or better |
| ii) | Repeatability | : | ± 0.05% of Span or better |
| iii) | Response time | : | 100 msec or better |
| iv) | Stability | : | ± 0.1% of Calibrated Span for 6 months up to 70 Kg/cm ² and ± 0.25% of Calibrated Span for more than 70 Kg/cm ² |
| v) | Zero and span drift | : | ± 0.015% per deg. C at max span and 0.11% per deg. C at min span |
| 18. | Sealing/Isolation | : | Extended diaphragm with 5 meters SS armored capillary for corrosive, viscous and dirty fluid applications. Material for separator |





WBPDCCL

EPC Bid Document
Sagardighi Thermal Power Project
1x660 MW Unit No. 5, Phase - III

diaphragm shall be as per application. Where the process fluids are corrosive, viscous, solid bearing or slurry type, diaphragm seals shall be provided. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application

- | | | | |
|-----|-------------|---|--|
| 19. | Diagnostics | : | Self indicating feature |
| 20. | Accessories | : | <ul style="list-style-type: none"> a) Universal mounting bracket suitable for 2" pipe mounting. b) High tensile carbon steel U- bolts. c) Installation accessories as per relevant installation drawing. d) Syphons for steam and hot water services. e) ½" NPT 2-valve stainless steel manifold for pressure transmitters constructed from SS316 bar stock. In case it becomes necessary to use a DP transmitter for gauge pressure measurement then a 2-valve manifold should be used in place of 5-valve manifold. f) Companion flange with nuts, bolts and gaskets. g) Hand held configurator kit for calibration of Smart Transmitter. |

1.02.00 Differential Pressure Transmitter

- | | | | |
|-----|------------------------|---|---|
| 01. | Type | : | Microprocessor based Smart, HART protocol compatible |
| 02. | Transmission | : | 2-Wire |
| 03. | Output signal | : | Simultaneous transmission of digital and 4-20 mA DC signal. |
| 04. | Signal Processing Unit | : | Silicon solid-state electronic circuitry |
| 05. | Sensor type | : | Capsule/Diaphragm |
| 06. | Element material | : | AISI-316 (Stainless Steel) or better |
| 07. | Static Pressure/ | | |



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- | | | |
|----------------------------------|---|---|
| Overload Pressure | : | Maximum line (or static) pressure on either side without permanent deformation or loss of accuracy |
| 08. Turn-down ratio | : | 10 :1for vacuum/very low pressure application; 30 : 1 minimum for other applications. |
| 09. Span and Zero | : | Locally adjustable, non-interacting |
| 10. Enclosure class | : | Weather proof as per IP-65 with durable corrosion resistant epoxy coating (Explosion proof for NEC Class-1, Division 1 area wherever required)) |
| 11. Zero suppression / elevation | : | At least 100% of Span |
| 12. Output Indicator | : | Backlit LCD type |
| 13. Nameplate | : | Tag number and Service engraved in stainless steel tag plate |
| 14. Body | : | Forged Carbon Steel (SS for DM Water) |
| 15. Ambient temperature | : | 0 - 50° C |
| 16. Power supply | : | 16 - 48 Volts DC |
| 17. Load | : | 500 Ohms (min.) at 24 Volts DC |
| 18. Performance :- | | |
| i) Accuracy | : | ±0.2 % of span or better |
| ii) Repeatability | : | ± 0.05 % of span or better |
| iii) Response time | : | 100 msec or better |
| iv) Stability | : | ± 0.1% of Calibrated Span for 6 months up to 70 Kg/cm ² |
| v) Zero and span drift | : | ± 0.015% per deg. C at max span and 0.11% per deg. C at min span |
| 19. Sealing/Isolation | : | Extended diaphragm with 5 meters. SS armored capillary for corrosive, viscous and dirty fluid applications. Material for separator diaphragm, depending on application. |
| 20. Diagnostics | : | Self indicating feature |
| 21. Accessories | : | a) Universal mounting bracket suitable for 2" pipe mounting. |





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- b) High tensile carbon steel U-bolts.
- c) Installation accessories as per relevant installation drawing.
- d) Syphons for steam and hot water services.
- e) ½" NPT 5-valve stainless steel manifold, constructed from SS316 bar stock.
- f) Companion flange with nuts, bolts and gaskets.
- g) Hand held configurator kit for calibration of Smart Transmitter.

1.02.00 DISPLACER TYPE LEVEL TRANSMITTERS

- | | | | |
|-----|--------------------------------------|---|---|
| 01. | Type | : | SMART |
| 02. | Stages of operation | : | Continuous |
| 03. | Material - | | |
| | i) Displacer | : | AISI 316 SS |
| | ii) Suspension wire | : | AISI 316 SS |
| | iii) Torque tube housing application | : | Carbon steel or SS as per application |
| | iv) Torque tube | : | Inconel |
| | v) Displacer chamber | : | Carbon steel or SS as per process application |
| | vi) Transmitter Housing | : | Die cast aluminium or better |
| 04. | Power supply | : | 16-48 Volts D.C. |
| 05. | Transmission | : | 2-wire |
| 06. | Output Signal | : | Simultaneous transmission of digital and 4-20 mA DC signal. Standard HART protocol. |
| 07. | Signal processing | : | Solid-state electronic circuitry |
| 08. | Static / overload pressure | : | Maximum static pressure without permanent deformation or loss of accuracy. |
| 09. | Turn-down ratio | : | 10 : 1 or better |





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10. Zero & Span : Easily accessible (local zero & span adjustment and non-interactive type)
11. Enclosure Class : IP-65 (Explosion proof for NEC Class-1, Division 1 area)
12. Output Indicator : Yes, Backlit LCD type
13. Nameplate : Tag number and Service engraved in stainless steel tag plate
14. Ambient Temperature : 0 - 50°C
15. Load Impedance : 500 Ohms at 24 Volts (minimum)
16. Process Connection : 2" Companion flange with nuts, bolts and gaskets
17. Performance -
 Accuracy : $\pm 0.2\%$ of span or better
18. Accessories :
 - a) Counter Flange, nuts, bolts, gaskets etc.
 - b) Weights for 5 point calibration of instruments.
 - c) Vent and drain plugs
 - d) Special calibration tool/configurator, if any.
19. Preferred Features :
 - a) Test plug connection and cutout terminals physically separated from other electronics.
 - b) Electronic Damping facility (adjustable).

1.03.00 MASS FLOW METER

A. Sensor

01. Measuring Principle : Coriolis Mass flow.
02. Primary Element : Flow Tube of 316SS or better
03. Temperature Control : To be provided for heavy fuel oil application. Heating arrangement shall be integral.
For Heating
04. Process Connection : Flanged and rating as per process requirement.
05. Drain : Self-draining facility



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06. Enclosure : Stainless steel
07. Accessories : Counter flanges, Mounting nuts, bolts, gaskets etc.
- B. Transmitter
 01. Measured quantities : Mass Flow rate, Total Mass Flow, Density, Temperature as minimum.
 02. Input Signal Processing : Digital Processing.
 03. Display : Digital Display (LCD).
 04. Output : 2 Nos. isolated output of 4-20mA DC with HART protocol, selectable from four measured quantities & field bus output for softlink with DCS
 05. Load : < 750 ohms.
 06. Power supply : "UPS", (if the external power supply is 230V AC, 50 HZ).
 07. Turn Down : 100:1
 08. Accuracy : $\pm 0.2\%$ of measured value
 09. Housing : IP 65 (Explosion proof for NEC Class-1, Division 1 area).
 10. Hazardous duty Version : FM Standards.
 11. Nameplate : Tag number, service engraved in stainless steel tag plate
 12. Accessories :
 - a) As required for field mounting
 - b) Handheld configurator
 - c) Mounting U-bolts, nuts, bolts, prfab cable etc.

1.04.00 Turbine Flow meter

- A. Sensor
 01. Type : Turbine (in line full-bore, based on magnetic pick up pulses)





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02. Output Signal : Pulse
03. Material of Construction :
 - a) Body : AISI 316
 - b) Rotor: AISI 431 or 410
 - c) Bearings: Tungsten Carbide / Stellite Sleeve
04. Flow rate range : As required.
05. Linearity : $\pm 0.25\%$ or better.
06. Repeatability : $\pm 0.02\%$ or better.
07. Ambient temperature : 50°C
08. Mounting : On-Line, flanged
09. Enclosure : IP 65
- B. Transmitter
 01. Electronics : Solid State
 02. Power Supply : "UPS", if the external power supply is 230V AC, 50 HZ.
 03. Input : Input from Sensor
 04. Display : Backlit LCD
 05. Output : Isolated 4-20mA DC with HART protocol.
 06. Measuring Accuracy : $\pm 0.5\%$ of full scale range
 07. Totalized Value : Required
 08. Housing : IP-65 (Explosion proof for NEC Class-1, Division 1 area)
 09. Nameplate : Tag number, service engraved in stainless steel tag plate
 10. Accessories :
 - a) Clamping strip, bracket, prefab cable etc.
 - b) Calibration or configurator kit.

1.05.00 Vortex Flow meter

A. Sensor

01. Type : Vortex



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02. Output Signal : Pulse
 03. Material of Construction : AISI 316
 04. Sensor Seal : PTFE / higher based on temperature
 05. Flow range : As required.
 06. Linearity : $\pm 1\%$ or better.
 07. Repeatability : $\pm 0.2\%$ or better.
 08. Ambient temperature : 50°C
 09. Mounting : On-Line, flanged.
 10. Enclosure : IP 65
 11. Accessories : Nuts, bolts, gaskets etc.
- B. Transmitter**
01. Electronics : Solid State-remote mounting
 02. Power Supply : 24 V DC.
 03. Input : Input from Sensor
 04. Display : Backlit LCD
 05. Output : Isolated 4-20mA DC.
 06. Protocol : HART
 07. Totalized Value : Required
 08. Housing : IP-65 (Explosion proof for NEC Class-1, Division 1 area)
 09. Nameplate : Tag number, service engraved in stainless steel tag plate
 10. Accessories :
 - a) Clamping strip, bracket, prefab cable etc.
 - b) Special tool kit for calibration/ configuration .





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1.06.00

Rotameter

01. Type : Online upto 2" and Bypass above 2" line size"
02. Metering tube : Borosilicate glass
03. Float : AISI 316-SS unless the process fluid demands some other material.
04. Body MOC : SS as per fluid condition.
05. Scale : Aluminium Graduated - Engraved black on white background.
06. Process connection : Flanged to line size or threaded for connection size ½" or less.
07. Accuracy : ± 2% of full scale detection or better for on-line type and ±4% of full-scale detection or better for by-pass type.
08. Nameplate : Tag number, service engraved in stainless steel tag plate
09. Accessories : Slip-on orifice plate of 316-SS and taps of / SS as per application. Applicable SS Isolation valves and SS Range Orifice - for bypass type rotameters.
10. Housing protection class : IP- 65.

1.07.00

Pressure Gauge and Differential Pressure Gauge

01. Type : Bourdon/Bellows/Diaphragm
02. MOC Sensing & Socket : AISI-316 SS
03. Movement Material : AISI-304 SS
04. Case Material : Stainless steel..
05. Bezel Material : SS 304.
06. Socket Material : SS 316
07. Enclosure : IP-65.
08. Dial Size : 150 mm



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- | | | | |
|-----|-------------------------------|---|---|
| 09. | Scale | : | Black lettering on white background in 270 Deg. arc. |
| 10. | Window | : | Shatterproof glass |
| 11. | Range Selection | : | Normal process pressure – 50 ~ 70 % of range (approximately). |
| 12. | Over-range Protection | : | 125% of maximum range by internal stop. External stop at zero |
| 13. | Adjustment | : | Micrometer screw for zero adjustment. Internal micrometer screw for range adjustment.

External zero adjustment for glycerine filled gauges. |
| 14. | Element Connection | : | Argon welding |
| 15. | Process Connection | : | 1/2" NPT(M) Bottom connection for local mounting, back connection for panel mounting. |
| 16. | Performance | : | Accuracy of ± 1.0 % of span or better. |
| 17. | Operating ambient temperature | : | 0 - 50°C |
| 18. | Safety Feature | : | Blow out disc./diaphragm at the back |
| 19. | Accessories | : | a) Snubbers and Glycerin filled for pulsating fluid applications and at pump discharge.

b) Stainless steel Diaphragm chemical seals for corrosive, viscous and solid-bearing or slurry type process fluids. diaphragm chemical seal shall be provided with the following:
1) Top chamber : SS 304
2) Bottom Chamber: SS 316
3) Sealing fluid: Silicon DC 200
4) Diaphragm: SS 316

c) 3-way SS gauge cock/ 2-Valve SS-316 barstock manifold for pressure gauges with 1/2" NPT process connection.. |





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- d) 5-valve SS316 manifold constructed from barstock for differential pressure gauge. Process connection ½" NPT.
- e) Union, nut & tail piece and other Installation accessories as required.
- f) Syphons for steam and hot water services.

- 20. Applicable standard : IS-3624 / 1996 , EN-837-1
- 21. Nameplate : Tag number, service engraved in stainless steel tag plate

1.08.00 Temperature Gauge

- 01. Type : Inert gas filled remote mounting system.
- 02. Sensing Element Material : Bourdon - AISI-316 SS
- 03. Capillary Armoring : Stainless steel flexible
- 04. Movement Material : AISI 304 SS
- 05. Bulb / Stem Diameter : 12 mm
- 06. Bulb / Stem Material : AISI 316
- 07. Capillary : Stainless Steel
- 08. Thermometer connection to well : ½" NPT
- 09. Case Material : Stainless steel
- 10. Dial Size : 150 mm in general (100 mm for SWAS gauges)
- 11. Scale : Black lettering on white background in 270 Deg. arc.
- 12. Mounting : Surface/Panel
- 13. Over range Protection : 125 % of range or more
- 14. Instrument connection : Bottom connection for local mounting and back connection for panel mounting.



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|-----|-----------------|---|---|
| 15. | Range | : | Normal temperature – 50 ~ 70% of range approximately. |
| 16. | Zero adjuster | : | Micrometer screw adjustable from front. |
| 17. | Window | : | Shatterproof glass. |
| 18. | Accuracy | : | $\pm 1\%$ or better |
| 19. | Enclosure Class | : | IP-65 |
| 20. | Capillary | : | 5 meters (local)/15.0 meters (local panel) -
armoured stainless steel |
| 21. | Compensation | : | Capillary and Case Compensation |
| 22. | Accessories | : | a) Forged/barstock SS316 thermowell
screwed as per ASME PTC code.
Process connection M 33X2 (M).
Material of construction of thermowell:
1) SS 316: in general
2) Inconel: For flue gas application
3) Tungsten carbide: For coal mill
application

b) Installation accessories as required. |
| 23. | Nameplate | : | Tag number, service engraved in stainless
steel tag plate |

1.09.00

Thermocouples

- | | | | |
|------|--------------------|---|---|
| 01. | Type | : | a) Type-K (Chromel Alumel) / Type-R (Pt.-
Rhodium Pt.) / Type-E (Chromel
Constantan) [As per application]

b) Duplex (Triplex incase of
turbine/Generator/excitor bearing
temperature may be used)

c) Ungrounded |
| 02. | Wire gauge | : | 16 AWG for Type-K, 24 AWG for Type-R |
| 03. | Standard | : | ANSI-MC 96.1. |
| 04. | Protecting Tube :- | | |
| i) | O.D. | : | 8 mm |
| ii) | Material | : | 316-SS Seamless |
| iii) | Filling | : | Magnesium Oxide (Purity above 99.4%) |



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05. Response time with Thermowell : a) Less than 20 seconds for measurement.
 b) Less than 10 seconds for control.
06. Accuracy : $\pm 1.1^{\circ}\text{C}$ upto 300°C & 0.4% of measured temperature range above 300°C .
07. Head :
- i) Type : IP-65 universal screwed type. (Explosion proof for NEC Class-1, Division 1 area)
 - ii) Material : Die cast aluminum or better
 - iii) Terminal blocks : Nickel plated Brass - screw type / silver plated
 - iv) Instrument connection : $\frac{1}{2}$ " NPT to well
 - iv) Cable connection : $\frac{1}{2}$ " NPT gland and grommet.
 - v) Others : Terminal head cover with SS chain and suitable gasket. All thermowells in the high velocity steam service shall be checked for Strouhal's frequency limit to arrive at a safe size and design of thermowells"
08. Accessories : a) Adjustable nipple-union-nipple [$\frac{1}{2}$ " Sch 80 X $\frac{1}{2}$ " NPT (M)] with thermowell connection
 b) Compression fittings/unions
 c) Flanges etc. (for flanged connections only)
 d) Barstock thermowell of stepless tapered design as per ASME PTC19.3 code.
- Process connection M33x2 (M) in general or $1\frac{1}{2}$ " flanged for flue gas/Furnace/air etc. application.
- Material of construction of thermowell:
- 1) SS 316: in general
 - 2) Inconel: For flue gas application
 - 3) Tungsten carbide: For coal mill application.





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

1.10.00 Passing condition of various drain valves shall be monitored by measuring drain pipe metal temperature at the downstream of the drain valves. Also Drum, SH, RH metal temperature measurement shall be provided. Necessary thermocouples shall be provided as per the following specification.

01. Measuring medium : Metal temperature
02. Metal of thermocouple element : Chromel-Alumel Type-K
03. Type of thermocouple : Duplex with separate hot junctions, ungrounded type.
04. Insulation : Mineral insulation Magnesium Oxide
05. Thermocouple wire gauge : 16 AWG
06. Protective Sheath : SS 321
07. Protective Sheath Dia : 8 mm O.D.
08. Characteristics of thermocouple : Special limits of error as in ANSI MC 96.01.1975
09. Mounting Accessories : 1/2" BSP SS sliding end connector, weld pad, weld on clamps of heat resistant steel SS 310.
10. Cold end sealing : SS pot seal with colour coded PTFE headed sleeve insulated flexible tails. Sealing compound - Epoxy resin
11. Minimum Bending Radius : 30 mm
12. Length of T/C : 30 mtrs. (minimum)

1.11.00 Resistance Temperature Detector

01. Type : Platinum (Duplex), Ungrounded
02. Resistance : 100 ohm at 0°C
03. Base : Wound on ceramic (anti-inductive)
04. Wiring : 3 / 4 Wire



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05. Protecting Tube :-
- i) O.D. : 8 mm
 - ii) Material : SS-316, Seamless
 - iii) Filling : Magnesium oxide (Purity above 99.4%).
06. Response time : a) < 20 seconds for measurement.
b) < 10 seconds for control.
07. Calibration : DIN 43760
08. Accuracy : $\pm 0.5\%$ of range
09. Head :
- i) Type : IP-65 universal screwed type. (Explosion proof for NEC Class-1, Division 1 area)
 - ii) Material : Die cast aluminum or better
 - iii) Terminal blocks : Nickel plated Brass-screw type / silver plated
 - iv) Cable connection : $\frac{1}{2}$ " NPT gland and grommet.
 - v) Others : Terminal head cover with SS chain and suitable gasket. All thermowells in the high velocity steam service shall be checked for Strouhal's frequency limit to arrive at a safe size and design of thermowells"
10. Accessories : a) Adjustable nipple-union-nipple [$\frac{1}{2}$ " Sch 80 X $\frac{1}{2}$ " NPT (M)] with thermowell connection
b) Compression fittings/unions
c) Flanges etc. (for flanged connections only)
d) Barstock thermowell of stepless tapered design as per ASME PTC19.3 code.
- Process connection M33x2 (M) in general or $1\frac{1}{2}$ " flanged for flue gas/Furnace/air etc. application.
- Material of construction of thermowell:
- 1) SS 316: in general
 - 2) Inconel: For flue gas application





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3) Tungsten carbide: For coal mill application.

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

1.12.00 Pressure Switch

01. Type : i) Piston for high pressure application (above 40 bar)

ii) Bellow /Diaphragm for low pressure application (below 40 bar)

02. Sensing element material : AISI SS-316. All other wetted part SS316.

03. Case Material : Die-cast aluminum alloy with neoprene gasket.

04. Setter Scale : Black graduation on white linear scale. Graduation 0-100% with red pointer for set points.

05. Over range : 150 % of maximum pressure

06. Adjustments : a) Internal Set Point
b) Differential adjustment

07. End Connection : 1/2" NPT (M) bottom connected

08. Switch configuration : Two SPDT

09. Switch Rating : 240V, 5A AC/220V, 0.5A DC

10. Switch Type : Snap acting, shock & vibration proof

11. Terminal Block : Suitable for full ring lugs for cable connection.

12. Elect connection : Plug in socket

13. Enclosure Class : IP-65 weather and dust proof (Explosion proof for NEC Class-1, Division 1 area).

14. Performance : a) Repeatbility $\pm 0.5\%$ of full range
b) Accuracy of Setting Indication of $\pm 1.5\%$

15. Ambient temperature : 0 – 50°C





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- | | | | |
|-----|-------------|---|--|
| 16. | Nameplate | : | Tag number, service engraved in stainless steel tag plate |
| 17. | Accessories | : | a) Remote diaphragm seal with SS-316 capillary for viscous & corrosive application. MOC of seal material shall be as per process fluid requirement.

b) Snubbers for pulsating fluid application.

c) Syphons for steam and hot water services.

d) Retention ring and screws for surface mounting.

e) 1/2" NPT 2 Valve SS-316 manifold constructed from barstock

f) Brass cable gland |

1.13.00 Differential Pressure Switch

- | | | | |
|-----|--------------------------|---|---|
| 01. | Type | : | Bellows / Diaphragm / Piston actuated |
| 02. | Sensing element material | : | AISI SS-316. For all other wetted part SS 316 |
| 03. | Case Material | : | Die-cast aluminum alloy with neoprene gasket. |
| 04. | Setter Scale | : | Black graduation on white scale with 0-100% graduation and provided with red pointer for set point adjustment |
| 05. | Over range | : | Static pressure on any one side, the other side being open to atmosphere. |
| 06. | Adjustments | : | a) Internal set point adjustment
b) Differential adjustment |
| 07. | Process Connection | : | 1/2" NPT (M) bottom connected / back connected. |
| 08. | Switch configuration | : | Two SPDT |
| 09. | Switch rating | : | 240V, 5A AC/220V, 0.5A DC. |
| 10. | Switch type | : | Snap acting type contacts, shock and vibration proof. |





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11. Terminal Blocks : Suitable for full ring lugs for cable connection.
12. Elect connection : Plug in socket
13. Performance : a) Repeatability $\pm 0.5\%$ of full range
 b) Accuracy of set point Indication: $\pm 1.5\%$
14. Operating Ambient Temperature : 0 - 50°C
15. Enclosure : IP-65 (Explosion proof for NEC Class-1, Division 1 area).
16. Accessories : a) Snubbers for pulsating fluid application.
 b) Syphons for steam and hot water services.
 c) Retention ring and screws for surface mounting.
 d) 1/2" NPT 3-Valve SS-316 manifold constructed from barstock
17. Nameplate : Tag number, service engraved in stainless steel tag plate
18. Remote Seal type for special application : a) Silicone oil / fluorolube filled remote diaphragm seal for dirty / viscous / corrosive fluid.
 b) SS armoured capillary at least 3 meters each.
 c) Adapter flanges with nuts, bolts and gaskets for instrument and process side.

1.14.00 Temperature Switch

01. Type : Inert gas filled-in
02. Sensing Element Material : Bellow / Bourdon AISI SS-316
03. Bulb Material : AISI SS-316
04. Capillary : Stainless steel armoured
05. Movement Material : AISI SS-304
06. Case material : Epoxy coated steel plate or die-cast aluminum alloy with neoprene gasket and



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clear glass where applicable cover conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).

07. Scale : Black lettering on white background
08. Over range Protection : 120 %
09. Instrument connection : Bottom
10. Switch configuration : Two SPDT
11. Switch rating : 240V, 5A AC/220V, 0.5A DC
12. Switch type : Snap acting, shock and vibration-proof.
13. Adjustability : Internal Set point adjustable over span range
14. Elect connection : Plug in socket
15. Compensation :
 - a) Capillary compensation with invar wire throughout the capillary length.
 - b) Case compensation
16. Performance :
 - i) Scale Accuracy : ± 1.0 % of full scale
 - ii) Repeatability : < 0.5 % of full range
 - iii) Response time : Less than 40 seconds with thermowell
17. Capillary length : 5 meters (minimum) for local mounting/15 meters for local panel mounting.
18. Nameplate : Tag number, service engraved in stainless steel tag plate
19. Accessories : Thermowell from SS barstock, Mounting accessories, $\frac{1}{2}$ " NPT cable gland.

1.15.00 Level Switch

01. Type : External cage float operated. Magnetically coupled.
02. Float Material : AISI-316 stainless steel or better
03. Other wetted parts : AISI-316 stainless steel or better
04. External Cage : Carbon steel / Stainless steel or better as per process requirements, welded type / flanged



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construction. Cage pressure rating shall equal or exceed the rating of the main vessel.

- | | | | |
|-----|------------------------------|---|---|
| 05. | External cage mounting | : | Side-Side. |
| 06. | External cage connection | : | 25 NB socket welded. |
| 07. | Switch housing | : | Epoxy coated die-cast aluminum alloy with neoprene gasket conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area). |
| 08. | Type of switch configuration | : | 2 SPDT (two nos.) |
| 09. | Contact rating | : | 5A, 240V/AC, 0.25A, 220V DC |
| 10. | Accessories | : | a) Counter flange, nuts & bolts, suitable gasket etc.
b) Steel globe type drain valve.
c) ½"NPT cable gland
d) Stainless steel alpha-numeric engraved for service and tag.
e) Globe drain valve |
| 11. | Preferred feature | : | Switch operating point marked on cage |
| 12. | Mounting | : | On standpipe |

1.16.00 Conductivity Type Level Switch

- | | | | |
|-----|--------------|---|--|
| 01. | Type | : | Conductivity discrimination. |
| 02. | Application | : | Drain pots viz. on CRH line |
| 03. | Mounting | : | Flanged – on external cage. |
| 04. | Probe MOC | : | Stainless steel with high purity ceramic. |
| 05. | Probe rating | : | > Maximum design pressure of vessel. |
| 06. | Input | : | Four independent channel with selectable switching threshold for water conductivity. |
| 07. | Relay Output | : | Four isolated output relays for Hi, Lo, Hi-Hi, Lo-Lo. |





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08. Contact type & rating : 2SPDT or 1 DPDT @ 5A 30V DC.
09. Local Display : Coloured LEDs for Hi, Lo, Hi-Hi, Lo-Lo, Power & fault.
10. Power supply : Dual 240V AC, 50 Hz, 1Ph UPS supply.
11. Enclosure : IP-65, corrosion resistant & wall mounting type (Explosion proof for NEC Class-1, Division-1 area).
12. Accessories :
 - a) PTFE cable from probe to electronics
 - b) Mounting accessories
 - c) External cage
 - d) Washer & gasket
13. Test pressure : Two times rated pressure
14. Elect connection : Plug in socket

1.17.00 Capacitance Type Level Switch

01. Type : Capacitance type
02. Probe :
 - a) Rod or suspended electrode
 - b) Rope type probes may be used only where required probe length is greater than 1.5 meters.
 - c) Reference rod for non grounded tank.
03. Probe Mounting : 1-1/2" Flanged
04. Material of construction : 316 SS and to suit fluid type
05. Insulation : PTFE/PP/Kynar Part/Full as required
06. Enclosure : Powder coated Die cast aluminium. with neoprene gasket conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).
07. Ambient temperature : 0-60°C.
08. Mounting : Top Mounting
09. Supply voltage : 240V AC, 50 Hz, 1Ph UPS supply/ 24V DC



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10. Relay output : 2 SPDT
11. Contact rating : 5A min. at 240V AC on resistive load
12. Response time : 100 msec or better
13. Elect connection : Plug in socket
14. Accessories : Counter flange, cable gland, prefab cable and stainless steel name plate engraved with alpha-numeric.

1.18.00 RF Type Level Switch

- Sensing Probe :
01. Type : Rigid
 02. Material : SS-316
 03. Mounting : Threaded
 04. Probe Head Housing : Cast Aluminium
 05. Protection : IP-66
- Electronic Controller :
01. Supply Voltage : 240V AC (UPS)
 02. Relay Output : 2 nos. SPDT
 03. Contact Rating : 240V AC,5A/ 220V DC, 0.25A
 04. Housing Material : Cast Aluminium
 05. Protection : IP-65
 06. Local LED Indication : Power On, Alarm Level, Probe Healthy
 07. Switching Repeatability : $\pm 0.5\%$
 08. Accessories : Coaxial cable probe connection to controller
1/2"NPT Cable Gland

1.19.00 Ultrasonic Level Switch

01. Principle of operation : Ultrasonic contact level technology
02. Input Power : 24V DC/ 240V AC



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- | | | | |
|-----|--------------------|---|---|
| 03. | Output Contact | : | 2 SPDT (240V AC, 5A/ 220V DC, 0.25A) |
| 04. | Switch Mounting | : | Integral |
| 05. | Sensor Material | : | SS-316 |
| 06. | Enclosure | : | Cast Aluminium (IP-65) |
| 07. | Process Connection | : | 2" Flanged |
| 08. | Repeatability | : | 2 mm |
| 09. | Power supply | : | 240V AC, 50 Hz, 1Ph UPS supply/ 24V DC |
| 10. | Cable connection | : | 1/2" NPT with cable gland |
| 11. | Accessories | : | Cable gland, cable, companion flange, bolts & nuts, gaskets etc. along with all mounting hardware |

1.20.00 Ultrasonic Level Transmitter

- | | | | |
|-----|-----------------------------|---|---|
| 01. | Principle of operation | : | Detection of reflected ultrasonic pulse |
| 02. | Signal processing | : | Microprocessor Controlled Signal Processing |
| 03. | Type | : | Smart |
| 04. | Display | : | Large alpha-numeric back lit LCD/LED |
| 05. | Calibration & configuration | : | Accessible from front of panel |
| 06. | Diagnostic | : | On-line |
| 07. | Status | : | For power, Hi / Lo / V. Hi / V. Lo-level indication, fault etc. |
| 08. | Construction | : | Plug-on board |
| 09. | Power supply | : | 240V AC, 50 Hz, 1Ph UPS supply/ 24V DC |
| 10. | Signal Output | : | 4-20 mA DC (isolated) - 500 Ohm load with HART protocol. |
| 11. | Hysteresis | : | Fully adjustable preferred |
| 12. | Output contacts | : | 2SPDT Potential free changeover contacts @ 5A 230V AC. |





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13. Accuracy & Repeatability : 0.25% of span or better
14. Resolution : 0.1% of span
15. Operating temp. : Transmitter- 0 to 50° C and Sensor 0 to 80° C
16. MOC Sensor : SS 316 in general / PTFE, PP for corrosive application.
17. Humidity : 1% to 95% non condensing.
18. Enclosure : IP-65 powder coated die cast aluminium
19. Cable connection : ½" NPT with cable gland
20. Mounting : 2" flanged for sensor and Transmitter on panel / surface.
21. Accessories : Cable gland, prefab cable, mounting accessories.

1.21.00 Conductivity Type E lectronic Level Indicator

01. Type : Conductivity discrimination.
02. Application : Separator drum Level .
03. No. of Probes : As per manufacturer standard.
04. Probe Mounting : Flanged – on standpipe.
05. Probe MOC : Stainless steel with high purity ceramic.
06. Probe rating : > Maximum design pressure of vessel.
07. Input : Independent channel with selectable switching threshold for water conductivity.
08. Relay Output : Four isolated output relays for Hi, Lo, Hi-Hi, Lo-Lo.
09. Contact type & rating : 2 SPDT or 1 DPDT @ 5A 30V DC.
10. Current output : Isolated 4-20 mA DC
11. Local Display : a) Coloured (Red & Green) LEDs for level.
b) Flashing LEDs for fault.
12. Remote Display : Red, Green & flashing yellow LEDs for steam, Water & Fault indication respectively.



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13. Power supply : Dual 240V AC, 50 Hz, 1Ph UPS supply.
14. Enclosure :
 - a) IP-65, corrosion resistant & wall mounting type for local electronics.
 - b) IP-42 for remote indicator
15. Accessories :
 - a) PTFE cable from probe to electronics
 - b) Mounting accessories.
 - c) Standpipe
 - d) Washer & gaskets
 - e) Double isolation valves on each connection, double drain valves & double vent valves with mechanical lock.
 - f) 1/2" NPT cable gland
16. Test pressure : Two times design pressure

1.22.00

Air Filter Regulator

01. Filter Element : Sintered Bronze
02. Filter Size : 5 microns
03. Input Air : 10.0 Kg/Sq. cm (maximum)
04. Output : Adjustable from 0-2.0 Kg / Sq. cm or 0-7.0 Kg / Sq. cm (continuous) as applicable.
05. Effect of Supply : Maximum 0.02 Kg/Sq. cm for a change pressure variation in supply pressure of 4 Kg/Sq. cm
06. Bowl Material : Metallic.
07. Accessories : 2" dial size output pressure gauge
08. Feature : No perceptible drop of pressure on opening the drain port.

1.23.00

SOLENOID VALVE

01. Operating Principle : Electromagnetic (noiseless)
02. Coil voltage rating : 24V DC (in general) other 220V DC /240V AC /110V AC as required



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|-----|---------------------|---|---|
| 03. | Ways | : | 3 ways in general other depending on requirement |
| 04. | Port size | : | 1/4" NPT all ports |
| 05. | Body | : | SS Bar Stock |
| 06. | Trim | : | AISI SS-316 |
| 07. | Manual Operator | : | In built |
| 08. | Duty | : | Suitable for continuous energization |
| 09. | Sealing | : | Airtight and leak proofing with nitrile (NBR) and polyurethane (PUR) material |
| 10. | Ambient Temperature | : | 0 - 50° C |
| 11. | Fluid Temperature | : | 0-150° C (approx.) |
| 12. | Coil Enclosure | : | Stainless Steel |
| 13. | Insulation | : | Class-H |
| 14. | Coil Casing | : | IP-65 (Explosion proof for NEC Class-1, Division-1 area) |
| 15. | Response time | : | 4-7msec |
| 16. | Mounting | : | On pipe or on panel |
| 17. | Cable Connection | : | ½" NPT cable gland |
| 18. | Accessories | : | Mounting brackets, nuts and bolts |
| 19. | Special feature | : | (i) LED indication for power

(ii) Double coil type for open & close operation of valve / damper.

(iii) Solenoid valve directly integral to actuator body shall have NAMOOR interface for uniformity |

1.24.00 ORIFICE PLATE

- | | | | |
|-----|-------------------|---|---|
| 01. | Application | : | Low fluid velocity flow measurement |
| 02. | Design Standard | : | Concentric as per ASME PTC-19.5 (Part –II), ISA RP-3.2 or BS-1042, Part-I |
| 03. | Number of Tapings | : | As required plus one additional pair of taps |
| 04. | Diameter Ratio | : | Between 0.34 to 0.7 |



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- | | | | |
|-----|----------------|---|---|
| 05. | Thickness | : | 3mm for main pipe of diameter upto 250mm, 6mm for main pipe of diameter above 250mm and 10mm for diameter above 500 mm |
| 06. | Document | : | Beta ratio calculation, assembly drawing and Flow vs. DP curve. |
| 07. | Meter run pipe | : | Same as pipe material |
| 08. | Accessories | : | Flanges, gaskets, nuts & bolts, root valves (1" 316 SS globe) jack screw, meter run pipe, Drain & vent hole as per application etc. |

1/2" SS316 globe

NOTE: One flow element of each type shall be calibrated in the test laboratory for validation of computed flow calculations.

1.25.00 FLOW NOZZLE

- | | | | |
|-----|-----------------|---|--|
| 01. | Application | : | High fluid velocity flow measurement |
| 02. | Design Standard | : | ASME PTC 19.5 |
| 03. | Tapings | : | D and D/2 (Numbers as required plus one additional pair of taps) |
| 04. | Diameter Ratio | : | Between 0.4 and 0.7 |
| 05. | Material | : | 316 SS (321 SS for high temperature) |
| 05. | Document | : | Beta ratio calculation, assembly drawing and Flow vs. DP curve. |
| 06. | Meter run pipe | : | Same as pipe material |
| 07. | Accessories | : | Meter run pipe, nipples and root valves (1" 316 SS globe).(Inspection port assembly for nozzles used in plant performance purpose) |

NOTE: One flow element of each type shall be calibrated in the test laboratory for validation of computed flow calculations.

1.26.00 GAUGE GLASS

- | | | | |
|-----|-----------------|---|--|
| 01. | Type | : | Reflex |
| 02. | Glass | : | Toughened borosilicate. Resistant to mechanical and thermal shocks. |
| 03. | Body material | : | Carbon steel / stainless steel- As per process requirements (Flanged Connection) |
| 04. | Pressure rating | : | Twice the maximum working pressure |



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- 05. Temperature rating : 300^o C
- 06. Bolts and nuts : Rust proof alloy steel
- 07. Accessories : Suitable ball check valves of SS-304/316 body, gaskets, companion flange etc.

1.27.00 LEVEL GAUGE (FLOAT & BOARD)

- 01. Type : Float and Board
- 02. Float & Tape MOC : AISI 316
- 03. Pulley and Pulley Housing material : SS 304
- 04. Guide wire : SS 316 Stainless steel
- 05. Accuracy : +/- 2 mm
- 06. Indication : Vertical dial
- 07. Rating : Twice the design pressure
- 08. Spring tension assembly : SS 304
- 09. Anchor plate : SS304
- 10. Calibrated scale board: Aluminium with black graduation

Note: The measuring rope/tape shall be passed through conduits

1.28.00 POWER CYLINDERS (PNEUMATIC)

- 01. Mounting Type : a) Fixed position mounting (End mounting).
 : b) Trunnion mounting
- 02. Control Signal : 4-20 mA DC to smart positioner with HART protocol for modulating purposes. 24V/48VDC operated solenoid valve operating on pneumatic line for open & closing purpose of on & off drive.
- 03. Supply Air : 0-7 Kg / Cm².
- 04. Selection : Based upon thrust / torque, stroke length, angular movement, full-scale travel time, repeatability, space factor etc. Provision for air-to-open and air-to-close operation.
- 05. Casing : IP-65.



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06. Accessories (as required) :
- a) Air lock relay
 - b) Hand wheel.
 - c) Air filter regulator with gauge.
 - d) Volume Booster.
 - e) Limit Switches.
 - f) Smart Positioner with integral I-P convertor, feedback position Transmitter (4-20 mA DC output), Input & Output pressure gauges, local keypad & display.
 - g) Solenoid Valve
 - h) Junction box with cable gland
07. Fail-safe operation : Stay put for regulating duty.
08. Repeatability : Better than 0.5% of full travel.
09. Hysterisis : Less than $\pm 1\%$ of full travel
10. Operating Temp. limit : 80°C (min.)

1.29.00

SIGHT GLASS

01. Type : Flap-type
02. End connection : Screwed / Flanged
03. Material :
- a) Body : SS-304
 - b) Cover Plate : SS-304
 - c) Indicator : SS-316
04. Sight Glass : Toughened Borosilicate
05. Gasket : Neoprene
06. Bolts & Nuts : High tensile steel
07. Hydraulic Test
- Pressure : 1.5 times maximum working pressure
08. Accessories : As required

~~1.30.00~~

~~**SMOKE DENSITY ANALYZER**~~

- ~~01. Type : Insitu dry visible light (through LED)~~
- ~~02. Principle of~~



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05. Alarm/ Annunciation : Four Relay contacts, dual alarm set points (240V AC, 5A)
06. Indication : LCD Display
07. Sampling System : Extractive
08. Enclosure : IP-65
09. Power Supply : 240V AC (UPS)
10. Location : On Chimney
10. Accessories : a) Inbuilt calibration facility through calibrator. Inbuilt cell for Zero & Span calibration to be provided. Handling of Liquid Mercury to be avoided.
 b) Remote calibration facility to be provided.
 c) The Mercury analyser cabinet to be placed inside an enclosed AC environment.

1.36.00 DEW POINT METER

01. Type : Direct mounting capacitance type with change in output proportional to moisture present
02. Sensing Element : Ceramic/ Aluminium Oxide sensor
03. Service : Dry Air
04. Range : -90 Deg.C to 10 Deg.C Dew point temperature
05. Sensor Accuracy : ± 2 Deg.C Dew point
06. Repeatability : 0.5 Deg.C Dew point
07. Op.Ambient Temperature : -40 Deg.C to 50 Deg.C
08. Op. Pressure : 0-10 Kg/cm²
09. Display : Combined enclosure with 5 digit seven segments LED display
10. Element Filter : 80 micron sintered stainless steel
11. Output : 4~20 mA DC loop powered
12. Power Supply : 24V DC nominal





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- 13. Enclosure Class : IP-65
- 14. Interchangeability : Fully Interchangeable Transmitters
- 15. Accessories : Sampling System, cables, sensor holder, dessicant chambers, souble compression fittings, ¾" cable gland, mounting fixture etc.

1.37.00 DENSITY METER

- 01. Operating Principle : Vibration Density measurement
- 02. Wetted Part Material : SS-316L
- 03. Case Material : Cast Aluminium
- 04. Output : 4~20 mA DC
- 05. Electrical connection : ½" NPT
- 06. Enclosure Class : IP-65
- 07. Local Display : Digital 5 digit, density display with temp. compensation
- 08. Accuracy : ±1.0 %
- 09. Power Supply : 240V AC (UPS)
- 10. Location : At the discharge of Gypsum bleed pump in FGD system.

1.38.00 RADAR TYPE LEVEL MEASUREMENT

- 01. Type : Radar based on Time Domain Reflectometry
- 02. Antena : Co axial / single rod type guided wave or Horn type as required for the application
- 03. Communication : Two wire 4-20mA DC, HART protocol
- 04. Environmental temperature : 0 – 50°C
- 05. Enclosure : Explosion proof /IP 65 as per application
- 06. Cable Entry : ½" NPT
- 07. Calibration : a) Self calibration with internal reference
b) Zero & Span calibration
- 08. Programming : Handheld programmer & Local key pad
- 09. Process Connection : Flanged /screwed



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|-----|--------------------|--|
| 10 | Transmitter Beam | |
| | Angle | : 10 degree or less |
| 11 | Blocking distance | : less than 300 mm |
| 12. | Electronic Housing | : Epoxy painted Die-Cast aluminium alloy |
| 13. | Antenna / Flange | |
| | assembly | : 316 SS or Hest alloy (as required) |
| 14. | Output Indicator | : Digital Integral Display (Backlit LCD/LED) |
| 15. | Accuracy | : 5 mm or 0.1% of probe length |
| 16. | Accessories | : a) Programming tool kit
b) Gasket |

1.39.00 CHLORINE LEAK DETECTOR

- | | | |
|-----|-----------------------|--------------------------------------|
| 01. | Type | : Electrochemical |
| 02. | Resolution | : 0.1 ppm |
| 03. | Display Type | : Digital Indicating Meter |
| 04. | Operating Temperature | : 0~45°C |
| 05. | Alarm Contacts | : Dual Alarm setpoints (240V AC, 5A) |
| 06. | Enclosure Class | : IP-65 |
| 07. | Mounting | : Wall mounting |
| 08. | Power Supply | : 240V AC |
| 09. | Output | : 4~20 mA DC (600 Ω load) |

1.40.00 RESIDUAL CHLORINE ANALYZER

- | | | |
|-----|--------------|--|
| 01. | Type | : Amperometric |
| 02. | Electrode | : Platinum/ Gold and copper electrode shall be provided with cell cleaning system |
| 03. | Display Type | : LCD in Analyzer Panel |
| 04. | Range | : 0 to 20.0 mg/L (ppm) |
| 05. | Accuracy | : 2% or better . The measurement accuracy shall not be affected by presence of treatment chemicals as chromates, |



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phosphates, de-former highly polluted water, change in temperature etc.

- | | | | |
|-----|-----------------|---|---|
| 06. | Sensitivity | : | 0.01 mg/L |
| 07. | Alarm Contacts | : | Dual Alarm setpoints (240V AC, 5A) |
| 08. | Enclosure Class | : | IP-65 |
| 09. | Power Supply | : | 240V AC |
| 10. | Output | : | 4~20 mA DC (600 Ω load) |
| 11. | Calibration | : | Zero & Span adjustment. Final calibration adjustments of the analyzer to be done at site and duly verified bt titration. Temperature compensation range 0-50°C. |
| 12. | Mounting | : | Field mounting conform to IP-65 |
| 13. | Accessories | : | Chemical reagents, sample drain, pumping system (if required) etc. |

1.41.00 ELECTRIC TO PNEUMATIC (E/P) CONVERTERS

- | | | | |
|-----|----------------------|---|---|
| 01. | Air Supply | : | 1.5 kg/cm2 |
| 02. | Max. supply Pressure | : | 7 kg/cm2 |
| 03. | Input Signal | : | 4-20 mA DC (as required by the design of control system). |
| 04. | Output Signal | : | 0.2 to 1.0 kg/cm2 |
| 05. | Control Action | : | Air to Close, Air to Open and Fail freeze-field selecable |
| 06. | Response Time | : | 5 seconds for 0 to 90% output pressure |
| 07. | Repeatability | : | +/- 0.1% span typical |
| 08. | Accuracy | : | +/- 0.25% span typical |
| 09. | Linearity | : | 0.5% of span or better |
| 10. | Hysteresis | : | 0.1% of span or better |
| 11. | Ambient Temp. | : | |
| | effect | : | Less than 0.02% of span per °C between |



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-20 °C to +60 °C

12. Supply pressure effect: less than 1%
13. Span and zero adjustment : screw
14. Mounting : Close to Actuator (but not on the actuator)
15. Output Capacity : To suit the actuator
16. Protection Class : IP 65
17. Allowable Drift Rate : $\pm 2\%$ of set point / hour maximum

On loss of control signal, the last set point pressure shall be maintained so that the associated control valve remains in stay put condition.

1.42.00 SMART POSITIONER

01. Type : Universal design (linear or rotary application)
02. Input Signal : 4-20mA DC , 2 wire loop with 24V DC.
03. Output Signal (position F/B) : i) 4-20mA
ii) Configurable end position switch
04. Supply Pressure : Single acting 1.2 to 7.0 bar
Double acting 1.2 to 10.5 bar
05. Air Delivery : Single acting 10.0 SCFM at 2.1 bar supply
Double acting 7.2 SCFM at 2.1 bar supply
06. Housing : IP 65
07. Repeatability : $\pm 0.3\%$ of span or better
08. Accuracy : $\pm 0.1\%$ of span or better
09. Communication : Hart protocol
10. Power-up with position : < 150 ms or better control
11. Power interruption without reset : <100ms or better
12. Body Material : Aluminium
13. Response Time : Less than 10 sec





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14. Features :
- i) Noncontact position feedback sensor
 - ii) Integral Electro-Pneumatic convertor
 - ii) Self calibration with tunable response time
 - iii) Online diagnostics
 - iv) Pressure guages to be provided on positioner (I/P & O/P pressure)

1.43.00 MAGNETIC LEVEL INDICATOR

- 01. TYPE : Magnetically coupled level indicator
- 02. Display : Coloured flags
- 03. Chamber material : Stainless steel
- 04. Wetted part material : Stainless steel
- 05. Process connection : Side Side Flanged
- 06. Drain & Vent : Flanged
- 07. Scale : Standard, Stainless steel
- 08. Accessories : Counter flange, gaskets

1.44.00 FLOW SWITCH

- 01. Type : Paddle /Piston/Disk
- 02. Wetted part material : Stainless steel or Hastelloy for acidic application
- 03. End connection : i) Threaded upto 1" line size with integral Tee
 ii) Flanged for line size > 1 ½"
- 04. Enclosure material : Die cast aluminium
- 05. Enclosure class : IP 65
- 06. Switch configuration : 2 SPDT
- 07. Contact rating : 240V AC 15A
- 08. Repeatability : 2%
- 09. Cable connection : ½"NPTF



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10. Accessories : Tee, counter flange

1.45.00 ULTRA SONIC TYPE FLOW METER

- a) Ultrasonic Flow meter shall be dual path transit time clamp-on type.
- b) The flow meters shall be of proven reliability, accuracy and repeatability requiring a minimum of maintenance. They shall comply with relevant international standards and shall be subject to approval.
- c) CW flow shall be measured by redundant Ultrasonic Flow meter.
- d) All accessories required for mounting/erection of these instruments shall be furnished, erected and installed as necessary for completeness of the system though not specifically asked for. Also the equipment shall include necessary cables, flexible conduits, junction boxes required for the purpose.
- e) Flow meters shall be provided with suitable environment protection devices / structures such that they shall be suitable for continuous operation in the operating environment of a coal fired utility station without any loss of function or departure from the specification requirements.

f) Technical Requirements

- 01. Type : Transit time Clamp On Ultrasonic meter
- 02. Mounting Style : Dual path with two sets of transducers on the same pipe
- 03. Flow measurement : Instantaneous Flow rate as well as totalized flow & velocity
- 04. Power supply : 240V AC, 50Hz with built –in battery back up.
- 05. Analog Outputs : Isolated 4-20mA linear outputs for each path with HART for volumetric flow and velocity
- 06. Binary Output : Contact relay outputs, 2 NO + 2 NC for alarm
- 07. Communication ports : RS 232 C digital
Hand held terminal port
- 08. Display/Indication : Flow meter with LCD screen backlight based local display and keypad. If required, transmitter shall be suitably located away from the sensor for better access and visibility.

09. Recording / Totalizing /



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- Logging Facilities : Yes. Should be able to compute cumulative flow over intervals selectable by Owner i.e., daily, weekly, monthly etc. The data shall be stored in the memory of flow computer for access in future.
10. Software features : Compensation for any cross path errors Programming, configuration, shall be possible from front panel.
11. Diagnostics : False signal tolerance , power supply failure etc.
12. Protection Class : IP-65 or better, Weather protection against direct sunlight, rain etc for Flow meter and suitable for Cooling water for Transducer.
13. Accuracy : $\pm 1\%$
14. Electrical connection : Plug and socket
15. Accessories : All mounting hardware required like clamping fixtures, mechanism to remove the transducers online, interconnecting cables etc.
 All weather canopy for protection from direct sunlight and direct rain. Material of all fittings shall be SS 316
- g) Bidder shall submit certified flow calculation and differential pressure Vs. flow curves for each element for Owner's approval. Sizing calculation, precise flow calculation for all the flow elements, fabrication and assembly drawings and installation drawings shall be submitted for Owner's approval.

2.00.00 NOT USED

3.00.00 CONTROL PANEL/DESK MOUNTED INSTRUMENTS AND ELECTRICAL SYSTEM ACCESSORIES.

(For electrical System's Meter and for synchronisation, bidder shall refer to Electrical volume of specification)

3.01.00 Digital Indicator (If required)

01. Type : Five and half digit LED seven-segment display with sign.
02. Display Character : 13.8 mm, RED (LED)
03. Accuracy : 0.1% of reading, ± 2 digit



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- 04. Input : 4-20mA DC/1-5 V DC/ pulse (as applicable)
- 05. Mounting : Flush Panel
- 06. Power Supply : 240V \pm 10%, 50 \pm 2.5 Hz

3.02.00 PUSH BUTTON

- 01. Type : Shrouded square format
- 02. Face Dimension : 32 x 32 mm (maximum)
- 03. Contact Configuration : 2 NO + 2 NC
- 04. Contact Addition : Add-on block up to 4 each with 2 pairs of contacts
- 05. Contact Material : Hard Silver Alloy
- 06. Contact Rating : 500V / 10 A
- 07. Utilization Category : AC11 / DC11
- 08. Insulation Voltage : 2 KV for 1 minute between terminals and earth
- 09. Mechanical Life : 1 million operation
- 10. Construction : Aluminum shrouding with plastic lens
- 11. Colors : Red, Green, Yellow, Black, etc.
- 12. Connection : Screw terminals
- 13. Enclosure Class : IP-52
- 14. Legend : Engraving

3.03.00 ILLUMINATED PUSH BUTTON

- 01. Type : Square format
- 02. Face Dimension : 32 x 32 mm (maximum)
- 03. Contact Configuration : 2 NO + 2 NC (minimum)
- 04. Contact Addition : Add-on-Block up to 4 each with 2 pairs of contacts
- 05. Contact Material : Hard Silver Alloy
- 06. Contact Rating : 500 V/ 10A



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07. Utilization Category : A C11 / DC11
08. Insulation Voltage : 2 KV for 1 minute between terminals and earth
09. Mechanical Life : 1 Million Operation
10. Lamp : LED with built-in resistors as required
11. Lamp Rating :-
 - a) Voltage : 240 V AC
 - b) Watt : 2 Watt (approx.)
12. Lamp and Lens Replacement : From front
13. Construction : Transparent Plastic Lens
14. Color : Red, Green, Amber, Yellow etc.
15. Connection : Screw terminals
16. Enclosure Class : IP-52
17. Legend : Engraving

3.04.00

SELECTOR SWITCH

01. Type : 2/3/4 position stay put type with rotary lever actuator.
02. Face Dimension : 32 x 32 mm (maximum)
03. Contact Configuration : 4 pair of contacts
04. Contact Addition : Add-on-Block up to 4 each with 2 pairs of contact
05. Contact Material : Hard silver Alloy
06. Contact Rating : 500 V/10 A
07. Utilization Category : AC11 / DC11
08. Insulation Voltage : 2 KV for 1 minute between terminals and earth
09. Mechanical Life : 1 million operation
10. Construction : Aluminum shrouding
11. Connection : Screw terminals



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- | | | | |
|-----|-----------------|---|-------|
| 12. | Enclosure Class | : | IP-52 |
|-----|-----------------|---|-------|
- 3.05.00 INDICATING LAMP
- | | | | |
|-----|---------------------------|---|--------------------------------|
| 01. | Type | : | LED with built-in resistor |
| 02. | Face Dimension | : | 32 x 32 mm (maximum) |
| 03. | Voltage | : | 240 V AC |
| 04. | Watt | : | 2.5 Watt (approximate) |
| 05. | Lamp and Lens Replacement | : | From front |
| 06. | Construction | : | Transparent Plastic lens |
| 07. | Color | : | Red, Green, Amber, Yellow etc. |
| 08. | Connection | : | Screw terminals |
| 09. | Legend | : | Engraving |
- 3.06.00 INDICATING METERS (A.C)
- | | | | |
|-----|-----------------|---|---|
| 01. | Type | : | Rectifier type taut band |
| 02. | Face Dimension | : | 96 x 96 mm |
| 03. | Scale | : | Radial arc of 240 Deg. |
| 04. | Accuracy | : | 1.5% of full scale.
±0.5 Hz for frequency meter |
| 05. | Input | : | 0-1/0-5A for current measurement, 0-240V for voltage measurement, 50 ± 2.5 Hz for Frequency measurement |
| 06. | Zero Adjustment | : | Screw on meter face |
| 07. | Enclosure | : | Shielded Case IP-52 |
| 08. | Mounting | : | Flush Panel |
| 09. | End Scale | : | |
| | Suppression | : | 6 times the measuring range only for motor ammeters |
- 3.06.01 INDICATING METERS (D.C)
- | | | | |
|-----|----------------|---|-----------------------|
| 01. | Type | : | Taut band moving coil |
| 02. | Face Dimension | : | 96 x 96 mm |





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- | | | | |
|-----|-----------------|---|--|
| 03. | Scale | : | Radial arc of 240 Deg. |
| 04. | Accuracy | : | 1.5% of full scale |
| 05. | Input | : | 0-75 mA for current measurement. Direct reading for voltage measurement. |
| 06. | Zero Adjustment | : | Screw on meter face |
| 07. | Enclosure | : | Shielded case IP-52 |
| 08. | Mounting | : | Flush Panel |
| 09. | End Scale | : | |
| | Suppression | : | 2 times the measuring range only for motor ammeters. |

3.07.00 AUXILIARY RELAY

- | | | | |
|-----|-----------------------|---|---|
| 01. | Type | : | Plug-in type with base/DIN rail Mounted |
| 02. | Coil voltage | : | 240 V AC/24V DC / 220V DC |
| 03. | Contact Configuration | : | 2 NO & 2 NC (Minimum), additional contacts as per requirement |
| 04. | Contact rating | : | 250V/5A (A.C/D.C.) |
| 05. | Operating range | : | 80 to 110% of rated voltage |
| 06. | Insulation | : | 2 KV for 1 minute between terminals & earth. |
| 07. | Mechanical life | : | 20 million operations |
| 08. | Enclosure | : | Transparent cover |
| 09. | Connection | : | Screw terminals. |
| 10. | Mounting | : | Projection mounting inside panel /DIN rail Mounting |

Note : Coil protection: diode/surge suppressor shall be provided

3.08.00 COUPLING RELAY

- | | | | |
|-----|--------------|---|---|
| 01. | Type | : | Miniature plug-in type/ DIN rail Mounting |
| 02. | Coil voltage | : | 24 V D.C. / 48 V DC or others as required. |
| 03. | Contact | : | 2 NO & 2 NC (Minimum)-Additional contact as per requirement |



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- | | | | |
|-----|-----------------|---|--|
| 04. | Contact rating | : | 250 V/10A (A.C)/220V/2A (D.C) |
| 05. | Operating range | : | 70 to 110% of rated voltage. |
| 06. | Insulation | : | 2 KV for 1 minutes between terminal & earth. |
| 07. | Mechanical life | : | 20 million operations |
| 08. | Coil protection | : | Diode |
| 09. | Indication | : | Coil on LED |
| 10. | Enclosure | : | Transparent cover |
| 11. | Connection | : | Screw terminals. |
| 12. | Mounting | : | Projection mounting inside panel / DIN rail mounting |





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4.00.00 **CONTROL VALVES, ACTUATORS & ACCESSORIES**

4.01.00 GENERAL REQUIREMENTS

4.01.01 Bidder shall exercise extreme caution in selecting severe service control valves like BFP recirculation valves, HP & LP bypass valves, superheater & reheater attemperator valves, PRDS valves for Boiler & Turbine, Soot blower steam pressure control valve, control valves whose down stream are connected to condenser and in vacuum such as HP/LP heater emergency level control, condenser make up water control valve and CEP minimum flow control valve etc. For such critical applications, Bidder shall offer valves which are proven for similar application for not less than 2 years of continuous service in power plant environment. All the above valves shall have leakage class equal or better than class-V or as specified hereunder with metal-to-metal seating. For Severe Service Control Valves viz. BFP Recirculation Valves, PRDS Valves, Feed Control Valve, SH/RH Attenuation valve, Soot blower steam pressure control valve etc. multistage-multipath discrete pressure drop stage design shall be provided. HP and LP Bypass valves shall be designed for 60% bypass capacity with twin valves. Typical Requirements for these Control Valves shall be as follows:

Service	:	BFP Recirculation Valve/RH-SH Attenuator Valves
Type	:	Multi Stage, Multi Path stack Plate radial Flow design
Trim	:	Angle Design (side inlet and bottom outlet, over the plug flow) or Globe design (for straight pipe)
Trim exit <i>velocity</i>	:	Not exceeding 23m/sec
Pressure reducing /drop	:	Achieved in multi stage orificed, drilled hole or axial flow cage design
Seat Leakage	:	In accordance with MSS-SP-61
Actuator type	:	Pneumatic Piston type ensuring MSS-SP-61 seat leakage

4.01.02 Control valves for regulating service shall normally be globe body, cage guided, metal-to-metal seated, pneumatically operated and shall be provided with characterized plugs having ANSI leakage class-IV as minimum. All steam temperature conditioning control valves shall be ANSI leakage class-V.

4.01.03 Where the operating time is critical for the operation of the plant, as in case of HP or LP bypass valves, hydraulic actuators with electro-hydraulic interface shall be offered. Block valve in the spray water line for HP or LP bypass valves shall also be hydraulically operated.





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- 4.01.04 Bidder shall provide redundant control valves for main condensate control station, Superheat attemperation control and Reheat attemperation control as a minimum. For other application, if the availability criteria for the plant can not be met even with the best established product, redundant control valves shall be provided.
- 4.01.05 All control valves shall be located near floor or platform for ease of access with adequate clearances for maintenance and lay-down and shall be placed as control station with up-stream and down-stream motorized isolating valves, manual drain valves and motorized inching bypass valve. For Superheat attemperation control and Reheat attemperation control, upstream and down stream isolation valves shall be solenoid operated pneumatic on-off valves. Block valve in the spray water line shall also be solenoid operated pneumatic on-off valve.
- 4.01.06 Control Valves and accessories shall be designed and tested in accordance with the latest applicable requirements of code for pressure piping ANSI B 31.1, ASME Boiler and pressure vessel code, Indian Boiler Regulation (IBR), ISA and other standards as specified elsewhere and in accordance with the applicable requirements of the Federal Occupational Safety and Health Standards, USA or acceptable equal standards.
- 4.01.07 The start-up system control valves and HP & LP bypass control valves shall be proven in similar application.
- 4.01.08 All control valves shall meet the specification requirements and process requirements.
- 4.01.09 For large flow conditions with low pressure drops, as in case of cooling water applications, butterfly valves shall be used.
- 4.01.10 High Pressure Bypass Control Valve
1. Body shall be designed to withstand thermal cycling. Thin walled sections shall be provided in areas after pressure reduction to reduce thermal fatigue.
 Transitions between thick and thin wall sections shall be gradual. The body shall be a single shape steam entry from the bottom (under the plug) to facilitate easy and clean installation.
 2. Valves shall be designed that they can operate in any orientation. For maintenance purposes the preferred orientation is vertical.
 3. The HP bypass shall have desuperheating function in the valve body. Water injection must be at a fixed point inside the valve spraying into the turbulent steam flow. Water shall not be injected through the stem due to leakage potential past internals seals and to eliminate possibility of stem cracking due to combined thermal and mechanical stress. Water spray should be fully atomized within 1m of valve outlet to ensure uniform reheater temperature and flexibility in downstream piping layout.
 4. Body shall be protected from damage due to water injection by means of multi function contoured cage. Contoured cages shall be used as they have higher mechanical strength and no tendency to resonate.





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5. Cage material must be of a high alloy material such as X20Cr Mo V121 for good thermal cycling and erosion resistance.
6. Contour of cage to be of hour glass shaped form to improve the strength of the cage. The cage shall be firmly attached at one end and located radically at the other end to provide good guiding and allow axial growth due to thermal differentials.
7. Plug type shall be channel slotted design for acoustic attenuation and to allow passages of nominal contamination. Plugs of multiple holes design are unacceptable due to contamination catching between plug and seat. Contoured plug designs are not allowed because of poor acoustic performance.
8. Packing box design shall consist of two independent sets of rings separated by a metallic spacer. Packing to be compressed by means of a bolted flange design. Screwed gland type packing retainers shall not be provided.
9. Bolted bonnets are preferred. If pressure seal bonnet are used, seal areas shall be inlaid with corrosion resistant materials to minimize leakage potential.
10. The bypass valve should conform to MSS SP-61 or EN12266-1 Rate C leakage class (block/isolation valve tightness). Bidder to provide calculation.

4.01.11 Low Pressure Bypass Control Valve

1. Body shall be designed in angle shape for ease of installation and maintenance.
2. Valves shall be designed that they can operate in any orientation.
Note that the typical orientation for LP-Bypass valves is horizontal with straight outlet to the condenser.
3. Skirted-plugs shall not be used due to potential for contamination and sticking between plug and seat. A combination of cage guiding and top guiding for plugs shall be provided to eliminate possibility of vibration.
4. No components may be screwed or welded inside the valve body for ease of maintenance.
5. Inlet cage and seat shall be easily removable for inspection maintenance and replacement. They shall be hold in place by the bonnet bolting and flexible gaskets shall accommodate differential thermal expansion.
6. Water injection to be downstream of pressure reduction to maximize evaporation.
7. Diffuser in the outlet to reduce noise and guide steam towards spray nozzles for good mixing of water and steam.
8. Water shall not be injected through the stem due to leakage potential past internals seals and to eliminate possibility of stem cracking due to combined thermal and mechanical stress.
9. Water injection shall be performed through spray nozzles. Spring loaded nozzles are preferred to maximize atomization at lower flow



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rates. Multiple nozzles shall be used for uniform spray pattern. Water injection shall be perpendicular to stem flow for good penetration and mixing.

10. Packing to be compressed by means of a bolted flange design. Screwed gland type packing retainers shall not be provided.
11. Bolted Bonnets are preferred. If pressure seal bonnets are used, seal areas shall be inlaid with corrosion resistant materials to minimize leakage potential.
12. The bypass valve should conform to MSS SP -61 or EN12266 – 1 Rate C leakage class (block/isolation valve tightness). Vendor to provide calculation.

4.01.12 Spray water Valves

1. Valves shall be provided with rated cavitation index (K_{cr}) above Cavitation index for the process (K_c) where $K_c = (P_1 - P_2) / (P_1 - P_v)$
2. Valves shall be free of cavitation. Should process condition produce cavitation, valve design shall be upgraded to eliminate cavitation.
3. The trim should be quick change type. No parts should be screwed or welded.
4. Isolation valves must be provided upstream of the HP-Bypass spraywater control valves, to ensure tightness of the spraywater line whenever the steam valve is closed. Individual isolation valves per control valve are recommended. Isolation valves are to be shut whenever the steam valve is closed.
5. Isolation valves upstream of the LP-Bypass spraywater control valves are recommended to allow shut-off of the water line. Isolation valves are to be shut whenever the steam valve is closed.
6. The valves should conform to MSS SP -61 or EN12266 –1 Rate C leakage class (block/isolation valve tightness). Valve trim exit velocity should be below 23 m/sec.

4.01.13 Hydraulic System

Hydraulic actuation is used for positioning of bypass control valves to fulfill the high stroking speed, high actuation forces and accurate positioning requirements. The hydraulic actuation system consists of one or more hydraulic supply units as required by the capacity and the distances between the valves and the hydraulic actuators and accessories.

4.01.14 Hydraulic supply unit

The hydraulic supply unit shall have the following features:

- fully redundant main pumps with 100% capacity. Switch over from main to standby pump should be fully automatic. Both pumps can be main or standby pump.
- Operating pump should run continuously to avoid unnecessary switching of main pumps and power peaks.





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- Filter loop with continuous filtration of the oil. Filter change possible without switching off main pumps to avoid shutting down bypass for filter change.
- Oil filling must take place with the filter pump through the filter.
- Oil cooler with controlled fan to keep oil temperature within limits for the used hydraulic oil.
- Optional oil heater if ambient temperatures are getting below minimum limits of hydraulic fluid.
- The hydraulic supply unit should be able to generate constant outlet pressure of 160 bars and should have constant pressure and forces at the actuator.
- Accumulator pressure should be above the controlled outlet pressure to ensure sufficient reserve volume in the accumulators.
- Reserve volume in accumulator should be sufficient to allow min. 2 strokes of all actuators after trip of main pumps.
- Hydraulic supply unit should be equipped and completely wired and tested with local control and power switches. Manual control of the hydraulic supply unit through push buttons on the front panel for commissioning and testing.
- Drip tray shall be supplied together with the hydraulic supply unit.

4.01.15 Hydraulic actuators

- Hydraulic actuators shall be of compact heavy duty design and shall fulfill all force, stroke and stroke speed requirements of the valves.
- Actuators shall be of compact design with proportional valves and auxiliary elements directly flanged to the actuator, without connection pipes between these elements and the actuator
- Position control shall be performed with the help of proportional valves
- System must include accessories for quick stroking and safe opening and safe closing. Quick stroking accessories are not required if control through proportional valves meets quick stroking speeds (typically 2-3 seconds).
- Energy for safe opening or closing (e.g. condenser protection) shall be independent of the oil pressure from the HSU, either through steam force or a separate hydraulic accumulator.

4.01.16 Hydraulic positioner

- Hydraulic positioned shall be of digital smart type featuring simple adjustment through digital interface.
- For easy commissioning and maintenance positioners are located close to the valve/actuator and must be suitable for the harsh environment. Connections to the actuator shall be prefabricated and pluggable.
- The positioned is the only connection point for the plant cabling to the valve/actuator.





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- Positioner should be absolutely stable at stroke speeds of 2 seconds
- Positioner shall have standard 4-20 mA signals for position demand and position feedback.
- Power supply options must be available for easy adaptation to the power supply available in the plant.

4.01.17 Bypass Controller

- Control system shall be state of the art, digital type.
- Control system should have redundant power supply to ensure reliability
- Control system shall be suitable to operate from 0 to 50 degree Celsius.
- Input/output modules, Power supply modules and CPU modules shall have hot swap feature and shall be replaceable while the plant is in operation without any disturbance of the other module.
- Input/output modules, Power supply modules and CPU modules shall have no slot dependencies for easier use.
- Interface with main DCS shall be MODBUS.

4.02.00 VALVE CONSTRUCTION

4.02.01 All valves shall generally be of globe body design and straight through pattern with single seat unless otherwise is specified or recommended by the manufacturer for particular application. 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 full line pressure.

4.02.02 Valves with high lift cage guided plugs and quick replacement trims shall be provided for easy maintenance.

4.02.03 Plug shall be one piece construction either cast, forged or machined from solid stock. Plug shall be screwed and pinned to valve stem or shall be integral with valve stem.

4.02.04 Bonnet joint shall be of flanged and bolted type or manufacturer standard acceptable to Owner. Bonnet joints of internal threaded or union type is not acceptable.

4.02.05 Extension Bonnet shall be provided for fluid temperature above 280 deg C.

4.02.06 Valve characteristics shall match with the process characteristics.

4.02.07 All valves connected to vacuum on down stream side shall be provided with packing suitable for vacuum application (i.e. double vee type chevron packing).

maximum

4.02.08 Flanged valves shall have ~~minimum~~ body rating ANSI 300 lbs.

4.02.09 The direction of flow shall be clearly marked/engraved on the body.





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- 4.02.10 Valve body rating shall meet the process pressure and temperature requirement as per ANSI B 16.34.
- 4.02.11 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.
- 4.03.00 VALVE BODY

Valve body material shall generally be guided as per the Table below:

<u>SR. No.</u>	<u>SERVICE</u>	<u>BODY MATERIAL</u>
1.	Non corrosive, non-flashing and non cavitating service for fluid temperature upto 275°C (like Aux steam flow to Deaerator, condensate flow to Deaerator, CRH flow to Deaerator)	Compatible with piping material but not inferior to Cast carbon steel ASTM A216 Gr. WCB
2.	Severe flashing / cavitating services (like HP & LP heaters emergency drain, Deaerator overflow drain to hotwell etc.)	Alloy steel as per ASTM A217 Gr. WC9
3.	Low flashing / cavitating services (like HP & LP heaters normal drain level control, GSC minimum flow, gland seal steam pressure control etc.)	Alloy steel as per ASTM A217 Gr. WC6
4.	DM water application (like condenser hotwell normal and emergency make up, ECW DP control etc.)	316 stainless steel ASTM A351 Gr. CF8M

- 4.04.00 VALVE TRIM
- 4.04.01 Valve trim for most 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 shall be substituted if required for corrosion and other fluid conditions.
- 4.04.02 Balanced trim valves shall be offered for high shut-off pressure or high pressure drop condition to reduce the size of the actuators. For flashing services and two stage mixtures, the trim material shall be 17-4 PH or equivalent. If cavitating condition is foreseen, Bidder shall offer multistage or labyrinth trim valves. Trim of severe service valves as indicated in Cl. 4.01.01 shall be of multistage and multipath design with sufficient no. of discrete





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pressure drop stages to eliminate the chances of erosion, cavitation, noise and vibration throughout the control range of the valve.

4.04.03 Quick replacement type trim shall be considered for easy maintenance.

4.04.04 Trim Material

Valve trim material shall generally be guided as per the Table below :

<u>SR. No.</u>	<u>SERVICE</u>	<u>MATERIAL</u>
1.	Non corrosive, non-flashing : and non cavitating service for fluid temperature upto 275°C.	316 SS with satellite faced guide posts and bushings
2.	Severe flashing / cavitating : services	400 series SS or equivalent to suit the specific requirement
3.	Low flashing / cavitating : services	400 series SS or equivalent to suit the specific requirement
4.	DM water application : (condenser hotwell normal, emergency make up etc.)	316 SS

cavitation resistance, corrosion resistance, temperature resistance, erosion resistance, hardness etc. of the offered material vis-à-vis the specified material for Bidder may offer valves with body and trim material better than the specified material and in such cases Bidder shall furnish the comparison of properties including Owner's approval.

4.05.00 VALVE END PREPARATION

Valve body ends shall be either butt welded/socket welded, or flanged (Rubber lined for condensate service). Control valves of size 65 mm and above shall have butt welded ends as per ANSI B 16.25. For valve size 50 mm and below welded ends shall be socket welded as per ANSI B 16.11. Flanged ends shall be of ANSI pressure-temperature class equal to or greater than that of control valve body.

4.06.00 VALVE SIZE

The control valve sizing (Cv / Kv) shall be based on following guidelines :

- The valves shall pass normal rate of flow (MCR condition) with 65 to 75 percent opening for linear characterised valves and 75 to 85 percent opening for equal percentage characterised valves.
- The valves shall have adequate rangeability to pass the minimum and maximum rated flows at 10% and 80% of the valve opening





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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 rated 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) The sizing procedure followed shall be as per latest edition of ANSI/ISA or equivalent standard.
- f) While deciding the valve size, Bidder shall ensure that valves port outlet velocity does not exceed 8 m/sec for liquid services, 150 m/sec for steam services and 50% of sonic velocity for flashing services.
- g) Control valve induced noise shall not greater than 85 dBA at 1 meter from the valve surface under actual operating conditions. The noise abatement shall be achieved by valve body and trim design and not by use of silencers.
- h) Bidder shall submit the sizing calculation clearly indicating the valve outlet velocity, noise calculation during detail engineering stage for Owner's approval.

4.07.00 VALVE TOPWORK

4.07.01 Topwork 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.

4.07.02 Bonnet material shall be same as that of valve body or equivalent forged material.

4.07.03 Extended bonnet/Finned bonnet and high temperature packing shall be used for high temperature application. Extension bonnet shall be used when the fluid temperature is high and may damage valve stem packing.

4.07.04 The gland material shall be chosen to suit the operating temperature. PTFE may be chosen for low temperature application and for high temperature application graphited asbestos glands are to be provided. For vacuum services, the glands shall be dry seal type.

4.08.00 NOISE LEVEL

The equivalent sound level measured at 1.5 M 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. If the calculated noise is more than the above limit, even with low noise trim design, diffusers shall be included. Diffusers shall be made of stainless steel and shall be integrally connected to the control valve with necessary spool piece. The spool piece shall be in conformity with the main line piping specification.





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4.09.00 VALVE ACTUATORS

4.09.01 Spring-diaphragm type valve actuators shall be used in general applications. However piston type actuators shall be offered in case of high shut-off pressure & quick response requirement. Bidder shall provide piston type actuators for regulating services for the following services as a minimum requirement. Piston actuator shall be of double acting type for the regulating duty valves with long stem travel for better regulation and quick response.

- a) Auxiliary Pressure reducing & De-super heating stations.
- b) Superheat and Reheat Spray Control Valves.
- c) Condensate extraction pump minimum recirculation valve.
- d) Feed control valves

4.09.02 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.

4.09.03 All the actuators shall be supplied mounted on the valve with all the accessories integrally mounted. The diaphragms shall be designed for 200% maximum operating pressure.

4.09.04 Nylon reinforced neoprene shall be used as diaphragm material.

4.09.05 Valve actuators shall be capable of operating at 60 deg C ambient, continuously.

4.09.06 Entire actuator assembly shall be painted with corrosion inhibiting paint.

4.09.07 Air connection size shall be 1/4" NPT (F) unless otherwise dictated by process response time. Integral tubing shall be of stainless steel construction.

4.09.08 Bidder shall indicate the stroking time of the valve assemblies with positioner, which shall not exceed 10 sec unless otherwise stated.

4.09.09 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.

4.09.10 HP and LP bypass and spray valves, turbine inlet stop & control valves shall be electro-hydraulic actuators and all other control valves shall have pneumatic actuators.

4.10.00 VALVE POSITIONERS

4.10.01 All regulating service valves shall be offered with HART protocol based Smart Electro Pneumatic Positioners to ensure accuracy and repeatability of response.

4.10.02 Positioners shall have integral I-P converter, Position feedback transmitter, input and output gauges, local keypad & display .





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- 4.10.03 Positioners shall be capable of functioning under hot, humid and vibrating conditions.
- 4.10.04 Positioner casings shall be dust tight, corrosion resistant and weatherproof (IP-55).
- 4.10.05 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. Remote calibration from control room shall be possible through HART management station.
- 4.11.00 VALVE ACCESSORIES
- The accessories of the valves shall include side mounted hand wheels, smart positioner, limit switches, tubing and air set, junction boxes, airlock relays, volume booster, solenoid valves, and any other devices as required.
- 4.12.00 TESTS
- All valves shall be tested in accordance with the Quality Assurance Programme (QAP). Bidder shall submit QAP for Owner's approval. The tests shall include but not be limited to the following :
01. Non destructive test as per ANSI B 16.34.
 02. Hydrostatic shell test as per ANSI B 16.34 prior to seat leakage test.
 03. Valve closure test and seat leakage test as per ANSI B 16.34 and as per the leakage class
 04. Functional test : The fully assembled valves with actuator and all accessories shall be functionally tested to demonstrate from open to close position and vice versa. Valve lift shall be checked at 5 points at 0, 25, 50, 75 and 100% in both the directions with increasing and decreasing inputs. Performance of the valve with Positioner shall be as follows :
 - a. Linearity : +/- 1%
 - b. Hysteresis : +/- 1%
 - c. Sensitivity : +/- 0.5%
 - d. Deadband : +/- 1%
 - e. Reproducibility : 0.3% of total stroke
 - f. Overall accuracy : +/- 1%
 05. CV test : Cv test shall be carried out as type test on each size, type and design of the valves as per ISA 75.02 standard and test report shall be submitted for Owner's approval.

5.00.00 CONTROL DESK / PANEL / RACK

- 5.00.01 Convenient and logical approach to operational interfaces shall be considered to enhance aesthetics in the overall view of the control room..





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- 5.00.02 For items susceptible to vibration, suitable rubber gaskets or padding shall be provided to prevent damage or malfunction.
- 5.00.03 All items like MCB, Terminals, instruments, lamps etc. inside the panels/cabinets shall be neatly arranged with easy access/ maintenance approach to avoid undue disturbing the wiring.
- 5.00.04 Incoming power supply feeders shall be Redundant UPS Power supply feeders, so that a single failure shall not affect the operation of the unit. Required isolation & protection through MCB shall be provided in all cases. Alarm shall be provided against failure of a single power supply. Duplication/looping of Power supply feeders at the Panel terminal is not acceptable. Redundant UPS power supply feeders shall form Primary & Secondary power supply Bus and further power distribution shall be from these busbars.
- 5.00.05 Desk / panel shall be provided with interior illumination lamp with door switch, space heater with thermostat and 5A, 3 Pin receptacle with plug. Exhaust/cooling fans with fan failure alarm shall be provided.
- 5.00.06 Lamp, heater, exhaust fan and receptacle circuits shall be suitable for available AC supply and furnished with individual ON-OFF switch. The ON-OFF switch of the 3 pin receptacle circuit shall be Illuminating type.
- 5.00.07 Panel / Desk shall have gland plate at cable entry to panel. Thickness of gland plate shall not be less than 3 mm.
- 5.00.08 Panels / enclosure shall be provided with 20% spare terminals. In addition, the spare hot on rail mounted input output channels /modules shall be in fully wired & terminated condition for system cabinets.
- 5.00.09 Wire shall be routed/laid in the covered PVC cable trough/tray.
- 5.00.10 Nameplate
- a) Nameplate shall be furnished for each instrument or device mounted on the panel/desk.
 - b) The material shall be laminated phenolic, 3 mm thick with white letters on black background.
 - c) The nameplates for panels / consoles shall be provided both on the front and the rear.
 - d) Nameplates for all devices shall be located adjacent to the respective devices.

5.01.00 UNIT CONTROL DESKS

- 5.01.01 All devices mounted on the control desks shall be flush type. Instruments / devices shall be so mounted that the removal and replacement can be accomplished individually without interruption of services to others.





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xiv) Front and Rear door shall be considered.

5.02.00 BACK UP PANEL / ELECTRICAL PANEL

5.02.01 Back Up Panel shall be of free standing type vertical panel with doors at the back. Construction shall be made from sheet steel of thickness not less than 3mm with mosaic grid structure of approximate size 24 X 48 on the front surface. Grid shall be heat resistant, flame retardant, self extinguishing, shrinkage free, non reflecting type. Finish shall be mat type without flaring. Indicators /ammeters, conductivity type EWLI for seperator, electromatic safety valve controls etc. shall be mounted on the panel..

5.02.02 Electrical Panel construction & design shall be similar to back up panel. Required control switches, meters, indicators, synchronizer, excitation control switch, annunciation window etc. alongwith associated mimic diagram shall be provided for manual synchronization of generator.

5.02.03 Crating of the panels shall protect against shock, vibration, inappropriate handling and inclement weather conditions during transportation and warehousing. Mounted equipment shall have protection against damage during handling, transit and storage. Suitable desiccant shall be used inside the packing case.

5.03.00 CABINETS / ENCLOSURE / PANELS

- | | | | |
|-----|----------------------------|---|---|
| 01. | Material of construction | : | Cold rolled steel sheet |
| 02. | Thickness of Sheet | : | a) 3.0 mm for faces supporting instruments / terminals. Mounting plate shall also be 3.0 mm.
b) 2.0 mm for other sides inclusive of top. |
| 03. | Construction | : | Welded throughout as per (metallic parts) approved National Standards. |
| 04. | Panel height | : | 2300 mm maximum |
| 05. | i)Corners | : | 7 mm inner radius |
| | ii) Dimensional Tolerances | : | a) In height & length - 3 mm
b) In height between adjacent sections - 2 mm.
c) Total for a group - 6 mm |
| 06. | Doors | : | Double, recessed, turned back edges. Doors shall have 4 point IP Lock |
| | i) Thickness of Sheet | : | 2 mm |





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- 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. Door swing shall be Min. 110-120 Degree
- vi) Louvers : With removable wire mesh to ensure dust and vermin proof.
- 07. Color of interior : Brilliant white (Approval shall be accorded by owner during detail engineering)
- 08. Colour external : RAL 7032
(Approval shall be accorded by Owner during engineering)
- 09. Painting : Epoxy powder coated or better. Minimum Paint thickness shall be 80-100 microns
- 10. Gland plates : Removable 4 mm thick (bottom)
- 11. Cable entry : Bottom
- 12. Hardware :
 - a) Anti vibration pad- 15 mm
 - b) Predrilled base channel ISMC - 100 or equivalent for all sides.
 - c) Lifting hook / Eye bolt
 - d) Drawing pocket
 - e) Door switch, lamps, thermostat, heaters and fans
- 13. Enclosure Protection : As per environment condition of the area of installation. Refer to Section-I of Vol-II E clause 6.16.00.

5.04.00 LOCAL INSTRUMENT RACKS & ENCLOSURE (EXCEPT OFFSITE/BOP AREAS)

Transmitters and switches located in the field shall be grouped together and shall be installed in the enclosure (Closed Transmitter Racks) in case of outdoor area such as Boiler area etc. and in Open Type Rack in case of



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covered area. Racks shall be factory prefabricated & painted and complete with internal tubing, manifold, isolation valves, integral junction box with outside access door, illumination etc. Racks used for furnace, flue gas and air application shall be provided with intermittent & continuous air purging. Following requirements for LIE/LIR shall be met:

- 1) Not more than Six (6) Instruments shall be grouped in a single Rack/enclosure".
- 2) Racks shall be installed above the tapping points for air, flue gas and coal air mixture application where as for applications such as for water and steam, racks to be installed below the source point.
- 3) Service air connection shall be provided for continuous and intermittent purging of impulse pipe in dusty medium. Continuous purging shall be adopted for differential and gauge Pressure measurements such as flue gas, furnace and coal air mixture applications. Intermittent purging shall be adopted for Pressure measurements in air application or wherever required.

5.04.01 Closed Type Transmitter Racks

- a) Required number of transmitter racks shall be furnished to house transmitters, switches and converters by grouping them suitably, area-wise / function-wise. Closed type Instrument rack to have the list of the Transmitters & Switches along with the service and KKS tag on the inner face of the front door. Moreover each Transmitter/switches mounted on the 2" pipe shall have label indicating the KKS tag.
- b) The transmitter enclosures shall be constructed of 3 mm thick steel plate. The enclosures shall preferably be of modular construction and with two end plate assembly bolted to the frame. Base frame shall be made of ISMC 100 and black colour finish
- c) The enclosure shall approximately be 1200 millimeters wide, 1000 millimeters deep and 2200 millimeters high to allow easy access to the internals. Racks shall be reinforced as required to ensure true surfaces and to provide adequate support for instruments and equipment mounted therein. Double interlocking doors shall be provided and shall be arranged for maximum possible access to the interior. Center posts or any member which would reduce access shall not be provided.
- d) 2"NB Galvanised pipes shall be laid horizontally and supported at two end channels to mount transmitters/switches at accessible height. Adequate support for Manifold, impulse pipe and cable tray to be provided and the same shall be adjustable.
- e) Doors shall have concealed quick removal type pinned hinges and locking handles. Doors locks shall accept the same key all over the plant. Gaskets shall be used between all mating sections to achieve dust proof enclosure rating for the modules and a IP-65 waterproof



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and dust tight rating on the terminal boxes. All enclosures shall have access doors on front side. Doors shall have three point Locking system. Doors shall have concealed quick removal type pinned Stainless steel hinges.

- f) Bulkheads, especially designed to provide isolation from process line vibration shall be installed on modular bulkhead plates of the transmitter enclosures to meet the process sensing line connection requirements. Removable top and bottom plates shall be furnished. Removable bulk head plates of thickness not less than 6mm shall be mounted on the racks with suitable high temperature gasket impulse line within the enclosures shall be properly clamped..
- g) All internal wirings and/or data bus connections, if any, between the transmitters and terminal junction box shall run through flexible dust tight conduits connected to the terminal box hub. No exposed wirings within transmitter racks, both open and closed type, is admissible.
- h) All racks shall have a common closed drain trough to connect transmitter drain points to a common header after suitable pressure breaking. Covered funnels shall be used for saturated liquid and steam service, whereas, open funnels may be used for cold liquid services. The trough shall be suitably sloped and shall have one end flanged and extending beyond the rack for connection to plant drain header. Individual Instrument blowdown line shall be connected to the common blowdown drain header through regulating globe type blowdown valves. The common blowdown drain header shall be 2" NB ASTM A106, Sch-80 Gr. C installed at a slope of 1:25
- i) 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.
- j) Service Power and Lighting
 - i) Each enclosure shall be provided with one receptacle, one light fixture with wire guard and one lighting switch. 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.
 - ii) 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.
- k) Control Air





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- i) A control air supply header shall be furnished in each enclosure having pneumatic devices. The header shall be 25 mm NB brass header stock drilled and tapped for 8 millimeter valves.
- ii) A valve with double compression end fittings shall be installed in each tap. Not less than three spare connections shall be furnished in each enclosure. The air header shall originate at a bulkhead penetration or fitting located in one of the bulkhead plates. Each pneumatic instrument shall have an individual air shut-off valve.
- iii) Pressure reduction shall be achieved by air filter regulator sets. One filter regulator shall be furnished for each group of components making a system.

l) Service Air

In case of Continuous air purging, a 25NB (1") service header shall be formed which shall receive air through isolation valve and air filter regulator. Air shall be fed from air header to impulse pipes near to take-off points through isolation valves and flow regulators. Service Air header shall be Stainless steel. Impulse pipe for such applications shall have four-way valve. one port of the valve shall have an adaptor to connect flexible stainless steel braided nylon to the service air. Rating of the hose having a burst pressure 15 Kg/Sq.cm. four way valve shall have two position operations. One position for service and other one for purging. Required pressure gauges shall be provided for monitoring of air pressure. Complete purging arrangement shall be integral to the enclosure and racks.

m) Power Supplies

Contractor shall supply all required transformers, regulators and other power supply equipment to adapt sources of power to the requirements of the enclosure mounted equipment. This shall include but not be limited to internal instrument illumination transformers. The circuits shall be separately isolated with MCBs.

n) Equipment Installation

Special attention shall be given in the piping layout to avoid air traps in liquid filled piping, or water pockets in piping.

o) Impulse Piping /Tubing

- i) Transmitter enclosures shall be complete with impulse piping & tubing, valves from enclosure bulkhead connection to all instruments and necessary drain / blow down connections. The type, size, material and pressure class of pipes/tubes, fittings, valves etc. shall be suitable for the intended applications.
- ii) Blow down piping / tubing may be shared, but individual instrument piping / tubing and valves shall be furnished. Piping / Tubing material



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within enclosures shall conform to the application requirements. The final flexible connection to each instrument shall be fabricated with a double offset so that it may readily be disconnected to permit "in situ" calibration of the instrument.

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





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

5.04.02 Open Type Transmitter Racks

- a) Open type transmitter racks may be provided for mounting transmitters, switches, gauges, converters and other accessories in rooms, buildings and closed areas like the power house building.
- b) The open type racks shall be shop fabricated. Transmitters, switches, converters and transducers of enclosure class IP-65 or better can be directly mounted on open racks. However, enclosures not conforming to the above protection standard shall have to be housed in enclosures conforming to IP-65 class prior to mounting them on open structures.
- c) The following shall be provided for open type transmitter racks:
 - 1. Rack shall be constructed from 6mm thick steel channel frame.
 - 2. Canopy shall be of 3mm thick CRCA steel.
 - 3. 2"NB Galvanised pipes shall be laid horizontally and supported at two end channels to mount transmitters/switches at accessible height.
 - 4. Adequate support for Manifold, impulse pipe and cable tray to be provided and the same shall be adjustable.
 - 5. Individual Instrument blowdown line shall be connected to the common blowdown drain header through regulating globe type blowdown valves. The common blowdown drain header shall be 2" NB ASTM A106, Sch-80 Gr. C installed at a slope of 1:25
- d) For operational convenience, the open type racks shall be used for mounting pressure and temperature gauges and switches and the local operating stations for electrical drives in the vicinity. Gauges mounted in racks shall be bottom connected and secured by double lock nuts. All gauges shall be located within 1500 mm from the floor for easy readability.
- e) The structural design shall be such that no item shall interfere with maintenance and removal of instrument, equipment and their accessories.
- f) Service Power and Lighting
 - i) Each rack shall be provided with 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.
 - ii) Power supply for receptacles and lighting shall be arranged. Power supplies for miscellaneous devices shall be provided with MCB located within the rack JB. MCBs shall be mounted in blocks. MCB ratings will be given on electrical schematic diagrams. Nameplates





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shall be furnished above the MCB blocks, identifying the devices being served.

g) Control Air

Same as for closed type transmitter rack. Refer 5.01.01 (j) above

h) Service Air

Same as for closed type transmitter rack. Refer 5.01.01 (k) above

i) Power Supplies

Same as for closed type transmitter rack. Refer 5.01.01(l) above

j) Equipment Installation

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

k) Impulse Piping / Tubing

Same as for closed type transmitter rack. Refer 5.01.01 (n) above

l) Instrument Tubing

Same as for closed type transmitter rack. Refer 5.01.01 (o) above

5.04.03 Wiring of the Racks

- a) A fully enclosed IP 65 type junction box shall be provided in each rack for housing the terminal blocks connectors, power supply fuses and other electrical accessories, as required.
- b) Junction boxes for modular enclosures shall be fabricated externally on one end of each enclosure assembly to accept field wiring/cabling through the top or bottom of the junction box. A hinged door shall give access to the interior of the junction box.
- c) All electrical connections between instruments and the junction box terminal blocks shall be made. In addition all utility wiring for lighting and service power shall be installed.
- d) All wiring used within the enclosures shall conform to NEC /IEC standards. All wiring shall run through flexible or rigid conduits and shall be terminated at suitable terminal blocks. Sufficient clearance shall be provided for all control and instrument leads and all incoming





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and outgoing leads shall be connected to terminal blocks suitably located for connecting external circuits.

- e) High impedance circuits shall be connected using shielded or coaxial wire suitable for the service.
- f) Conduits shall be supported properly at regular intervals with suitable conduit clamps.
- g) Wire shall be neatly arranged and routed/laid in PVC trough/tray.

5.04.04 Junction Box

Junction boxes shall be of metallic construction.

- a) Junction box shall be provided with front opening type cover. Junction box shall be of sheet steel construction with thickness not less than 2 mm. Junction box shall be complete with DIN rail mounted terminals, MCB, receptacles and earth bar. Earth bar shall be made of tinned copper of 25 X 6 MM size. Earth stud shall be furnished for safety grounding.
- b) Terminals shall be screwless cage-clamp type and 20% spare terminals shall be furnished. Power terminals shall be screw type.





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5.00.00 ANALYZERS & SAMPLING SYSTEM SPECIFICATIONS

All the analysers shall be microprocessor based with drift free, auto compensation and calibration provision. Analyzers shall have facility to programme from the front key pad and shall have necessary fault diagnostic features. Each analyzer shall have a self-contained readout meter.



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The general technical specification of the analyzers is provided in this section. The system design should ensure that the pH and conductivity transmitters are mounted close to the respective sensors.

Multichannel analyzers are acceptable only for Silica, Sodium, Chloride & Phosphate measurements, as these measurements are more to monitor the trend. In all other measurements, such as Conductivity, pH, Dissolved Oxygen & Hydrazine measurements, Single channel analyzers must be offered.

Silica analyzers must be able to have analysis cycle completed within less than 10 minutes. A grab sampling facility is a must with the silica analyzer, as this helps to compare lab readings of a known silica solution with the analyzer reading. Silica analyzer should be able to display silica concentration, Alarm status, Calibration Constants, channel selection, current outputs, diagnostics, trend curves, historical data. In the diagnostics the analyzer should give information such as Lack of Sample / Reagent, Calibration solution & Calibration error, hardware failure etc.

Bidder in his offer shall indicate the sample flow requirement of each analyzer and the total quantity of cooling water required for the system.

5.01.00 Conductivity Analyzer

A. Sensor

- | | | |
|------------------------------|---|--|
| 01. Type of Cell | : | Flow through type / removable type (withdrawable with sealing valve) |
| 02. Conductivity Range | : | As per instrument schedule |
| 03. Cell Constant | : | 0.01 / 0.1 / 1.0 depending upon range |
| 04. Temperature Compensation | : | Manual and Automatic (Integral) upto 0-100°C with PT-100 Sensor |
| 05. Process Connection | : | Screwed |
| 06. Wetted Parts | : | Electrodes : SS 316L or better
Insulators : KYNAR & VITON or better |
| 07. Pressure Rating | : | 10 kg/cm ² |
| 08. Accessories | : | Vessel (SS 316) with ½" NPT connection. |
| 09. Cable | : | Upto transmitter in flexible conduct |

B. Transmitter

- | | | |
|--------------|---|---|
| 01. Type | : | Microprocessor based, Single stream with multi-range facility |
| 02. Mounting | : | Flush Panel |





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03. Protection Class : IP-55 or better
04. Output : 4-20 mA DC (isolated) to a load of 600 ohms (min.)
05. Display
 - i) Digital Display of process variable in Engineering Unit, Temperature, Alarm Status.
 - ii) Back lit LCD
 - iii) Character Height 12 mm
06. Zero / Span Adjustment : Front Panel Membrane type Keyboard.
07. Temperature Compensation : Manual or Automatic - selectable through keyboard
08. Diagnostic : Self diagnostic programme for electronics, measuring electrode, open wiring etc.
09. Alarm : Dual alarm set point (2 SPDT, high & low), hysteresis and time delay adjustable from membrane keyboard. Switch contact rating of 5 Amp, 240 VAC / 0.2 Amp, 220 VDC
10. Enclosure : Polycarbonate or better ; Enclosure class IP-55 or better
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 full scale / month non-cumulative
15. Power Supply : 240 V AC, 50 Hz UPS
16. Operating Temp. : 0 -50°C
17. Accessories :
 - a) For cation conductivity analyzer Dual Ion-Exchange column, resin, etc. (minimum 12 months requirements).
 - b) Phenolic Nameplate, cable gland
 - c) Serial interface (RS 232) for data logger download to PC (No data loss after power failure, all data shall be saved in non-volatile memory)





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5.01.00 pH Analyzer

A. Sensor

- | | | | |
|-----|--------------------------|---|---|
| 01. | Type of Cell | : | Measuring and reference electrode combination with flow through type (polypropylene flow chambers). |
| 02. | Process Connection | : | Screwed |
| 03. | Type of measurement | : | Combination electrode |
| 04. | Temperature Compensation | : | a) Automatic (Integral) upto 0-100°C with PT-100 Sensor
b) Manual Temperature Compensation |
| 05. | Preamplifier | : | Integral or separate |
| 06. | Range | : | 0-14 pH |
| 07. | Measuring Electrode | : | Glass |
| 08. | Liquid Junction | : | Ceramic/Kyner or equivalent |
| 09. | Pressure Rating | : | 10 kg/cm ² |
| 10. | Accessories | : | Vessel (SS 316) with ½" NPT connection |
| 11. | Cable | : | Upto transmitter in flexible conduct |

B. Transmitter

- | | | | |
|-----|------------------|---|---|
| 01. | Type | : | Microprocessor based, Single stream with adjustable range facility |
| 02. | Mounting | : | Flush Panel |
| 03. | Protection Class | : | IP – 55 or better |
| 04. | Output | : | 4-20 mA DC (isolated) to a load of 600 ohms (min.) |
| 05. | Display | : | i) Digital Display of process variable in Engineering Unit, Temperature, Alarm Status.
ii) Back lit LCD
iii) Character Height 12 mm |
| 06. | Calibration | : | Two-point calibration with standard buffer solutions. |
| 07. | Temperature | : | Manual or Automatic - selectable through |



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Compensation	keyboard
08. Diagnostic	: Self diagnostic for "Calibration required"/ "Calibration O.K.", electrode checking etc.
09. Alarm	: Dual alarm set point (2 SPDT, high & low), hysteresis and time delay adjustable from membrane keyboard. Switch contact rating of 5 Amp, 240 VAC / 0.2 Amp, 220 VDC
10. Enclosure	: Polycarbonate or better; Enclosure class IP-55 or better.
11. Cable Termination	: Internal (cable entry through conduit)
12. Accuracy	: $\pm 0.2\%$ of FSD or better"
13. Repeatability	: ± 0.02 pH or better
14. Response Time	: Less than 2 seconds or better
15. Stability	: ± 0.001 pH / week
16. Power Supply	: 240 V AC, 50 Hz UPS
17. Operating Temp.	: 0 - 50°C
18. Accessories	: a) Ultrasonic Electrode Cleaner for uncleaned water. b) Phenolic nameplate giving tag number, service, cable gland etc. c) Pre-amplifier, special cable, ultrasonic cleaner, etc. d) Buffer tablets. e) Serial interface (RS 232) for data logger download to PC (No data loss after power failure, all data shall be saved in non-volatile memory)
19. Preferred feature	Self cleaning type sensor

5.02.01 Silica Analyzer

01. Type	: Colorimetric Analyzer, gravity / pumped feed Microprocessor based
02. Operating range	: As per instrument schedule
03. Output	: 4-20 mA DC (isolated) into 600 ohms



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- | | | | |
|-----|-------------------------------|---|---|
| 04. | Readout | : | Digital Indicating meter for direct readout |
| 05. | Accuracy | : | ±1% of F.S.D or better |
| 06. | Reproducibility | : | ± 2% of F.S.D. or better |
| 07. | Calibration | : | Manual & automatic |
| 08. | Cycle time | : | Less than 10 min or better |
| 09. | Operating ambient temperature | : | 0-45 °C |
| 10. | Ambient humidity | : | Up to 95% relative humidity |
| 11. | Enclosure | : | Polycarbonate or better; Enclosure class IP-55 or better |
| 12. | Mounting | : | Flush panel |
| 13. | Life of light source | : | 9,000 hours (approx.) |
| 14. | Power supply | : | 240V, 50 Hz, 1 Phase UPS |
| 15. | Alarm Facility | : | 2 HI & 2 LO independently adj. over span.
Contact rating, 5A, 240 V AC / 0.5A, 220 V DC. |
| 16. | Alarm for | : | a) Monitor mal-function
b) Monitor on standby
c) Monitor auto-zeroing
d) Concentration high
e) Loss of sample
f) Concentration low
g) Loss of reagent |
| 17. | Preferred features | : | a) Hi and Lo alarm LED visible from front.
b) Power supply on/failure LED visible from front. |
| 18. | Accessories | : | a) Reagent cabinet
b) Sample strainer
c) Reagent Reservoir etc.
d) Phenolic name plate
e) Reagents & consumables
f) Special cables upto transmitter with flexible conduit
g) Serial interface (RS 232) for data logger download to PC (No data loss after |





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power failure, all data shall be saved in non-volatile memory)

5.03.00 Sodium Analyzer Assembly

01. Type of Cell : Flow Through ion-selection electrode
02. Flow Chamber : Plexi Glass Body or equivalent
03. Operating Range : As per instrument schedule
04. Measuring Electrode : Sodium Selective Glass Electrode
05. Output : 4-20 mA DC (isolated) into 600 ohms
06. Temperature Compensation : Automatic upto 45 deg.C
07. Read Out : Digital Indicating meter
08. Accuracy : < 5% of reading
09. Response Time : 2 minutes or better
10. Operating Ambient Temperature : 0 - 45 ° C
11. Ambient Humidity : Up to 95% relative humidity
12. Mounting : Flush Panel
13. Enclosure : Polycarbonate or better; Enclosure class IP-55 or better
14. Calibration : Automatic
15. Power Supply : 240V, 50 Hz, 1 Phase UPS
16. Alarm Facility : 2 HI and 2 LO independently adjustable over span. Contact rating, 5A, 240 V AC / 0.5A, 220 V DC.
17. Accessories (Preassembled, pre-wired and pre-tubed in enclosure) :
 - i) Phenolic tag plate etc.
 - ii) Sample filter.
 - iii) Pressure regulator & flow meter
 - iv) Automatic calibration kit
 - v) Reagents and consumables
 - vi) Special cables upto transmitter with flexible conduit
 - vii) Serial interface (RS 232) for data logger download to PC (No data loss after power failure, all data shall be saved in non-volatile memory)





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5.04.00 Phosphate Analyzer Assembly

- | | | | |
|-----|-------------------------------|---|---|
| 01. | Type of Cell | : | Flow Through |
| 02. | Flow Chamber | : | Plexi Glass Body or equivalent |
| 03. | Operating Range | : | As per instrument schedule |
| 04. | Measurement Principle | : | Colorimetric Detection system |
| 05. | Output | : | 4-20 mA DC linear |
| 06. | Read Out | : | Digital Indicating meter |
| 07. | Accuracy | : | ± 5% of Scale Range or better |
| 08. | Response Time | : | 90% in 10 minutes or better |
| 09. | Operating Ambient Temperature | : | 0 - 45 ° C |
| 10. | Ambient Humidity | : | Up to 95% relative humidity |
| 11. | Mounting | : | Flush Panel |
| 12. | Calibration | : | Manual through Zeroing solution |
| 13. | Power Supply | : | 240V, 50 Hz, 1 Phase UPS |
| 14. | Alarm Facility | : | 2 HI and 2 LO independently adjustable over span. Contact rating, 5A, 240 V AC / 0.5A, 220 V DC. |
| 16. | Enclosure | : | Polycarbonate or better; Enclosure class IP-55 or better |
| 17. | Accessories | : | i) Phenolic tag plate etc.
ii) Sample filter.
iii) Pressure regulator & flow meter
iv) Automatic calibration kit
v) Reagents and consumables
vi) Serial interface (RS 232) for data logger download to PC (No data loss after power failure, all data shall be saved in non-volatile memory) |

5.05.00 Hydrazine Analyzer

- | | | | |
|-----|-----------------|---|-------------------------------|
| 01. | Type | : | Electrochemical |
| 02. | Operating Range | : | As per instrument schedule |
| 03. | Output | : | 4-20 mA DC linear & 1-5 volts |



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- | | | | |
|-----|-------------------------------|---|--|
| 04. | Readout | : | Digital Indicating Meter, linear read-out |
| 05. | Accuracy | : | ±2% of FSD or better |
| 06. | Reproducibility | : | 2% of FSD or better |
| 07. | Drift | : | 2 ppb/month or better |
| 08. | Temperature Compensation | : | Automatic up to 45 ° C |
| 09. | Operating Ambient Temperature | : | 0-45 ° C (maximum) |
| 10. | Response Time | : | 1 minutes or better |
| 11. | Mounting | : | Flush Panel |
| 12. | Enclosure | : | Polycarbonate or better; Enclosure class IP-55 or better |
| 13. | Pressure Rating | : | As required |
| 14. | Power Supply | : | 240V, 50 Hz, 1 Phase UPS |
| 15. | Alarm Facility | : | 2 HI and 2 LO independently adjustable over span. Contact rating, 5A, 240 V AC / 0.5A, 220 V DC. |
| 16. | Preferred Feature | : | i) 2 Hi and LO alarm LED visible from front
ii) Power supply on/failure LED visible from front |
| 17. | Accessories | : | i) All chemical reagents for 12 months operation etc.
ii) Phenolic nameplate etc.
iii) Serial interface (RS 232) for data logger download to PC (No data loss after power failure, all data shall be saved in non-volatile memory) |

5.06.00 Dissolved Oxygen Analyzer

- | | | | |
|-----|--------------|---|--|
| 01. | Type | : | Electro-chemical, Microprocessor based. |
| 02. | Range | : | As per approved instrument schedule |
| 03. | Type of Cell | : | Flow through sampling type (continuous) |
| 04. | Enclosure | : | Polycarbonate or better; Enclosure class IP-55 or better |
| 05. | Output | : | 4-20 mA DC isolated to a load of 600 Ohms (minimum) |
| 06. | Temperature | : | |





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- | | | | |
|-----|----------------------|---|---|
| | Compensation | : | Automatic up to 45°C |
| 07. | Ambient Temp. | : | 45 °C |
| 08. | Readout | : | Digital Indicating meter |
| 09. | Accuracy | : | Better than ±4% of full scale for Transmitter |
| 10. | Sensor Response Time | : | 90% in 30 seconds or better |
| 11. | Mounting | : | Flush panel |
| 12. | Readable Distance | : | 3 meters (minimum) |
| 13. | Power Supply | : | 240 V AC, Single Phase, 50 Hz UPS |
| 14. | Alarm Facility | : | 2 HI & 2 LO independently adjustable over entire span.
Contact rating, 5A, 240 V AC / 0.5A, 220 V DC. |
| 15. | Preferred Feature | : | a) HI & LO Alarm LED visible from front.
b) Power supply on/failure LED visible from front.
c) In-built calibration facility. |
| 16. | Accessories | : | a) Phenolic nameplate giving tag no., service etc.
b) Reagent Cabinet (if applicable)
c) Reagent Reservoir (if applicable)
d) Other as per requirement including piping etc.
e) Serial interface (RS 232) for data logger download to PC (No data loss after power failure, all data shall be saved in non-volatile memory) |

5.07.00 Chloride Analyzer

- | | | | |
|-----|--------------------------|---|--|
| 01. | Type | : | Electro-chemical, Microprocessor based. |
| 02. | Range | : | As per approved instrument schedule |
| 03. | Type of Cell | : | Chloride Ion Selective Electrode |
| 04. | Enclosure | : | Polycarbonate or better; Enclosure class IP-55 or better |
| 05. | Output | : | 4-20 mA DC isolated to a load of 600 Ohms (minimum) |
| 06. | Temperature Compensation | : | Automatic with Pt 100 |



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- | | | | |
|-----|---------------------|---|--|
| 07. | Ambient Temp. | : | 45 °C |
| 08. | Readout | : | Digital Indicating meter |
| 09. | Accuracy | : | ± 2% or better |
| 10. | Reproducibility | : | <3% |
| 11. | Detection Limit | : | 0.5 mg/l or better |
| 12. | Analysis Time | : | 5 minutes (max) |
| 13. | Cycle time | : | Adjustable |
| 14. | Calibration | : | Manual and automatic |
| 15. | Mounting | : | Flush panel |
| 16. | Readable Distance | : | 3 meters (minimum) |
| 17. | Power Supply | : | 240 V AC, Single Phase, 50 Hz UPS |
| 18. | Alarms | : | 1 HI, 1 LO and 1 system alarm
Contact rating, 5A, 240 V AC / 0.5A, 220 V DC. |
| 19. | Control accessories | : | a) Sample level detector
b) Reagent level detector
c) Calibration solution level detector
d) Automatic sample, rinse and drain valve
e) Pump for calibration solution
f) Pump for reagent solution |
| 20. | Accessories | : | a) Phenolic nameplate with tag no., service etc.
b) Reagent solution tank
c) Calibration solution tank
d) Serial interface (RS 232) for data logger download to PC (No data loss after power failure, all data shall be saved in non-volatile memory) |





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6.00.00 DESIGN CRITERIA

This section lays down the general design criteria to be adapted in designing the Control & Instrumentation system of the plant.

6.01.00 General Requirements

6.02.00 Instrumentation, control and automation devices and accessories shall be designed with the following considerations:

- a) Stable in spite of temperature fluctuations.
- b) Able to withstand high humidity.
- c) Weather proof.
- d) Dust proof.
- e) Corrosion resistant.
- f) Erosion resistant.
- g) Able to withstand high vibration.
- h) Easily accessible for operation & maintenance.

6.03.00 Parts subject to high pressure, temperature or other severe duty shall be of materials and construction suitable for the service conditions and long operating life.

6.04.00 Components of instruments, control devices, accessories, piping etc. which contact steam, condensate or boiler feed water shall be manufactured from copper-free materials.

6.05.00 Instrument Accuracy, Standard Scales and Ranges

6.05.01 Instrument Accuracy

Instruments shall meet the following general requirements.

- a) Pressure measurement shall be linear with respect to the measured pressure.
- b) Flow meter shall meet the specified accuracy criteria when operating between 25 and 100 % of full-scale flow. The accuracy shall include the effect of errors in the differential head measuring device, square root converter and signal generator.
- c) Level measurement shall be linear with respect to the measured level based on a water specific gravity of 1.00.
- d) Wherever the measured parameter is influenced by process pressure & temperature, required compressibility correction shall be introduced.



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6.05.02 Instrument Scale Displays

- a) All displays shall be in engineering units. Instrument scales displayed on screen will have graduations with scale divisions based on multiples of 10. The smallest division shall preferably be a whole number approximately 1% of the scale range if not otherwise impracticable.
- b) Pressure instrument shall have the unit suffixed with 'a' or 'g' to indicate absolute or gauge pressure, respectively.
- c) Scales and charts of all instruments shall have linear graduations

6.05.03 Instrument Ranges

Instrument range shall be selected to have the normal reading, preferably between 50% and 70% of full scale for linear parameters and 70% to 80% for flow measurements. Deviation indicators shall have the null position at mid scale. The normal operating parameter shall be identified with a clear green mark.





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6.11.00 Burn-In And Elevated Temperature Test

Solid-state equipment / system shall be certified to be tested for a minimum period of 168 hours continuously under power. Solid-state logic systems shall be subject to the elevated temperature test and burn-in test as complete assemblies.

6.12.00 Elevated Temperature Test

- a) During the first 48 hours the ambient temperature shall be maintained at 50° C and the equipment shall be made to repeatedly perform operations it will be expected to perform in service with loads on various components being equal to those which will be experienced in actual service.
- b) The 48 hours test period shall be continuous but shall be divided into four 12-hour segments. The power supply voltage during each 12 hours segment shall be nominal voltage for 11 hours; followed by 110 percent of nominal voltage for 30 minutes; followed by 90 percent of nominal voltage for 30 minutes.
- c) During the elevated temperature test the cubicle doors shall be kept closed and inside temperature in the zone of highest heat dissipating

component /module shall be monitored. Temperature rise inside the cubicle shall not exceed 10 Deg.C above the ambient temperature of 50 Deg.C.

6.13.00 Burn in Test

The 48 hours elevated temperature test shall be followed by 168 hours of burn in test at normal operating temperature. This test shall also be conducted as per above procedure.

6.14.00 Panels, Cubicles and Enclosures

6.14.01 General

- a) All panels, cubicles and enclosures shall be furnished complete with integral piping, internal wiring, convenience outlets, internal lighting, grounding, ventilation, space heating, vibration isolating pads and other accessories.
- b) Unless otherwise specified cable entry for panels / desks / cabinets shall be through bottom via glanding plate. Fireproof seal shall be used to seal the bottom to prevent entry of dust.
- c) Panels and cabinets shall be constructed from steel sheet reinforced as required to provide true surface and adequate support for devices mounted thereon. Thickness of the CRCA steel for UCP / backup panel and other panels/cabinets shall be as described in Section VII of this volume of the specification. Panels and cabinets shall be of adequate strength to support mounted components during shipment





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and to support a concentrated load of 100 Kilograms on their top after erection.

- d) Panel /cabinet shall have eyebolt on top for lifting.
- e) Mounting , wiring , powering of all items to be mounted / installed on desks irrespective of the source of procurement shall fall in the scope of erection of Bidder ,this shall include freeissue items furnished by Owner.

6.14.02 Surface Preparation and Painting

Sheet metal exterior steel surfaces shall be sand blasted, ground smooth and painted as specified below:

- a) 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. Oil, grease and salts etc. shall be removed from by one or more solvent cleaning methods prior to blasting.
- b) Two spray coats of epoxy primer surface shall be applied to all exterior and interior surfaces, each coat of primer surface 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 Min. Paint shade thickness at exterior & Interior shall be 80 to 100 Microns. The finish colors for exterior and interior surfaces shall conform to the following shades:
 - i) Exterior : RAL 7032
 - ii) Interior – Brilliant White (Preferred) / RAL 7032.
- c) Paint films, which show sags, cheeks, blisters, teardrops, fat edges or other painting imperfections shall not be acceptable.

6.14.03 Wiring

Wiring within the panels shall conform to NEC standards and shall be factory installed and tested at the works. All interior wiring shall be installed neatly. Features shall not be limited to the following :

- a) All spare contacts of relays, switches and push buttons shall be wired up to the terminal blocks.
- b) Each wire shall be identified at both ends with wire designation as per approved wiring diagram. Heat shrinkable type ferrules with indelible computerized print shall be used with cross- identification.
- c) Wire termination shall be made with insulated sleeve and crimping type lugs. All external connections shall be made with one wire per terminal. Wire shall not be spliced or tapped between terminals. Open-ended terminal lugs shall not be used.





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- d) Internal wiring shall be terminated uniformly on one side of the terminal block leaving the other side available for termination of outgoing cables.
- e) 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.
- f) All low-level signal cables shall be separately bundled from control cable.
- g) Wires shall be dressed and run in troughs with clamp-on type covers. Wirings shall 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.
- h) Shield wires shall be terminated on separately.
- i) Common connections shall be limited to two wires per terminal. Looping of wires for power distribution in the panel to be avoided. Busbars to be provided for Power distribution".
- j) 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 to the conductor.
- k) Wiring shall be arranged to enable instruments or devices to be removed and/or serviced without disturbing the wiring. 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.
- l) Panel internal wiring shall follow distinct color-coding to segregate different voltage levels viz. 24V DC, 48V, 110V AC, 240V AC, 220V DC etc.
- m) Panels /cabinets /desks shall be provided with removable gasketed cable gland plates and cable glands. Split type grommets shall be used for prefab cables.
- n) Wire shall be multistranded annealed flexible high purity copper conductor with heat resistant FRLS PVC insulation and shall pass vertical flame test per IPCEAS-1981.
- o) Wire sizes used for internal wiring shall not be lower than the followings :

Control wiring (switches, : 1.5 Sq.mm
pushbuttons etc.)

Power supply /receptacle : 2.5 sq. mm or higher as per
illumination wiring load



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4-20mA DC current and low : 0.5 Sq. mm
voltage signal upto 48V DC

- p) Identification of conductors shall be done by insulation color-coding identified on drawings or by printed wiring lists.

6.14.04 Grounding

- a) System cabinet AC and DC ground shall be electrically isolated from each other and also electrically isolated from the Instrumentation signal ground. All the above ground shall be individually connected to the single point on the ground pit. Dedicated redundant earth pit shall be provided which shall be away from the HV equipment. This earth pit shall not be shared with other electrical equipment ground and shall also be insulated from other electrical system ground to ensure single point grounding of the system. Grounding resistance shall be better than 1.0 ohm. IEEE guideline shall be followed while designing the grounding system.
- b) Panels and cabinets shall be provided with a continuous tinned copper ground bus bar of minimum 25 mm x 6 mm cross section, extending along the entire length of the panel / desk / cabinet assembly. The ground bus shall be bolted to the panel structure and effectively ground the entire structure.
- c) The panel /desk /enclosure /JB ground shall have two (2) bolt drilling with GI bolts and nuts at each end to connect to GI/ copper flat ground riser by means of insulated copper ground cable of required cross section with lug.
- d) Circuits requiring grounding shall be individually and directly connected to the panel ground bus.
- e) For electronic system cabinets, the electronic system ground bus shall be similar but insulated from the cabinet and shall be separately connected to the system ground. Signal cable shields shall be grounded at the panel end only and shall not be left open. The ground in between panels of a shipping section shall be firmly looped.
- f) Electrical meters, relays, transmitters and switching devices, operating at a voltage less than 50V may be grounded through the steel structure.

6.15.00 Panel / Cabinet/ Desk/ Enclosures / junction boxes & instruments Environmental Protections

- a) Panels, cabinets, desks, distribution boxes, racks ,junction boxes, terminal boxes , instruments and all other field mounted equipment / enclosures shall suit the environmental condition of the area and shall not be inferior than the requirement indicated in the following table.





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SL. NO.	LOCATION	ENCLOSURE TYPE
1.	Indoor type non- ventilated enclosure in non-hazardous area	IP-54
2.	Indoor type ventilated enclosure in non-hazardous area	IP -42
3.	Enclosure in Air conditioned area	IP-32 with suitable canopy at top to prevent ingress of dripping water.
4.	Outdoor type in non-hazardous areas	IP-65 with anticorrosion coating.
5.	Outdoor in hazardous areas	As per requirements of the NEC Code for the location

- b) The construction of electrical enclosures located in areas subject to conditions classified in the National Electrical Code (NEC) as hazardous shall be of a type designated suitable for the environment in which they are located.

6.16.00

Terminal Blocks

- a) Terminals shall be chromated galvanized DIN rail mounted screwless cage clamp type or maxi termi type. Terminals shall have screwed connection for conductor cross-section above 2.5 mm². Terminal blocks shall conform to IEC 947-7-1.
- b) The characteristics of the terminal blocks shall be as follows.
- High contact force, independent of conductor cross-section and large contact surface area.
 - Integrated self-loosening protection to avoid shifting of contact surface that may allow contamination of connection point.
 - Inspection and maintenance free (resistant to thermal aging and vibration)
 - Low and constant voltage drop
- c) Material of the clamping yoke of screwed terminals shall be electroplated, chromated, case hardened steel with high strength clamping screw. For screwless terminals, the tension spring shall be made of high quality, non-rusting, acid-resistant steel. The current bar shall be of tin-lead plated copper or brass.
- d) Terminals shall be of non flammable suitable thermoplastic material such as polyamide.





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- e) Terminal blocks shall be mounted vertically in panels and cubicles with clearance for at least 100 mm between two sets and between wall and terminal block.
- f) Terminal blocks shall be provided with white marking strips / self-adhesive marker cards. Power terminals shall have protection covers.
- g) At least 20 percent spare unwired terminals shall be provided for all panels /cabinets /desks /junction box etc... This shall be in addition to 20% spare wired terminals of spare IO channels.
- h) Bottom of the terminal block shall be at least 200 mm above the cable gland plate for bottom entry type panels.
- i) 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.
- j) 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.
 - vi) The terminal blocks for Power, control and signal cable terminal block shall be separate with separate colour coding for ease in recognition..

7.00.00 METERING BASES AND CHART UNITS

The following system of units shall be followed for various displays and scales unless otherwise mentioned:

- i) Pressure : Kg/cm²
 Differential Pressure : mm of H₂O column / Kg/cm²
- ii) Draught : mm of H₂O column
- iii) Vacuum : Kg/cm² (abs)/mm of Hg column



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iv)	Temperature	: Degree Celsius ($^{\circ}$ C)
v)	Flow (Steam, Water)	: Tonnes / hr, M ³ /Hr
vi)	Flow (Oil)	: M ³ / Hr, Liter/Hr
vii)	Flow Air	: Tonnes / hr / M ³ / Hr.
viii)	Density	: gms / c.c.
ix)	Level	: mm /%
x)	Conductivity	: Micro Siemens / cm
xi)	Gas Analyzer	: Percentage by weight or as specified in respective case.
xii)	Dissolved Oxygen / Silica / Sodium	: ppm /ppb

8.00.00 PROCESS CONNECTION & INSTRUMENT HOOK UP

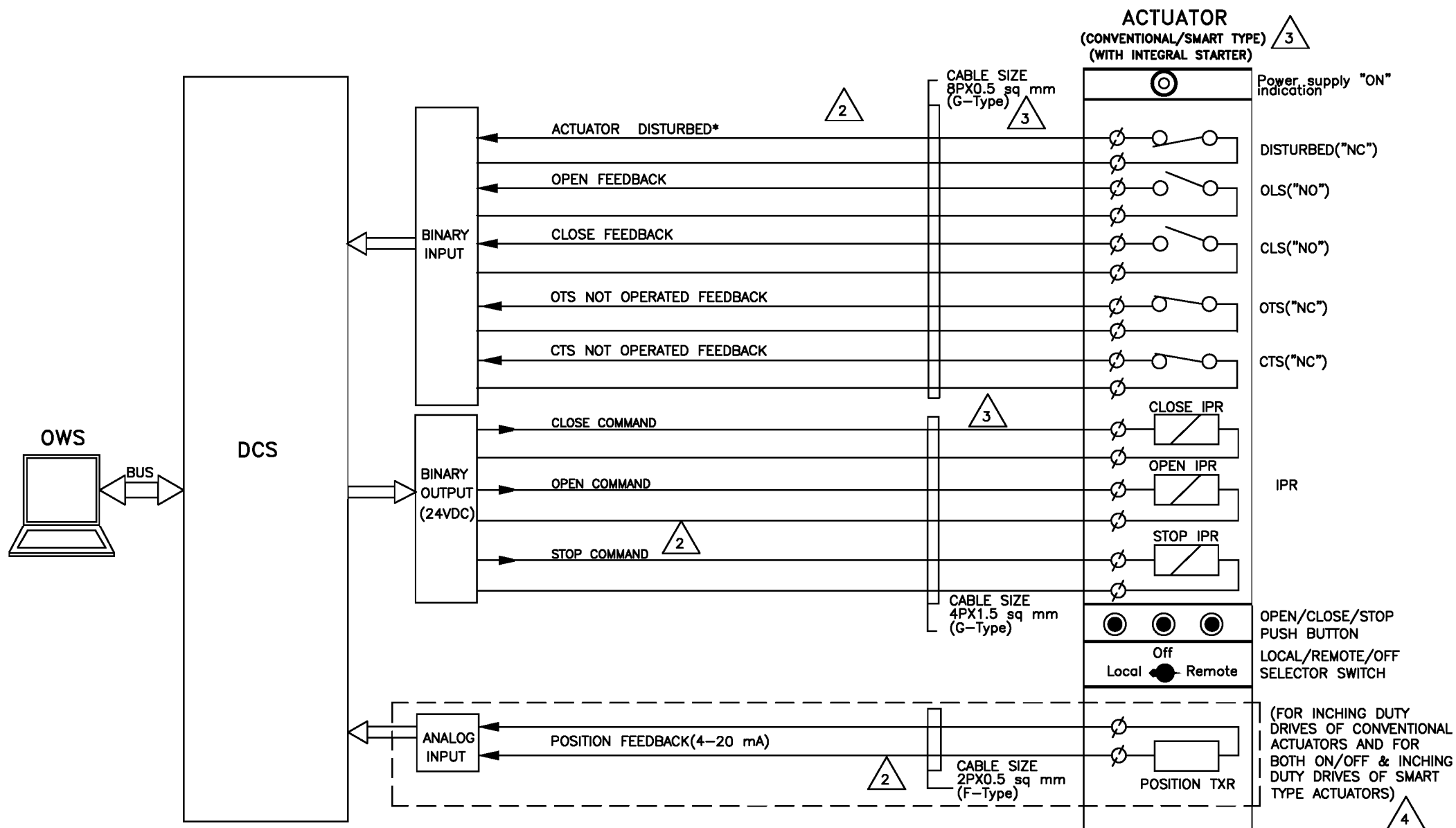
- 8.01.00 Instrument connection to the process system (piping, vessel etc.) shall be according to the process & piping specification upto and including the root valves. Root valves shall be installed as close as possible to the piping or vessel.
- 8.02.00 Each instrument shall have its own independent connection to the process except for instruments located on standpipe. Each instrument shall be connected independently to the standpipe through isolation valve.
- 8.03.00 Process connection for instruments lines and vessels shall be in accordance to standards such as ASME or other recognized international standards.



	C&I SPECIFICATION FOR CONDENSATE POLISHING UNIT	SECTION: C SUB SECTION: C&I
<div>SIGNL EXCHANGE BETWEEN DRIVES & DCS</div>		

291681/2021/PS-PEM-MAX

DCS INTERFACE FOR BIDIRECTIONAL DRIVE(WITH INTEGRAL STARTER)



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PROJECT: 1X660MW SAGARDIGHI THERMAL POWER
EXTENSION PROJECT (UNIT #5)

TITLE DDCMIS INTERFACE FOR
BIDIRECTIONAL DRIVE

DRG.NO. PE-DM-445-145-1002

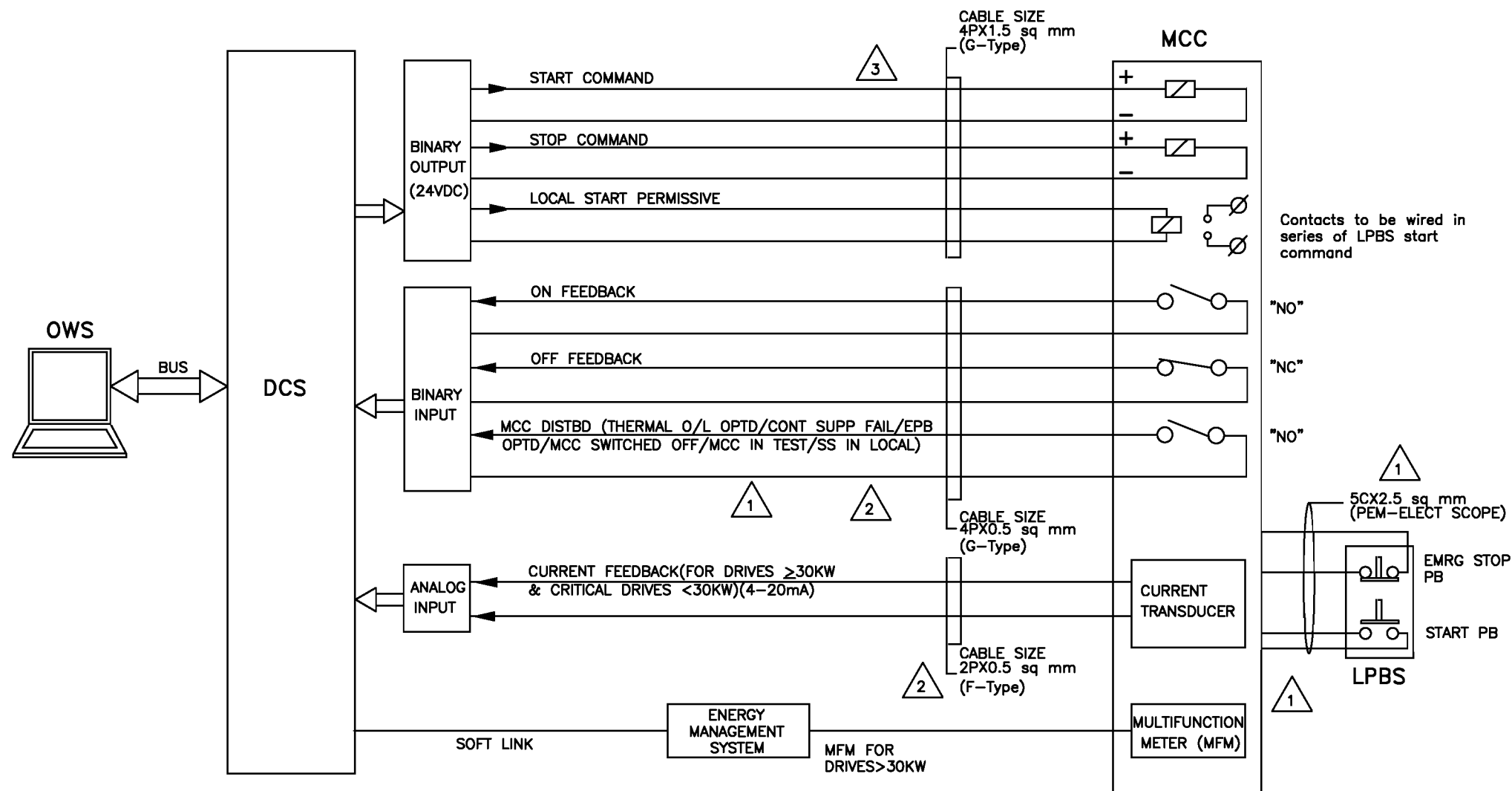
DATE 15.03.2021

REV.NO. 04

SHT 7 **OF** 11

291681/2021/PS-PEM-MAX

DCS INTERFACE FOR UNIDIRECTIONAL LT DRIVE (CONTACTOR OPERATED)



NOTES:

REDUNDANCY IN OUTPUT SHALL BE PROVIDED FOR ALL CRITICAL LT DRIVES



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PROJECT: 1X860MW SAGARDIGHI THERMAL POWER
EXTENSION PROJECT (UNIT #5)TITLE DDCMIS INTERFACE FOR
UNIDIRECTIONAL LT DRIVE (CONTACTOR OPERATED)

DRG.NO. PE-DM-445-145-I002

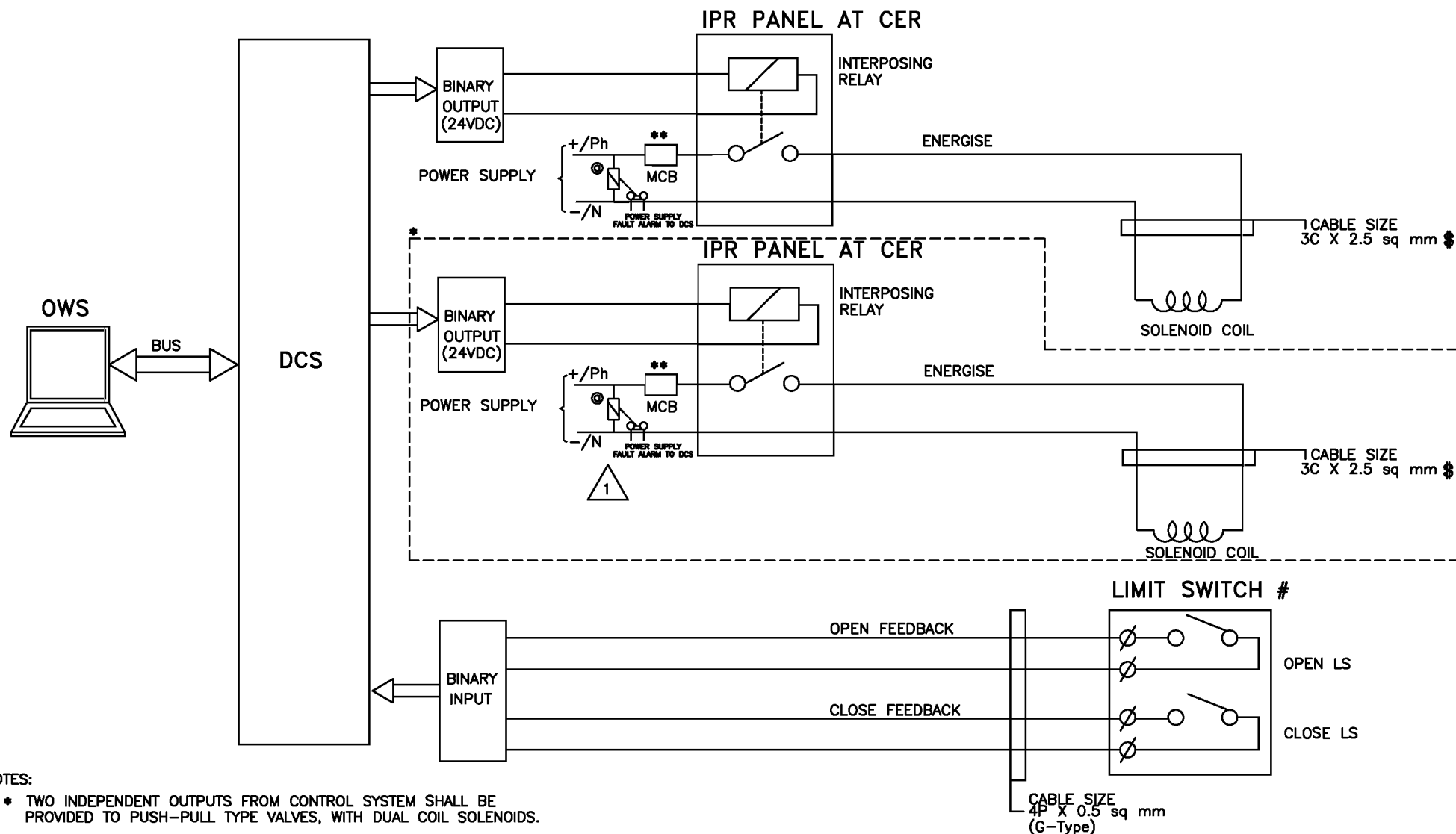
DATE 15.03.2021

REV.NO. 04

SHT 8 OF 11

291681/2021/PS-PEM-MAX

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



NOTES:

* TWO INDEPENDENT OUTPUTS FROM CONTROL SYSTEM SHALL BE PROVIDED TO PUSH-PULL TYPE VALVES, WITH DUAL COIL SOLENOIDS.

** MCB SHALL BE PROVIDED FOR EACH SOLENOID

FOR ON/OFF TYPE, SOLENOID ACTUATED CONTROL/ PNEUMATIC VALVE.

⊙ COMMON FOR ALL SOLENOID VALVES SIMILAR COIL VOLTAGE RATING PER PANEL.

⌘ POWER CABLE CROSS SECTION SHALL BE AS PER CABLE SIZING CALCULATION.



603 of 601

PROJECT: 1X860MW SAGARDIGHI THERMAL POWER
EXTENSION PROJECT (UNIT #5)

TITLE DDCMIS INTERFACE FOR
SOLENOID DRIVE

DRG.NO. PE-DM-445-145-I002

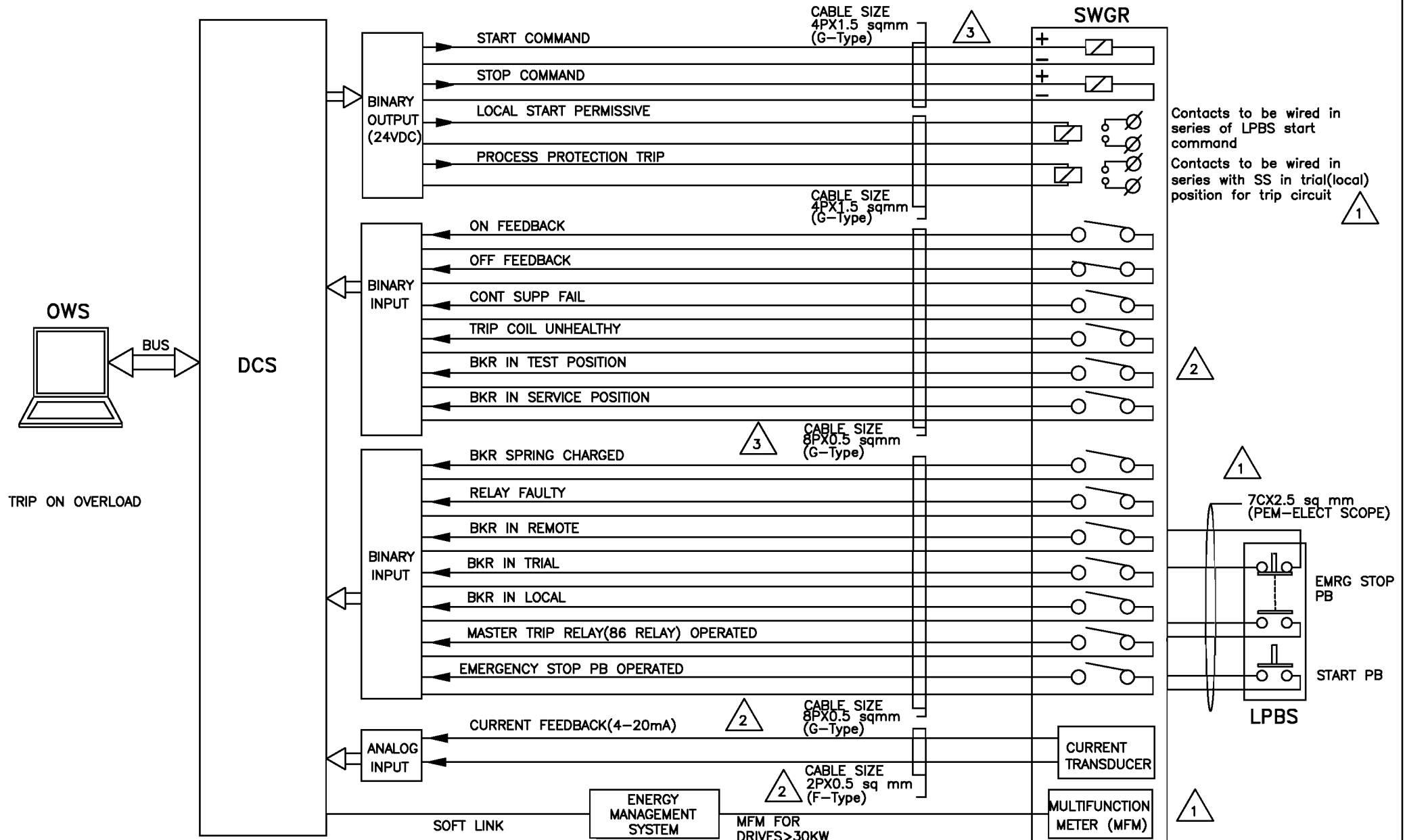
DATE 15.03.2021

REV.NO. 04

SHT 9 OF 11

291681/2021/PS-PEM-MAX

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



NOTES:

REDUNDANCY IN OUTPUT SHALL BE PROVIDED FOR ALL HT AND CRITICAL LT DRIVES



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PROJECT: 1X860MW SAGARDIGHI THERMAL POWER
EXTENSION PROJECT (UNIT #5)

TITLE

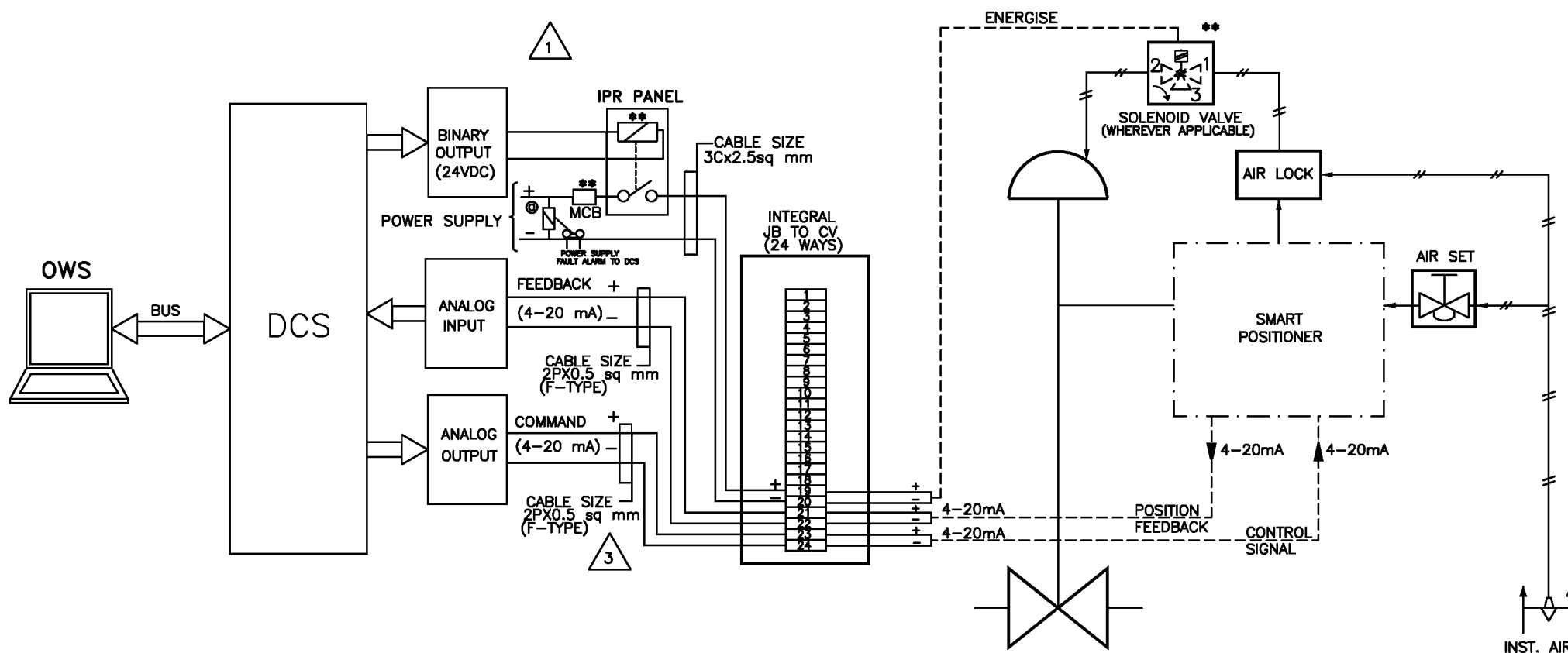
DDCMIS INTERFACE FOR
UNIDIRECTIONAL HT DRIVE

DRG.NO. PE-DM-445-145-I002

DATE 15.03.2021

REV.NO. 04

SHT 10 OF 11



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

- 1


REDUNDANCY IN OUTPUT SHALL BE PROVIDED FOR ALL MODULATING DRIVES



505 of 601

TITLE	TYPICAL HOOK-UP DIAGRAM
01	ANALOG DRIVE (WITH SMART POSITIONER)

SHT	11	OF	11
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	C&I SPECIFICATION FOR CONDENSATE POLISHING UNIT	SECTION: C SUB SECTION: C&I
<div>INSTRUMENTATION CABLE INTERCONNECTION AND TERMINATION PHILOSOPHY</div>		



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**EPC Bid Document
Sagardighi Thermal Power Project
1x660 MW Unit No. 5, Phase - III**

11.00.00 INSTRUMENTATION CABLES

11.01.00 General Requirements

11.01.01 Bidder shall supply, erect, terminate and test all instrumentation cables for control and instrumentation equipment/devices/systems included under his scope.

11.01.02 Any other application where it is felt that instrumentation cables are required due to system/operating condition requirements, are also to be provided by Bidder.





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- 11.01.03 Other type of cables like co-axial cables for system bus, cables for connection of peripherals etc. (under Bidder's scope) are also to be furnished by the Bidder.
- 11.01.04 Bidder shall supply all cable erection and laying hardware like cable trays, supports, flexible conduits, cable glands, lugs, pull boxes etc. on as required basis for all the systems covered under this specification.
- 11.01.05 All instrumentation cables covered in this specification shall comply with VDE 0815, VDE 0207, Part 4, Part 5, Part 6, VDE 0816, VDE 0472, SEN 4241475, ANSI MC 96.1, IS-8784, IS-10810 (latest editions) and its amendments read along with this specification.
- 11.01.06 The thermocouple extension cables shall be of Two pair/multi pair, twisted & shielded, PVC insulated, FRLS PVC sheathed and compatible for the type of thermocouples employed. The material of conductor shall be as per ANSI MC-96.1.
- 11.01.07 Traid cables shall be used for all RTD (3-wire) measurements. In case of 4-wire RTD, 2 pair instrumentation signal cables shall be used.
- 11.01.08 All cables near high temperature zone like burner front devices, metal temperature thermo-couples on main steam & turbine casing etc. shall be high temp cables, which shall be terminated at a junction box in normal temperature zone. Thermocouple extension cables and copper conductor cables for high temperature applications shall be with insulation of individual conductor and outer sheath of extruded FEP (i.e., Teflon) as per VDE 0207 Part 6 and ASTM D 2116. The thickness of insulation shall be 0.5 mm nominal (i.e., 0.4 mm minimum). These cables shall be single/ multipair, twisted & shielded.
- 11.01.09 Cable accessories such as harnessing components, markers, bedding, cable joiner, binding tape etc. shall have flame retardant quality.
- 11.01.10 The thickness of outer sheath shall be as per the guidelines given in VDE 0816. Thickness of outer sheath shall not be less than 1.8 mm in any case. Allowable tolerance of overall diameter of the cables shall be ± 2 mm max. over the declared value in technical data sheets. The variation in diameter and the ovality at any cross section shall not be more than 1.0 mm.
- 11.01.11 The Cables shall be supplied in non returnable standard seasoned drums. The drum length shall be 1000m ($\pm 5\%$) up to & including 8 pairs and 500 m ($\pm 5\%$) above 8 pairs. Drum shall be anti rodent, anti termite and smooth finish. Both ends of cable shall be capped by means of non hygroscopic sealing material.
- 11.01.12 Durable marking shall be provided on the outer sheath of the cable at intervals not exceeding 5 metres. Marking shall include Manufacturer's name, Year of manufacture, Voltage grade, Type of cables (Conductor size & no. of pairs / type of compensating /extension cable, Analog or Binary), Insulation material, FRLS etc.

paired
instrument
ation cable
acceptable

11.01.07

11.01.08





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Sequential length marking shall also be provided at every metre interval on outer sheath of cable.

- 11.01.13 Bidder shall furnish all documentary evidence including cross-sectional drawings, test certificates to substantiate the suitability of cables offered for different applications. Bidder shall also clearly bring out the application wise details for each type of cable offered.
- 11.01.14 All prefabricated cables shall have 10% spare cores which will not be connected to pin connectors.
- 11.01.15 All the instrumentation cables i.e. twisted and shielded multipair cables, compensating cables, pre fabricated cables etc. shall be flame retardant low smoke and low halogen (FRLSH) type.
- 11.01.16 For all Digital Output (DO) signal from DCS or PLC, Minimum 1.5 Sq mm cable shall be used, except for Solenoid valves where 2.5 Sqmm cable shall be used. Moreover, bidder shall submit the calculations for selecting the cable size.

11.02.00 Instrumentation Cable Specifications

11.02.01 INSTRUMENTATION MULTI PAIRED SIGNAL CABLE

- 01. Conductor type : Multi-stranded annealed tinned high conductivity copper
- 02. Conductor size : 0.5 / 1.0 / 1.5 Sq.mm (as required)
- 03. Conductor resistance : 39 Ω/Km/18 Ω/Km/12 Ω/Km
- 04. Conductor Insulation : Extruded PVC meeting the requirements of VDE 0207 Part 4 compound Y I3. Insulation thickness for individual core shall be between 0.28 and 0.35 mm for 0.5 mm² cables, 0.5 to 0.6 mm for 1.0 mm² cables and 0.8 to 0.9 for 1.5 mm² cable.
- 05. Voltage Grade : 225 V (peak value)
- 06. Twisting : Twin twisted with lay of 50 mm (max)
- 07. Twisting Direction : All pairs in the same direction. Lapped to form bunch with mylar tape.
- 08. Screen (Pair & Overall) : Aluminium mylar tape with a thickness of 28 µm (min.) for individual pair screen and 60 µm (min.) for overall screen with 100% coverage and 25% overlapped edges. Over the individual pair screening tape two laps of 0.05 mm thick (min.) polyester tape shall be





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applied with minimum overlap of 25%.
 Metallic side of the screen shall be in contact with drain wire.

Analog signals - Individual pair & overall shield.

Binary signals - overall shield.

- | | | | |
|-----|------------------------|---|--|
| 09. | Drain wire | : | Annealed tinned copper wire, stranded. Size 0.5 Sq. mm. (No. of strands / size:- 7 / 0.3mm). Separate drain wire for individual pair shield (wherever applicable) as well as overall shield. |
| 10. | Inner Sheath | : | Extruded PVC (compound YM1) as per VDE 0207 Part 5 (anti rodent, anti termite & moisture resistant properties) and shall be of flame retardant low smoke (FRLS) type |
| 11. | Fillers | : | Non metallic flame & moisture retardant |
| 12. | Armouring | : | GI wire / strip |
| 13. | Outer Sheath | : | Extruded PVC (compound YM1) as per VDE 0207 Part 5 and shall be of flame retardant low smoke low halogen (FRLSH) type |
| 14. | Temperature Range | : | 70°C (continuous) except for high temperature resistant Teflon insulated cables which shall be suitable for continuous operation at 205°C |
| 15. | Sheath colour | : | Inner- Black and Outer- Sky Blue |
| 16. | Tests on outer sheath: | | a) Oxygen Index: Min.29% at room temp. (ASTMD-2863)
b) Acid Gas Gen.: Max.20% by weight as per IEC 754 Part-I
c) Temp Index : Min 250° C (ASTMD-2863)
d) Smoke Density Rating :Max.60% (ASTMD-2843).
e) Complete cable assembly shall pass Swedish Chimney Test- as per SEN-4241475 AND Flammability Test as per IEEE-383. |





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- f) Halogen Content Measurement as per ICEA T-33-655 (Permissible limit for halogen shall not be more than 0.2%)
17. High voltage test
- a) Core to core - 1.5 KV for 1 min.
- b) Core to screen - 1.0 KV for 1 min.
- c) Screen to Armour – 1.0 KV for 1 min
18. Rodent & Termite repulsion test Presence of lead shall be confirmed
19. Colour of core insulation for Instrumentation Cable

PAIR	CORE	COLOR
1st	1st	Blue
1st	2nd	Red
2nd	1st	Gray
2nd	2nd	Yellow
3rd	1st	Green
3rd	2nd	Brown
4th	1st	White
4th	2nd	Black

Above 4 Pairs, 4 Pairs making a unit shall have indelible printed colour coded bands like Pink for 1st unit, Orange for 2nd unit and Violet for 3rd unit and so on. In addition band marking, for example single band for 1st. unit, double band for 2nd. unit and so on, shall be provided on each conductor for identification of unit. Band marking on individual core shall be provided at regular intervals not exceeding 50 mm.

11.02.02 THERMOCOUPLE EXTENSION & COMPENSATING CABLE (TWO PAIR & MULTI-PAIR)

01. Conductor : Solid conductor
02. Conductor size : 16 AWG (1.31 Sq. mm)
03. Type : Kx (Extension) (Chromel Alumel),
Rx (Compensating) (Copper-Copper alloy),
04. Conductor Insulation : Extruded PVC meeting the requirements of VDE 0207 Part 4 compound Y I3. Insulation thickness for individual core shall be between 0.35 to 0.45 mm for 1.31 mm² cables
05. Voltage Grade : 225 V (peak value)





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06. Twisting : Twin twisted with lay of 50 mm (max)
07. Twisting Direction : All pairs in the same direction. Lapped to form bunch with mylar tape.
08. Screen (Pair & Overall) : Aluminium mylar tape with a thickness of 28 μ m (min.) for individual pair screen and 60 μ m (min.) for overall screen with 100% coverage and 25% overlapped edges. Over the individual pair screening tape two laps of 0.05 mm thick (min.) polyster tape shall be applied with minimum overlap of 25%. Metallic side of the screen shall be in contact with drain wire.
09. Drain wire : Annealed tinned copper wire, stranded. Size 0.5 Sq. mm. (No. of strands / size:- 7 / 0.3mm). Separate drain wire for individual pair shield as well as overall shield.
10. Inner Sheath : Extruded PVC (compound YM1) as per VDE 0207 Part 5 (anti rodent, anti termite & moisture resistant properties) and shall be of flame retardant low smoke (FRLS) type
11. Fillers : Non metallic flame & moisture retardant
12. Armouring : GI wire / strip
13. Outer Sheath : Extruded PVC (compound YM1) as per VDE 0207 Part 5 and shall be of flame retardant low smoke low halogen (FRLSH) type
14. Temperature Range : 70°C (continous) except for high temperature resistant Teflon insulated cables which shall be suitable for continous operation at 205°C
15. Sheath colour : Inner- Black and Outer- Yellow for Type Kx, Green for Rx.
16. Tests on outer sheath :
 - a) Oxygen Index: Min.29% at room temp. (ASTMD-2863)
 - b) Acid Gas Gen.: Max.20% by weight as per IEC 754 Part-I
 - c) Temp Index : Min 250° C (ASTMD-2863)
 - d) Smoke Density Rating :Max.60% (ASTMD-2843).





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- e) Complete cable assembly shall pass Swedish Chimney Test- as per SEN-4241475 AND Flammability Test as per IEEE-383.
 - f) Halogen Content Measurement as per ICEA T-33-655 (Permissible limit for halogen shall not be more than 0.2%)
 - g) Thermal EMF Test as per ANSI MC96.1
17. High voltage test
- a) Core to core - 1.5 KV for 1 min.
 - b) Core to screen - 1.0 KV for 1 min.
 - c) Screen to Armour – 1.0 KV for 1 min
18. Rodent & Termite repulsion test Presence of lead shall be confirmed
19. Conductor material & sheath color for thermocouple extension /compensating cable as per ANSI MC 96.1

CABLE TYPE	OVERALL SHEATH COLOR	WIRE	SHEATH COLOR	CONDUCTOR MATERIAL
Kx	Yellow	Positive	Yellow	Nickel / Chromium
		Negative	Red	Nickel / Aluminum
Rx	Green	Positive	Black	Copper
		Negative	Red	Copper Alloy

11.02.03 INSTRUMENTATION TRIAD CABLES

- 01. Conductor type : Stranded tinned Electrolytic copper
- 02. Conductor size : 1.0 Sq.mm
- 03. Stranding : 7 x 0.43 mm
- 04. Conductor Insulation : HRPVC Type-C, 0.6 mm thick
- 05. Twisting : Triad twisted with lay of 50 mm
- 06. Twisting Direction : All triads in the same direction. Lapped to form bunch with mylar tape.
- 07. Colour : Outer sheath colour shall be black for non-IS cable and light blue for IS cable.





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Individual traide color code shall be Light blue-Brown-Black.

- | | | | |
|-----|---|---|---|
| 08. | Individual Pair Overall Shield mm thick). | : | Polyethylene coated aluminum foil with 100% coverage with 25% Overlap (0.06 |
| 09. | Drain wire | : | Annealed Tinned copper wire, Size 0.5 Sq. mm. minimum |
| 10. | Inner Sheath | : | Extruded FR PVC, Thickness as per International Standard |
| 11. | Armoring | : | N/A |
| 12. | Outer Sheath | : | Extruded FR PVC, Thickness as per International Standard |
| 13. | Rip Cord | : | Yes |
| 14. | Operating Voltage | : | 300 V / 500V R.M.S (Core to Earth / Core to Core.) |
| 15. | Temperature Range | : | Up to 85 °C |
| 16. | Electrical Characteristics Resistance | : | 18.4 Ohms/Km (max.) at 20 °C |
| | Mutual Capacitance at 1 kHz | : | a) Between adjacent cores 150 nf / Km.
b) Between conductor and Screen 400 nf / Km |
| | L/R ratio | : | 25 µH/Ohms (max) |
| | Insulation at 20° C | : | 100 M Ohms/Km (Min) |
| 17. | Codes & Standards | : | a) IPCEA-S-61-402
b) IEC 332-1 ASTM-B-33 |
| 18. | Tests | : | a) Oxygen Index: Min.29 at room temp. (ASTM-D-2863)
b) Temp Index : Min 250 °C at 21Oxy. Ind. (ASTM-D-2863)
c) Flammability Test : as per IEC 332 Part-I
d) Swedish Chimney Test-S-424-1475
e) High Voltage Test :1.0 KV for1 Min |





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f) Type Test for material

19. No. of Triads : 2T, 6T, 12T

11.02.04 Cable parameters such as mutual capacitance between conductors, conductor resistance, insulation resistance, characteristic impedance, cross talk and attenuation figures at 20 deg. C (± 3 deg. C) for various types of cables as applicable shall be as specified in TABLE-1.

**TABLE- 1
 CABLE PARAMETERS**

SL. No.	PARAMETER / TYPE	TYPE – E, F	TYPE – G, I	TYPE – A, B & C	REMARKS
01.	Mutual Capacitance at 0.8 kHz (max.)	120 nF/Km.	100 nF/Km.	120 nF/Km.	
02.	Conductor Resistance (max.)	73.4 Ohm/km (Loop) For Type F, 13.3 ohm/km (loop) for Type E	73.4 ohm/km (loop)	26.6 ohm/km (loop)	
03.	Insulation Resistance (minimum)	100 M ohm/km	100 M ohm/km	100 M ohm/km	
04.	Cross-talk figure at 0.8 kHz (minimum)	60 dB	60 dB	60 dB	
05.	Characteristic Impedance (maximum) at 1 kHz	320 ohm	340 ohm	320 ohm	
06.	Attenuation at 1 kHz (maximum)	1.2 dB/Km for Type F; 0.8 dB/Km for Type E	1.2 dB/Km	1.2 dB/Km	

11.02.05 Identification of the cores & pairs shall be done with suitable colour coding & band marking as well as by numbering of cores/pairs as per VDE: 0815. The details of colour coding etc. shall be as approved by Owner during detailed stage. Also refer TABLE - 2 for description of various type of cables.





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TABLE- 2
DESCRIPTION OF VARIOUS TYPES OF CABLES

SL. No.	TYPE	CONDUCTOR SIZE IN SQ.MM	REMARKS
01.	A	1.31	Two pair shielded and twisted pair thermo-couple, extension cable, ANSI type Kx, solid alloy conductor.
02.	B	1.31	Two pair shielded & twisted thermo-couple, extension cable, ANSI type Sx, solid alloy conductor.
03.	C	1.31	Two pair shielded & twisted Heat resistant Teflon insulation & outersheath thermo-couple, extension cable, ANSI type Kx, solid alloy conductor.
04.	E	0.5	Two pair individual pair and overall shielded twisted pair instrumentation cable for both analog and digital signal to be used from field mounted instruments to local junction box.
05.	F	0.5	Multipair individual pair & overall shielded twisted pair instrumentation cable (4/8/12pair) for analog signals with stranded copper conductor.
06.	G	0.5	Multipair overall shielded & twisted pair instrumentation cable (4/8/12pair) for binary signals with stranded copper conductor.
07.	H	1.0	2 Triad / MultiTriad individual pair & overall shielded instrumentation cable (2/6/12Triad) for RTD signals with stranded copper conductor.
08.	I	0.5	Type F cable / type G cable with heat resistant Teflon insulation & outersheath for high temperature application.
09.	S	As per specific standard / requirement for each applicable	Multicore / multipair shielded cable for system specific cables like conductivity type level switches, system bus cable, flame scanner etc. as applicable.

11.03.00 Instrumentation Cable Interconnection and Termination Philosophy

The cable interconnection philosophy to be adopted shall be such that extensive grouping of signals by large scale use of field mounted Group JB's at strategic locations (where large concentration of signals are available, e.g. switchgear) is done and consequently cable with higher number of pairs are extensively used. JB's to be furnished under this specification shall be of 6/12/24/36/48 way. The material dimension and interior / exterior colour of JB's shall be subject to Owner's approval. The details of termination to be followed is mentioned in TABLE – 3 :





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TABLE- 3
CABLE TERMINATION TO BE FOLLOWED

SL. No	APPLICATION		TYPE OF TERMINATION		TYPE OF CABLE
	FROM (A)	To (B)	END (A)	END (B)	
01.	Valves / Dampers Drive (Integral Junction Box)	Marshalling Cubicle / Local Group JB / Termination Control Cabinets / System Cabinets	Plug-in Connector	Post mounted Maxitermi / Cage Clamp type	G
02.	Transmitters, Process actuated switches to be mounted in LIE / LIR	Integral Junction Box of LIE / LIR	Plug-in Connector	Maxitermi / Cage Clamp (Rail mounted) type.	F, G
03.	RTD Heads	Local Junction Box	Plug-in Connector	Maxitermi / Cage Clamp (Rail mounted) type.	H
04.	Thermocouples	CJC Box	Manufacturer's standard	Screwed / Cage Clamp Type	A,B,C*
05.	Local Junction Box, CJC Box, Int. Junction Box of LIE / LIR / Group JB / MCC / Switchgear	Marshalling Cubicle / Local Group JB / Termination / Control Cabinets / System Cabinets	Maxitermi / Cage Clamp (Rail mounted) type.	Post mounted Maxitermi / Cage Clamp type	F, G
06.	Local Junction Box, MCC / Switchgear	Group JB	Maxitermi / Cage Clamp (Rail mounted) type.	Maxitermi / Cage Clamp (Rail mounted) type.	F, G
07.	Field mounted Instrument	Group JB	Maxitermi / Cage Clamp (Rail mounted) type.	Maxitermi / Cage Clamp (Rail mounted) type.	F, G
08.	Marshalling Cubicle /	Electronic System	Post mounted Maxitermi /	Post mounted Maxitermi /	F, G





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SL. No	APPLICATION		TYPE OF TERMINATION		TYPE OF CABLE
	FROM (A)	To (B)	END (A)	END (B)	
	Termination Cabinet	Cabinet	Cage Clamp type.	Cage Clamp type.	
09.	UCP mounted equipments	Post mounted Maxitermi / Cage Clamp type	Post mounted Maxitermi / Cage Clamp type.	Plug in Connector / Cage Clamp type (rail mounted)	F, G (with connector at one end)
10.	DCS/ PLC Cabinets	PC, Printers etc.	Plug connector in	Plug connector in	Manufacturer Standard

NOTES :

01. For Sl. No. 05, 06, 07 & 08, normally 10% spare core shall be provided.
02. For analog signals individual pair shielding & overall shielding & for Binary signals only overall shielding of instrumentation cables shall be provided.
- 03 *For high temperature application only.

11.04.00 CONTROL & POWER CABLE

Bidder shall refer to Volume IIF of the electrical specification for detail.

11.05.00 OPTICAL FIBER CABLE

11.05.01 This specification defines the minimum general requirements for the Design, manufacture, supply, inspection, installation, testing & commissioning of optical fiber cables and accessories, such as fiber distribution (patch) panels, adapters, connectors, joint boxes, pigtailed and other components, as required to complete the system. Bidder shall consider all related activities, such as cable stripping, cable entry in boxes and panels, cable fiber splicing/fusion, cable performance testing and other services, to achieve a properly documented and operational cable network. all Fibre Optic cables shall be Single Mode type.

11.05.02 Fiber Optic Cables shall be installed on cable tray, duct bank, cable trench installation as necessary. For outdoor applications the cable shall be armoured with Poly Ethylene sheathing. In all cases cable shall be routed through suitable grade HDPE permanently lubricated protection pipe as per IS 4984, IS 12235 & TEC.G/CDS-08 /01 of suitable size @ 53% fill factor. Permanent route marking in FRP (Fibre Reinforced Plastic) material shall be provided at intervals not exceeding 5 meters for all FO cables layed outdoor buried under the ground.

11.05.03 The Optical Fiber core shall be of ultra pure fused silica glass coated with UV-cured acrylate suitable to withstand temperature of about 80°C (continuous).





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Fiber optic distribution panels shall be provided as required. The fiber optic distribution panels shall be of a standard wall mounted sheet metal enclosure type. Fiber optic distribution panels shall be equipped to secure optical fiber patch cables and pigtails to prevent damage during all operation and maintenance functions. In general splice enclosure are envisaged. However, If no optical fiber splice enclosures are implemented, than the fiber optic distribution panels shall be equipped with splice trays for storage and protection of fusion splice connections of single-mode fiber optic cable and pigtails. Each fiber optic distribution panel shall be fully equipped with 'SC' type bulk head connector sleeves or equivalent. Unused sleeve ports shall be equipped with reusable caps to prevent the intrusion of dust.

11.06.03 Pigtail and Patch Cord

All pigtails shall be factory SC-connectorized, and satisfy specified performance for optical links. All unused pigtails (including spares) shall be terminated with the connector to a bulkhead connector sleeve, protected by a reusable cap on the opposite sleeve port, to prevent the intrusion of foreign material or dust. All necessary connectorized pigtails shall be provided in the lengths required.

11.06.04 Fiber Optic Tool Kit

Fiber Optic Splicer, Terminator And Tool Kit Box

Bidder shall provide new unused tools comprise of Splicer and Fusion Jointer and tool kit comprise of cutter, stripper, polishing tool, handheld microscope, heat shrinkable sleeve, scissor, knife etc. as required for maintenance and commissioning.

11.07.00 Tests

Following minimum test as per any approved standards shall be carried out on the cables

- a. Attenuation And Dispersion Characteristics Tests
- b. Proof Tests
- c. Macro-Bend Resistance Test
- d. Mechanical Tests
- e. Low And High Temperature Cable Bend Test
- f. Impact Resistance Test
- g. Compressive Strength Test
- h. Tensile Strength Test
- i. Cable Twist Test
- j. Cable Cyclic Flexing Test
- k. Environmental Characteristics Test
- l. Temperature Cycling Test






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- m. Color Permanence Test Cable Aging Test
 - n. Water Penetration Test
 - o. Lightning Test
 - p. Routine Test / Sample Test
- Site Test (Like Continuity & Attenuation)



	C&I SPECIFICATION FOR CONDENSATE POLISHING UNIT	SECTION: C SUB SECTION: C&I
<div>ERECTION HARDWARE</div>		



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- m. Color Permanence Test Cable Aging Test
 - n. Water Penetration Test
 - o. Lightning Test
 - p. Routine Test / Sample Test
- Site Test (Like Continuity & Attenuation)

12.00.00 ERECTION HARDWARE

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.

12.01.00 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 ANSI C 80.1 and UL6. The conduit interior and exterior surfaces shall have a continuous zinc coating with an over coat of transparent enamel or zinc chromate. Conduits shall be furnished in standard length of 3 meters, threaded at both ends.
- iv) All conduit fittings shall conform to the requirements of ANSI C 80.4 and UL-514 where these standards apply.

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





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- 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.

12.01.01 Junction Box

01. Type of Enclosure : Dust tight & weatherproof conforming to IP 65
02. Material : 2 mm sheet steel
03. Type of Cover : Solid Hinged Door with steel handle and IP lock
04. Paint : 631 IS 5 Epoxy Powder Coated
05. Mounting : Surface
06. Cable Entry : 3 mm (min) Gland plate
07. Gasket : Neoprene
08. Grounding : Brass earth lug with green screw head
External-2 nos , Internal-1no.M6.
09. Number of Drain Holes : Two at bottom capped.
10. Identification : Label for JB and Tags for cable
11. Accessories : a) Rail mounted cage clamp type screwless terminals with markers
b) Cable gland
c) Ferrules
d) Canopy at top

12.01.02 Cable Gland

01. Type : Double compression
02. Entry Thread : NPT
03. Material : Brass
04. Finish : Cadmium Plated.
05. Protection : IP 65 or better





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06. Accessories : Neoprene gasket, locknuts, reducers etc.

12.01.03 Cable Tray

01. Material : Mild steel
 02. Thickness : not less than 2.0 mm
 03. Finish : Hot dip galvanized
 04. Perforation : As per MFR standard.
 05. Cover : Suitable for tray

06. Height of the cable tray : 100 mm for 450mm and above width.
 (width cannot be less than 100 mm)

12.02.00 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.

12.02.01 Specification for Process Hook Up Materials





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07.	BFP SUCTION / CONDENSATE SYSTEM / EXTRACTION TO LPH / EXTRACTION-4 TO BFP-T, DEAERATOR / AUXILIARY STEAM	G	ASTM- A106 GR. B	80 (½ INCH)	ASTM- A105	ASTM-A- 182 GR. F6A	3000 LB	800
10.	Purge Air	—	ASTM- A106 Gr. C	80 (¾ inch)	ASTM- A 105 Gr. F-22	SS or better	3000 lb	800
11.	DM Cooling Water	—	ASTM A312 TP 316	40 (½ inch)	ASTM A182 F316	SS or better	3000 lb	800
12.	CW & ACW	—	ASTM- A106 Gr. C	80 (½ inch)	ASTM- A 105	SS or better	3000 lb	800
<p>NOTE :</p> <p>(1) RATING OF PIPING / FITTINGS / VALVES ETC. IS SUBJECTED TO THE DESIGN PRESSURE & TEMPERATURE DURING THE DETAILED ENGINEERING.</p> <p>(2) IN CASE TEMPERATURE IS MORE THAN 540 DEG. C, THE MATERIAL SHALL BE P-91 ONLY.</p>								





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12.02.02 Seamless Stainless Steel Pipe

- 01. Reference : ASTM A-312 TP 316
- 02. Material Grade : TP 316
- 03. Type : Seamless /Plain end
- 04. Size : ½" NB
- 05. Schedule : 40
- 06. Standard Length : 5 meter

12.02.03 Stainless Steel Pipe Fittings

- 01. Reference : ASTM A-182 F 316 / ANSI B16.11
- 02. Type : Forged
- 03. Rating : 3000 lbs / 6000 lbs / 9000 lbs
- 04. Size : ½" NB
- 05. End connection : Generally socket weld
- 06. Type of Fittings : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.

12.02.04 Seamless Stainless Steel Tube

- 01. Reference : ASTM A-213 TP 316
- 02. Material Grade : TP 316
- 03. Size : ½" OD X 2.1 MM Thick
- 04. Type : Cold drawn annealed, pickled, passivated, de-scaled, hydraulically cleaned seamless tube.
- 05. 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.
- 06. Test Pressure : 400 Kg/Sq. cm (minimum)
- 07. Tolerance : ± 0.13 mm for outside diameter
 ± 15 % for wall thickness



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- 08. Standard Length : 5 meter
- 09. Test : Flare, Hardness, Ball and Bubble Test

12.02.05 Stainless Steel Tube Fittings

- 01. Reference : ASTM-A-182
- 02. Type : Double ferrule double compression
- 03. Material : 316 Stainless steel forged
- 04. Ferrule : 316 Stainless Steel
- 05. Type of Fittings : Male / female connector, elbow, cross /equal tee, straight connector, bulkhead union, ferrule etc. as required to suit installation.
- 06. Size : To suit SS tubing and NPT end connection

12.02.06 C.S. Pipe

- 01. Reference : ASTM-A 106 Gr. C
- 02. Material : Cold drawn seamless black C.S.
- 03. Type : Seamless / Plain ends
- 04. Size : ½" NB
- 05. Schedule : 80, 160, XXS as required
- 06. Standard Length : 5 meter

12.02.07 C.S. Pipe Fittings

- 01. Reference : ASTM-A 105 / ANSI B16.11
- 02. Type : Forged
- 03. Rating : 3000 lbs / 6000 lbs / 9000 lbs
- 04. Size : ½" NB
- 05. End connection : Generally socket weld
- 06. Type of Fittings : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.



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12.02.08 A.S. Pipe

- | | | | |
|-----|-----------------|---|------------------------------------|
| 01. | Reference | : | ASTM-A 335 P22 AS PER ANSI B 36.10 |
| 02. | Material | : | Cold drawn seamless A.S. |
| 03. | Type | : | Seamless / Plain ends |
| 04. | Size | : | ½" NB |
| 05. | Schedule | : | XXS |
| 06. | Standard Length | : | 5 meter |

12.02.09 A.S. Pipe Fittings

- | | | | |
|-----|------------------|---|--|
| 01. | Reference | : | ASTM-A 182 F22 AS PER ANSI B 16.11 |
| 02. | Type | : | Forged |
| 03. | Rating | : | 9000 lbs |
| 04. | Size | : | ½" NB |
| 05. | End connection | : | Generally socket weld |
| 06. | Type of Fittings | : | Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc. |

12.02.10 Carbon Steel Globe Valve

- | | | | |
|-----|----------------|---|---|
| 01. | Reference | : | ASTM A-105 |
| 02. | Type | : | Globe |
| 03. | Construction | : | Forged Body Cadmium Plated |
| 04. | End Connection | : | ½" Socket Weld |
| 05. | Rating | : | CL. 800 / CL. 2500 |
| 06. | Material | : | Body - Carbon steel
Stem - Hardened Steel
Plug - AISI 316 SS
Seat- Stainless steel stellited |
| 07. | Packing | : | Teflon / Grafoil as required |



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- 08. Yoke : ASTM A105
- 09. Handwheel : Carbon steel
- 10. Design standard : As per ANSI B 16.34

12.02.11 Stainless Steel Globe Valve

- 01. Reference : ASTM A-182 F316
- 02. Type : Globe
- 03. Construction : Forged Body
- 04. End Connection : Socket Weld
- 05. Proof Pressure : 400 Kg/Cm2
- 06. Material : Body - Stainless steel
 Stem - Hardened Steel
 Plug - AISI 316 SS
 Seat- Stainless steel stellited
- 07. Packing : Teflon as required
- 08. Yoke : ASTM A182 F316
- 09. Handwheel : Carbon steel
- 10. Design standard : As per ANSI B 16.34

12.02.12 Alloy Steel Globe Valve

- 01. Reference : ASTM A-182 F22
- 02. Type : Globe
- 03. Construction : Forged Body
- 04. End Connection : ½" Socket Weld
- 05. Rating : CL. 2500
- 06. Material : Body - Alloy steel
 Stem - Hardened Steel
 Plug - AISI 316 SS
 Seat- Stainless steel stellited



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- 07. Packing : Grafoil as required
- 08. Yoke : ASTM A182 F22
- 09. Handwheel : Carbon steel
- 10. Design standard : As per ANSI B 16.34

12.02.13 Condensate Pot

- 01. Reference : ASTM A182 F22 /ASTM A105
- 02. Material : Alloy steel / carbon steel as per application
- 03. Construction : Drilled from barstock
- 04. End connection : 3 nos. ½" socket weld end
- 05. Accessories : Vent valves

12.02.14 Instrument Valve Manifold

- 01. Type : a) Two valve manifold
b) Five valve manifold
- 02. Mounting : Remote 2" Pipe Mounting
- 03. Construction : Single block (bar stock)
- 04. Material : Forged body and bonnet AISI 316 stainless steel
- 05. Ports : 1/2 " NPT (F)
- 06. Rating : 420 Kg/Sq. cm at ambient
- 07. Operating Temperature : (-) 30 to (+) 170 Deg C
- 08. Packing : PTFE Wafer
- 09. 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 : i) Plugs for all ports



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ii) Mounting Bracket , bolts , nuts

12.03.00 PNEUMATIC HOOK UP ACCESSORIES

12.03.01 Air Header

Technical Particulars :

		For Panel	For Field
01.	Material of Construction :	Stainless steel	Stainless steel
02.	Inlet Connection :	2" NPT (M)	1" NPT (M)
03.	Header Take-off :	Stainless steel	Stainless steel
04.	Take off connection :	1 / 2" NPT (M)	1/ 2" NPT (M)
05.	Take-off Valves :	stainless steel	stainless steel
06.	Tube Take-off :	Tube adapter on valve	Tube adapter on valve
07.	Drain :	SS drain valve at lowest point	SS drain valves at lowest point

12.03.02 Seamless Stainless Steel Tube

01.	Reference :	ASTM A-269 TP 31605
02.	Material Grade :	TP 316
03.	Size :	¼" OD X 0.049" wall thickness
04.	Type :	Cold drawn annealed, pickled, passivated, de-scaled, ,hydraulically cleaned seamless tube.
05.	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.
06.	Test Pressure :	400 Kg/Sq. cm
07.	Tolerance :	± 0.13 mm for outside diameter ± 15 % for wall thickness
08.	Standard Length :	5 meter



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09. Test : Flare, Hardness, Ball and Bubble Test



	C&I SPECIFICATION FOR CONDENSATE POLISHING UNIT	SECTION: C SUB SECTION: C&I
<div>QUALITY ASSURANCE</div>		



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2.00.00 **GENERAL REQUIREMENTS - QUALITY ASSURANCE**

- 2.01.00 All materials, components and equipment covered under this specification shall be procured, manufactured and tested at all the stages, as well as Services provided for erection, commissioning and testing shall be as per a comprehensive Quality Assurance Programme. An indicative programme of inspection/tests to be carried out by the Bidder for some of the major items is given in the respective technical specification. This is however, not intended to form a comprehensive programme as it is the Bidder's responsibility to draw up and implement such programme and reviewed by 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/Owner's representative for review. Schedule of finalisation of such quality plans will be finalised before award.
- 2.02.00 Manufacturing Quality Plan will detail out for all the components and equipment, various tests/inspection, to be carried out as per the requirements of this specification and standards mentioned therein and quality practices and procedures followed by Bidder's Quality Control organisation, the relevant reference documents and standards, acceptance norms, inspection documents raised etc., during all stages of materials procurement, manufacture, assembly and final testing/performance testing.
- 2.03.00 Field Quality Plans will detail out for all the equipment, the quality practices and procedures etc. to be followed by the Bidder's site Quality Control organisation, during various stages of site activities 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 Consultant's approval without which manufacture shall not proceed. In these approved quality plans, Owner/Authorised representative/Consultant shall identify Customer Hold Points (CHP), test/checks which shall be carried out in presence of the Owner/Consultant/Owners Owner's Engineer or his Authorised Representative and beyond which the work will not proceed without consent of Owner/Authorised representative/Consultant in writing. All deviations to this specification, approved quality plans and applicable standards must be documented and referred to Owner/Authorised Representative/Consultant for acceptance and dispositioning.
- 2.05.00 The Bidder shall provide adequate notice to the Owner for inspection before the material is dispatched as per the provisions of the Contract. 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





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all previous tests/inspections by Owner's Owner's Engineer/Authorised representative, and duly authorised for despatch issuance of Material Despatch Clearance Certificate (MDCC).

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 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 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 Bidder shall allow for trial assembly prior to despatch from place of manufacture.

2.08.00 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.

2.09.00 All welding and brazing shall be carried out as per procedure drawn and qualified in accordance with requirements of ASME Section-IX/BS-4870 or other International equivalent standard acceptable to the Owner.

All brazers, welders etc. employed on any part of the contract at Bidder's/Sub-Vendor's works or at site shall be qualified as per ASME Section-IX or BS-4871 or equivalent international standard approved by the Owner. Such qualification tests shall be conducted in presence of Owner/his authorised representative.

For welding of pressure parts and high pressure piping the requirements of IBR shall also be complied with.

Under no circumstances any repair or welding of castings be carried out without the consent of the Owner. Proof of the effectiveness of each repair by radiographic and/or other non-destructive testing technique, shall be provided to the Owner.

All pressure parts shall be subjected to hydraulic testing as per the requirements of IBR. Other parts shall be tested for one and half times the maximum operating pressure, for a period not less than thirty (30) minutes.

2.10.00 All non-destructive examination (NDT) shall be carried out in accordance with approved international standard. The NDT operator shall be qualified as per SNT-TC-IA (of American Society of non- destructive examination). Results of NDT shall be properly recorded and submitted for acceptance.

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





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penetrant examination according to the method outlined in ASME Boiler and Pressure Vessel code. Radiography, magnetic particle examination 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. Statutory payments in respect of IBR approvals including inspection shall be made by Bidder. Bidder's scope and responsibility shall also include preparation and submission of all necessary documents in the specific formats and manner stipulated by the statutory bodies, coordination and follow up for above approvals.

2.11.00 All the Sub-Vendors proposed by the Bidder 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 Bidder and finalised with the Owner shall be subject to Owner's review. Quality Plans of the successful Sub-Vendors shall be discussed, finalised and accepted by the Owner/Authorised representative and form part of the Purchase Order between the Bidder and the Sub-Vendor.

2.12.00 All the purchase specifications for the major bought-out items, list of which shall be drawn up by the Bidder and finalised with the Owner shall be furnished to the Owner for comments and subsequent acceptance before orders are placed.

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

Quality audit/acceptance 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 Bidder in earning satisfactory performance of equipment as per specification.

2.13.00 Quality requirements for main equipment shall equally apply for spares and replacement items.

2.14.00 Repair/rectification procedures to be adopted to make any job acceptable shall be subject to the acceptance of the Owner.

2.15.00 For quality assurance of all civil works refer to the specifications for civil works.

3.00.00 **QUALITY ASSURANCE DOCUMENTS**

3.01.00 The Bidder shall be required to submit two (2) copies and two (2) sets of microfilms 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 Bidder 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 Successful Bidder shall give the Owner's Engineer/Inspector fifteen (15) days written notice of any material being ready for testing. Such tests shall be to the Successful Bidder's account except for the expenses of the Inspector. The Owner's 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 failing which the Successful Bidder may proceed with test which shall be deemed to have been made in the Inspector's presence and he shall forthwith forward to the Inspector duly certified copies of test reports in six (6) copies.

4.02.00 The Owner's Engineer or Inspector shall within fifteen (15) days from the date of Inspection as defined herein give notice in writing to the Successful Bidder, or any objection to any drawings and all or any equipment and workmanship which is in his opinion not in accordance with the contract. The Successful Bidder 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 Owner's Engineer/Inspector giving reasons therein, that no modifications are necessary to comply with the contract.





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- 4.03.00 When the factory tests have been completed at the Bidder's or sub-Vendor's works, the Owner/Inspector shall issue a certificate to this effect fifteen (15) days after completion of tests but if the tests are not witnessed by the Owner/Inspectors, the certificate shall be issued within fifteen (15) days of the receipt of the Bidder's test certificate by the Owner/Inspector. Failure of the Owner/Inspector to issue such a certificate shall not prevent the Bidder from proceeding with the works. The completion of these tests, or the issue of the certificates shall not bind the Owner to accept the equipment should it, on further tests after erection be found not to comply with the contract.
- 4.04.00 The Bidder shall furnish quarterly inspection programme indicating schedule dates of inspection at customer hold point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and shall be furnished before beginning of each calendar month.



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 PEM :: C&I		QUALITY PLAN FOR ULTRASONIC FLOWMETER							QUALITY PLAN NO.: PE-QP-445-145-I011			
									VOLUME IIB			
									SECTION D			
									REV. NO. 01		DATE: 05.02.21	
									SHEET 2		OF 3	
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	
1.0	Electronic Housing	Chemical Property	Major	Visual	100%	Approved drg/ Data sheet	Technical catalogue/ Approved documents	Technical catalogue/ Approved documents	2	---	1	
2.0	Standard Certificates	Certificate of Compliance, Warranty Certificate	Major	Visual	As applicable	Technical documents/ Approved documents	Technical catalogue/ Approved documents	Technical catalogue/ Approved documents	2	---	2,1	
3.0	Visual Check	Mechanical	Major	Visual	100%	Technical catalogue/ Approved documents	Technical catalogue/ Approved documents	Technical catalogue/ Approved documents	2	1	1	
4.0	Complete assembly	Overall dimension and end connection	Major	Measurement	100%	Approved drg/ Data sheet	Technical catalogue/ Approved documents	Inspection Report	2	2	1	
		Marking-Tag No, direction of flow	Minor	Visual	100%	Approved drg/ Data sheet	Technical catalogue/ Approved documents	Inspection Report	2	2	1	
5.0	Function test & power ON	Electrical	Major	Visual	100%	Functional test report for meter & transducer	Approved documents	Technical catalogue/ Approved documents	2	---	1	
6.0	HART Communication	Electrical	Major	---	100%	Technical catalogue/ Approved documents	Technical catalogue/ Approved documents	Technical catalogue/ Approved documents	--	---	1	


LEGEND:

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

1 - BHEL
 2 - Vendor/Sub-vendor

1

291681/2021/PS-PEM-MAX

 PEM :: C&I		QUALITY PLAN FOR ULTRASONIC FLOWMETER						QUALITY PLAN NO.: PE-QP-445-145-I011				
								VOLUME	IIB			
								SECTION	D			
								REV. NO.	01	DATE: 05.02.21		
								SHEET	3	OF	3	
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	
1	7.0	PACKING & DISPATCH	Soundness of Packing against transit damage	Major	Visual	100%	Manufacturer Standard	Technical catalogue/ Manufacturer Standard	2	1	---	

NOTE:


1. Protection class shall be IP-65 or better or as per approved datasheet.
2. Type test certificates/Type test reports for "Protection class" shall be verified by BHEL.
3. CALIBRATION Test to be carried out at NABL or BHEL approved laboratory.
4. All test reports / test certificates shall be submitted to WBPDCI for information.


LEGEND:

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

1 - BHEL
 2 - Vendor/Sub-vendor



<div></div> <div>PEM :: C&I</div>		QUALITY PLAN FOR FLOW ORIFICE PLATE ASSEMBLY						QUALITY PLAN NO.: PE-QP-445-145-I005				
								VOLUME IIB				
								SECTION D				
								REV. NO. 00 DATE: 24.05.19				
								SHEET 5 OF 6				
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	
1.0 1.1	MATERIAL Orifice Plate	1. Physical, Chemical properties	MA	Physical, Chemical Tests	One / Plate OR One/ Heat	AP / DS / SP	AP / DS / SP	Lab Report	3/2	---	2,1	IBR certification (if applicable) to be verified by BHEL
		2. Dimensions	MA	Measurement	100%	AP	AP	IR	3/2		1	
1.2	Flanges A. Forgings	Chemical,Mech Properties, UT & Heat Treatment	MA	Chem & Mech UT test	Sample	Material Spec as per ASTM A 388 for UT	ANSI B 16.34	MTC,UT cert,HT cert	3/2	---	1	
	B. Machining	Dimensions	MA	Measurement	100 %	AP / DS	AP / DS	IR	3/2	----	1	
2.0	IN PROCESS Machine	1. Dimension	MA	Measurement	100%	AP	AP	IR	3/2	2	2	
		2. Surface finish	MA	Visual	100%	-----	Mirror Finish	-----	3/2	2	---	
		3. Surface flaw on machined surface	MA	Penetrant test	100%	ASTM 165 / IS:3658	No surface flaw	IR / TC	3/2	2	1	
3.0	ASSEMBLY and FINAL INSPECTION	1. Overall dimensions	MA	Measurement	100%	AP	AP	IR	3/2	2,1	----	
		2. Marking, Tag no. Direction of flow	MA	Visual	100%	AP / DS	AP / DS	IR	3/2	2	1	
		3. Calibration	MA	Performance Test	One per type	-----	SP	TC	3/2	----	1	
		4. Painting	MA	Visual	100%	SP / MS	SP / MS	IR / MR	3/2	----	1	
		5. Root valve BOQ	MA	Measurement	100%	AP / DS	AP / DS	IR	2	----	1	
LEGEND: * CR - Critical characteristics IR - Inspection Reports DS – Data Sheet MR- Manufacturer records ^{\$} P - Agency Performing the Test. 1 - BHEL MA - Major characteristics TC - Test Certificates SP – Tech. Spec. MS- Manufacturer standards W - Agency Witnessing the Test. 2 - Vendor MI - Minor characteristics AP – Approved Drawings/doc V - Agency Verifying the Test. 3 - Sub-vendor												

<div></div> <div>PEM :: C&I</div>		QUALITY PLAN FOR FLOW ORIFICE PLATE ASSEMBLY						QUALITY PLAN NO.: PE-QP-445-145-I005				
								VOLUME IIB				
								SECTION D				
								REV. NO. 00		DATE: 24.05.19		
								SHEET 6		OF 6		
Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks
									P	W	V	
4.0	PACKING	Soundness of Packing against transit damage	MA	Visual	100%	SP / MS	SP / MS	----	3/2	----	----	Refer Note 4

NOTE:


1. All test reports & dimension reports shall be verified by BHEL wherever verification is by BHEL at the time of Final Inspection. Positive material identification testing shall be performed by vendor and the same shall be witnessed by BHEL.
2. Minimum 2 coats of primer paint to be applied before dispatch.
3. CALIBRATION Test to be carried out at IIT-DELHI / FCRI or BHEL approved laboratory.
4. Sea worthy packing shall be provided, if called for in the Data sheets.

LEGEND: * CR - Critical characteristics IR - Inspection Reports DS – Data Sheet
 MA - Major characteristics TC - Test Certificates SP – Tech. Spec.
 MI - Minor characteristics AP – Approved Drawings/doc

MR- Manufacturer records
 MS- Manufacturer standards


\$ P - Agency Performing the Test. 1 - BHEL
 W - Agency Witnessing the Test. 2 - Vendor
 V - Agency Verifying the Test. 3 - Sub-vendor

291681/2021/PS-PEM-MAX

 PEM :: C&I	QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)							QUALITY PLAN NO.: PE-QP-445-145-I 006				
								VOLUME IIB				
								SECTION D				
								REV. NO. 01		DATE:		
								SHEET 1		OF 6		
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	
1.0	MATERIAL											
1.1	Body & Bonnet casting / forgings, plug, valve stem, seat ring/cage	1. Physical, Chemical properties	MA	Physical, Chemical tests	One/ Heat(HT Batch)	Approved drg. / data sheet	Approved drg. / data sheet	Test Certificate	3	---	2,1	TC for body/bonnet from foundry only
		2. Heat Treatment	MA	Review of H.T. Chart	Each H.T.	Approved drg. / data sheet	Approved drg. / data sheet	Test Certificate	3/2	2	1	1.IBR Certification (if applicable) to be verified by BHEL. 2.Applicable for body /bonnet only
		3. Internal quality of castings	MA	RT for Body & UT for Bonnet	100%	ASME B 16.34	ASME B 16.34	Test Report / FILM	3/2	2	1	Applicable for Body and Bonnet for rating ANSI 900 and above.
		4. Surface Quality	MA	1. Visual	100%	MSS-SP-55	MSS-SP-55	Test Certificate	3/2	---	2	
				2. MT/PT	100%	ASME B 16.34	ASME B 16.34	Test Certificate	3	2	1	After Machining on machined surface only
		5. Pressure test for shell	MA	Hyd. Test	100%	ISA-S-75.19/ ASME B 16.34	ISA-S-75.19/ ASME B 16.34	Test Certificate	2	2	1	For Body & Bonnet after machining
LEGEND: * CR - Critical characteristics RT- Radiographic Test PT – Dye penetrant Test \$ P - Agency Performing the Test. 1 - BHEL 4 - WBPDCI MA - Major characteristics UT – Ultrasonic Test MT- Magnetic Test W - Agency Witnessing the Test. 2 - Vendor MI - Minor characteristics V - Agency Verifying the Test. 3 - Sub-vendor												



291681/2021/PS-PEM-MAX

 PEM :: C&I		QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)						QUALITY PLAN NO.: PE-QP-445-145-I 006				
								VOLUME IIB				
								SECTION D				
								REV. NO. 01		DATE:		
								SHEET 2		OF 6		
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	
1.2	Diaphragm	1. Surface Quality	MA	Visual	100%	Mfr. standard	Mfr. standard	Test Certificate	3/2	---	2	
		2. Hardness	MA	Measurement	100%	Mfr. standard	Mfr. standard	Test Certificate	3/2	---	2	
		3. Endurance / Life cycle	MA	Cyclic test 10,000 cycles	One / Type	10,000 cycles/ Mfr. standard.	No damage	Test Certificate	3/2	---	2,1	
1.3	Spring	1. Composition	MA	Chemical-Analysis	One sample/ Heat	Material spec. / Mfr. standard	Material spec. / Mfr. standard	Test Certificate	3	---	2	
		2. Mech. Properties	MA	Mech. Test	One sample/ Heat	Material spec. / Mfr. standard	Material spec. / Mfr. standard	Test Certificate	3	---	2	
		3. Performance	MA	1. Stiffness ratio	100%	Material spec. / Mfr. standard	Material spec. / Mfr. standard	Test Certificate	3	---	2	
				2. Scragging	100%	Material spec. / Mfr. standard	Material spec. / Mfr. standard	Test Certificate	3	---	2	
				3. Cyclic test (Endurance)	One / type	10,000 cycles	Material spec. / Mfr. standard	Test Certificate	3	---	2,1	
				4. Dimension (Measurement)	One sample/ Lot	Mfr. standard	Mfr. standard	Record	3	---	2	
1.4	Electrical items [Limit switches, Solenoids, Position Transmitter(if provided externally)]	1. Routine Test	MA	HV, IR, Continuity function	100%	Relevant Standards	Relevant Standards	Test Certificate	3	---	2	
		2. Degree of protection	MA	IP/NEMA Tests	One sample / type	Approved Data sheet	Approved Data sheet	Test Certificate	3	---	2,1	

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

RT- Radiographic Test
 UT - Ultrasonic Test

PT - Dye penetrant Test
 MT- Magnetic Test


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

1 - BHEL
 2 - Vendor
 3 - Sub-vendor

4 - WBPDCI



291681/2021/PS-PEM-MAX

 PEM :: C&I		QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)						QUALITY PLAN NO.: PE-QP-445-145-I 006				
								VOLUME IIB				
								SECTION D				
								REV. NO. 01 DATE:				
								SHEET 3		OF 6		
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	
1.5	Pressure Gauges (if provided externally)	1. Performance	MA	Review of calibration certificates	100%	Mfr. Standard	Mfr. Standard	Test Certificate	3	---	2	
		2. Marking	MA	Visual	100%	Mfr. standard	Mfr. standard	Records	3	---	2	
2.0	IN PROCESS INSPECTION											
2.1	After machining, i. Body ii. Bonnet iii. Plug iv. Valve Stem v. seat ring/cage	1. Surface flaws	MA	Visual & MT/PT	100% (on accessible surfaces)	ASME B 16.34	ASME B 16.34	Test Records	2	---	1	Butt weld ends shall be included.
		2. Dimensional checks	MA	Measurement	100%	Mfr. Standard	Mfr. Standard	Records	2	---	1	
		3. Hard facing (wherever applicable)	MA	Hardness Measurement	One sample/Lot	Mfr. Standard	Mfr. Standard	Records	2	---	1	
3.0	TESTS ON COMPLETED VALVE											
3.1	Actuator Chamber	Leakage & Strength	MA	Pneumatic test	100%	Mfr. Standard	No Leakage	Test Certificate	2	1	1,4	Refer Note-4
3.2	Body	Leakage and Pressure test (Body Mount Leakage)	MA	Hydro test	100%	ISA - S-75.19/ ASME B16.34	No Leakage	Test Certificate	2	1	1,4	Refer Note-4
3.3	Seat leakage test for completed valve	Seat Leakage	MA	Pneumatic Test	100%	FCI-70.2	FCI-70.2	Test Certificate	2	1	1,4	Refer Note-4
4.0	OPERATION TEST ON COMPLETED VALVE (Final inspection)	1. Valve Travel	MA	Measurement	100%	Mfr. Procedure	Approved drg. / data sheet	Test Report	2	1	1,4	Refer Note-4
		2. Opening/Closing time	MA	Measurement	100%	Mfr. Procedure	Approved drg. / data sheet	Test Report	2	1	1,4	Refer Note-4
		3. Linearity/cam characteristic	MA	Measurement	100%	Mfr. Procedure	Approved drg. / data sheet	Test Report	2	1	1,4	Refer Note-4

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

RT- Radiographic Test
UT - Ultrasonic Test

PT - Dye penetrant Test
MT- Magnetic Test



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

1 - BHEL
2 - Vendor
3 - Sub-vendor

4 - WBPDCI



291681/2021/PS-PEM-MAX

 PEM :: C&I		QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)						QUALITY PLAN NO.: PE-QP-445-145-I 006				
								VOLUME IIB				
								SECTION D				
								REV. NO. 01 DATE:				
								SHEET 4 OF 6				
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	
		4. Repeatability	MA	Measurement	100%	Mfr. Procedure	Approved drg. / data sheet	Test Report	2	1	1,4	Refer Note-4
		5. Hysteresis	MA	Measurement	100%	Mfr. Procedure	Approved drg. / data sheet	Test Report	2	1	1,4	Refer Note-4
		6. Sensitivity	MA	Measurement	100%	Mfr. Procedure	Approved drg. / data sheet	Test Report	2	1	1,4	Refer Note-4
		7. Accuracy (Overall)	MA	Measurement	100%	Mfr. Procedure	Approved drg. / data sheet	Test Report	2	1	1,4	Refer Note-4
		8. Control Valve characteristics / CV Test	MA	◆ Measurement (Press. vs. discharge and discharge vs. opening 0-100% in steps of 10%)	One per type	Mfr. Procedure	Approved drg. / data sheet	Test Certificate	2	--	1,4	◆ Size = Body & port size Or Body size & CV for non std port. Refer Note 1.
		9. Operation of limit switch & solenoids and other accessories	MA	Function	100%	Mfr. Procedure	Approved drg. / data sheet	Test Report	2	1	1,4	On assembled valve Refer Note-4
		10. Overall dimensions	MI	Visual and dimensional	100%	Approved drg. / data sheet	Approved drg. / data sheet	Records	2	1	1,4	Refer Note-4
		11. Pre defined valve position in case of air failure	MA	Visual	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Certificate	2	1	1,4	
		12. Cleanliness, painting, stamping (for direction of flow), Tag No.	MA	Visual and dimensional, paint thickness	100%	Mfr. Procedure	Approved drg. / data sheet	Test Certificate	2	1	1,4	
		13. Surface Quality	MA	Visual	100%	MSS-SP-55	MSS-SP-55	Test Certificate	3/2	--	2,1,4	

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

RT- Radiographic Test
 UT - Ultrasonic Test

PT - Dye penetrant Test
 MT- Magnetic Test


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291681/2021/PS-PEM-MAX

<div></div> <div>PEM :: C&I</div>		QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)						QUALITY PLAN NO.: PE-QP-445-145-I 006				
								VOLUME IIB				
								SECTION D				
								REV. NO. 01		DATE:		
						SHEET 5		OF 6				
Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks
									P	W	V	
5.0	AUXILIARY ITEMS (Performance test of auxiliary items shall be performed on the completely assembled valve)											
5.1	Positioner	Overall leakage after assembly including Nozzles leakage	MA	Leak Test (in the steady state input signal)	100 %	Mfr. Standard	No leakage	Test Certificate	3/2	---	---	Certificate of Conformance (C.O.C)
5.2	Air filter regulator	1. Normal air consumption	MA	Measurement	Each type	Mfr. Standard	No leakage	Test Certificate	3/2	---	---	(C.O.C)
		2. Overall leakage	MA	Visual (soap solution)	100 %	Mfr. Standard	No leakage	Test Certificate	3/2	---	---	(C.O.C)
5.3	Air lock relay	Performance Test	MA	Leakage test	100%	Mfr. Standard	No leakage	Test Certificate	3/2	---	---	(C.O.C)
5.4	Electronic position transmitter(not applicable if provided integral to smart positioner)	1. Accuracy	MA	Operation	100%	Approved data sheet /	Approved data sheet /	Test Certificate	2	1	---	(C.O.C)
5.5	Current to Pneumatic converter(not applicable for smart positioner)	1. Physical Verification Make/Model	MA	Visual	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Certificate	2	---	---	(C.O.C)
		2. Degree of Protection	MA	IP/NEMA test	Each type	Relevant Standard	Relevant Standard	Test Certificate	3	---	---	(C.O.C)
		3. Linearity	CR	Measurement	100%	Approved drg. / data sheet /	Approved drg. / data sheet /	Inspection Report	2	---	---	(C.O.C)
		4. Hysteresis	CR	Measurement	100%	Approved drg. / data sheet /	Approved drg. / data sheet /	Inspection Report	2	---	---	(C.O.C)

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

RT- Radiographic Test
 UT - Ultrasonic Test

PT - Dye penetrant Test
 MT- Magnetic Test


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 2 - Vendor
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4 - WBPDCI



291681/2021/PS-PEM-MAX

 PEM :: C&I		QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)						QUALITY PLAN NO.: PE-QP-445-145-I 006				
								VOLUME IIB				
								SECTION D				
								REV. NO. 01 DATE:				
								SHEET 6		OF 6		
Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks
									P	W	V	
5.6	Smart Positioner (As Applicable)	1. Physical Verification Make/Model	MA	Visual	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Certificate	2	---	---	(C.O.C)
		2. Degree of Protection	MA	IP/NEMA test	Each type	Relevant Standard	Relevant Standard	Test Certificate	3	---	---	(C.O.C)
		3. Linearity	CR	Measurement	100%	Approved drg. / data sheet /	Approved drg. / data sheet /	Inspection Report	2	---	---	(C.O.C)
		4. Hysteresis	CR	Measurement	100%	Approved drg. / data sheet /	Approved drg. / data sheet /	Inspection Report	2	---	---	(C.O.C)
		5. Calibration with Hand Held Communicator	MA	Measurement	Each type	Mfr. Standard	Mfr. Standard	Test Certificate	2	---	---	(C.O.C)
6.0	PAINTING	Soundness of Painting	MA	Visual and Measurement	100%	Mfr. Standard	Mfr. Standard	Inspection Report	2	---	---	Refer Note-2
7.0	PACKING	Soundness of Packing against transit damage	MA	Visual	100%	Mfr. Standard	Mfr. Standard	Inspection Report	2	---	---	Refer Note-3

NOTES:

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

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

RT- Radiographic Test
 UT - Ultrasonic Test

PT - Dye penetrant Test
 MT- Magnetic Test

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 W - Agency Witnessing the Test.
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4 - WBPDCI





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

CHECK LIST FOR ANALYTICAL INSTRUMENTS

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

Legend :

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

Note :

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



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

CHECK LIST FOR TRANSMITTER

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

Legend :

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

Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- When material correlation 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 TEMPERATURE ELEMENT

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 No./TAG No.						
	PROCESS CONNECTION						
2	STABILITY			P	W	V	
3	INSULATION RESISTANCE			P	W	V	
4	ENCLOSURE CLASS			P	W	V	
5	RESPONSE TIME			P	W	V	
7	ACCURACY			P	W	V	
8	HYDROSTATIC TEST			P	W	V	
9	ELECTRICAL CHARACTERISTIC OF SENSOR (CONTINUITY OF T/C WIRES & INSULATION RESISTANCE OF RTD LEADS w.r.t. BODY			P	W	V	
10	TEMP CURVES / CHARTS			P	V	V	
11	AMBIENT TEMP. EFFECT CHECK			P	W	V	
12	HV TEST			P	W	V	

Legend :

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

Note :

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



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

CHECK LIST FOR SOLENOID VALVES

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	TYPE						
	MAKE						
	MODEL No.						
2	MATERIAL (BODY. PLUNGER/TRIM)			P	W	V	
3	PORT SIZE			P	W	V	
4	CABLE CONNECTION SIZE			P	W	V	
5	ENCLOSURE CLASS			P	W	V	TYPE TEST CERTIFICATE TO BE FURNISHED BY VENDOR
6	No. OF COILS & INSULATION CLASS			P	W	V	TEST CERTIFICATE TO BE FURNISHED FOR INSULATION CLASS BY VENDOR
7	POWER SUPPLY CHECK			P	W	V	
8	IR / HV TEST			P	W	V	
9	FUCTIONAL TEST			P	W	V	

Legend :

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

Note :

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



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

CHECK LIST FOR TEMPERATURE GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	DIAL SIZE						
	MODEL NO./TAG NO./TYPE						
	RANGE/SCALE						
	END CONNECTION						
2	CALIBRATION			P	W	V	
	ACCURACY						
	REPEATABILITY						
	HYSTERESIS						
3	OVER TEMP. TEST	P		W	V		
4	AMBIENT TEMP. COMPENSATION CHECK	1 OF TYPE		P	V	V	
5	REVIEW OF TC FOR MATERIALS OF	FOR LOT		V	V	V	
	SENSOR						
	MOVEMENT						
	PROCESS CONNECTION						
	THERMOWELL						
	HOUSING						
	6			REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST	V	
7	THERMOWELL	SEE NOTE-1 BELOW	AS PER APPD DWG		V	V	
	MATERIAL TC & DIMN. CHECK						
	HYD.TEST						
	OVER RANGE TEST						

Legend :

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

Note :

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



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

CHECK LIST FOR PRESSURE & DP GAUGE

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

Legend :

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

Note :

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



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

CHECK LIST FOR LEVEL GAUGE

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

Legend :

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

Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- Manufacturer to carry out ROUTINE TEST on 100 %.
- 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 SIGHT FLOW INDICATOR


[illegible]

Legend :

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

Note :

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

	C&I SPECIFICATION FOR CONDENSATE POLISHING UNIT	SECTION: C SUB SECTION: C&I
<div>TYPE TEST REQUIREMENT</div>		



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Sagardighi Thermal Power Project
1x660 MW Unit No. 5, Phase - III

13.00.00 TYPE TEST REQUIREMENTS

13.01.00 General Requirements

- 13.01.01 Contractor shall furnish the type test reports of all type tests as per relevant standards and codes as well as other specific tests indicated in this specification. A list of such tests are given for various equipment in table titled 'Type Test Requirement for C&I Systems' at the end of this sub-section. For the balance equipment instrument, type tests may be conducted as per manufacturers standard or if required by relevant standard.
- 13.01.02 Out of the tests listed, Bidder/ sub-vendor/ manufacturer is required to conduct certain type tests specifically for this contract (and witnessed by Owner or his authorized representative) even if the same had been conducted earlier, as clearly indicated subsequently against such tests.
- 13.01.03 For the rest, submission of type test results and certificate shall be acceptable provided:
- a) The same has been carried out by Bidder/ sub-vendor on exactly the same model / rating of equipment.
 - b) There has been no change in the components from the offered equipment & tested equipment.
 - c) The test has been carried out as per the latest standards along with amendments as on the date of bid opening.
- 13.01.04 In case the approved equipment is different from the one on which the type test had been conducted earlier or any of the above grounds, then the tests have to be repeated and the cost of such tests shall be borne by Bidder within the quoted price and no extra cost will be payable by Owner on this account
- 13.01.05 As mentioned against certain items, the test certificates for some of the items shall be reviewed and approved by Bidder or his authorized representative and the balance have to be approved by Owner.
- 13.01.06 The schedule of conduction of type tests/ submission of reports shall be submitted and finalized during pre-award discussion.
- 13.01.07 For the type tests to be conducted, Contractor shall submit detailed test procedure for approval by Owner. This shall clearly specify test setup, instruments to be used, procedure, acceptance norms (wherever applicable), recording of different parameters, interval of recording precautions to be taken etc. for the tests to be carried out.
- 13.01.08 Bidder shall indicate in his bid, the cost of the type test for each items only for which type tests are to be conducted specifically for this project.





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13.02.00 Special Requirement for Solid State Equipments/ Systems

The minimum type tests reports, over and above the requirements of above clause which are to be submitted for each of the major C&I systems like SG-C&I system, TG- C&I system, Station - C&I system, Flame monitoring system, Coal feeders control and instrumentation system, Boiler flame analysis system, Turbine supervisory system, BFP Turbine supervisory instruments, Analyzer instruments, Vibration monitoring systems, etc. shall be as indicated below:

13.02.01 Surge Protections for Solid State Equipments/ Systems

All solid state systems/ equipments shall be able to withstand the electrical noise and surges as encountered in actual service conditions and inherent in a power plant. All the solid state systems/ equipments shall be provided with all required protections that needs the surge withstand capability as defined in ANSI 37.90a/ IEEE-472. Hence, all front end cards which receive external signals like analog input & output modules, binary input & output modules etc. including power supply, data highway, data links shall be provided with protections that meets the surge withstand capability as defined in ANSI 37.90a/ IEEE-472. Complete details of the features incorporated in electronics systems to meet this requirement, the relevant tests carried out, the test certificates etc. shall be submitted along with the proposal. As an alternative to above, suitable class of IEC-255-4 which is equivalent to ANSI 37.90a/ IEEE-472 may also be adopted for SWC test.

13.02.02 Dry heat test as per IEC-68-2-2.

13.02.03 Damp heat test as per IEC-68-3.

13.02.04 Vibration test as per IEC-68-2-6.

13.02.05 Electrostatic discharge tests as per IEC 801-2 or equivalent.

13.02.06 Radio frequency immunity test as per IEC 801-6 or equivalent.

13.02.07 Electromagnetic immunity as per IEC 801-3 or equivalent.

Test listed at clause no. 13.02.05, 13.02.06 & 13.02.07 above are applicable for front end cards only as defined under clause no. 13.02.01 above.




13.03.00 Type Test Requirement for C&I Systems

SL. No.	ITEM		TEST REQUIREMENT	STANDARD	TEST TO BE SPECIFICALLY CONDUCTED	APPROVAL REQUIRED ON TEST CERTIFICATE	REMARKS
01.	THERMOCOUPLES		DEGREE OF PROTECTION TEST	IS-2147	NO	NO	
02.	RTD		AS PER STANDARD	IEC-751	NO	NO	
03.	C.J.C. Box		DEGREE OF PROTECTION TEST AMBIENT TEMP. EFFECT	IS-2147	NO	YES	
				APPROVED PROCEDURE	NO	YES	
04.	ELECTRONIC TRANSMITTER		AS PER STANDARD	BS-6447 / IEC-770	NO	YES	
05.	E/P CONVERTER		AS PER STANDARD	MFR. STANDARD	NO	YES	
06.	DUST EMISSION MONITOR		DEGREE OF PROTECTION TEST	IS-2147	NO	YES	
07.	INSTRUMENTATION CABLES TWISTED & SHIELDED				YES	YES	
	A)	CONDUCTOR	• RESISTANCE TEST	VDE-0815			
			• DIAMETER TEST	IS-10810			
			• TIN COATING TEST (DRAIN WIRE)				
	B)	INSULATION	• LOSS OF MASS	VDE-0472			
			• AGING IN AIR OVENS	VDE 0472 **			** AS PER VDE 0207 FOR TEFLON INSULATED CABLES
			• TENSILE STRENGTH AND ELONGATION	VDE 0472 **			
			• HEAT SHOCK	VDE 0472 **			
			• HOT DEFORMATION	VDE 0472			
			• SHRINKAGE	VDE 0472			
			• BLEEDING & BLOOMING	IS-5831			
	C)	INNER SHEATH	• LOSS OF MASS	VDE-0472			
			• HEAT SHOCK	VDE 0472 **			
			• COLD BEND / COLD IMPACT TEST	IS-5831			
			• HOT DEFORMATION	VDE 0472			

SL. No.	ITEM	TEST REQUIREMENT	STANDARD	TEST TO BE SPECIFICALLY CONDUCTED	APPROVAL REQUIRED ON TEST CERTIFICATE	REMARKS
		• SHRINKAGE	VDE 0472			
	D) OUTER SHEATH	• LOSS OF MASS	VDE-0472			
		• AGING IN AIR OVENS	VDE 0472 **			
		• TENSILE STRENGTH AND ELONGATION TEST BEFORE AND AFTER AGEING	VDE 0472 **			
		• HEAT SHOCK	VDE 0472 **			
		• HOT DEFORMATION	VDE 0472			
		• SHRINKAGE	VDE 0472			
		• BLEEDING & BLOOMING	IS-5831			
		• COLOUR FASTNESS TO WATER	IS-5831			
		• COLD BEND / COLD IMPACT TEST	IS-5831			
		• OXYGEN INDEX TEST	ASTMD-2863			
		• SMOKE DENSITY TEST	ASTMD-2843			
		• ACID GAS GENERATION TEST	IEC-754-I			
	E) FILERS	• OXYGEN INDEX TEST	ASTMD-2863			
		• SMOKE DENSITY TEST	ASTMD-2843			
		• ACID GAS GENERATION TEST	IEC-754-I			
	F) AL-MYLAR SHIELD	• CONTINUITY TEST				
		• SHIELD THICKNESS				
		• OVERLAP TEST				
		• NOISE INTERFERENCE	IEEE TRANSACTIONS			
	G) OVERALL CABLE	• FLAMMABILITY	IEEE 383			
		• NOISE INTERFERENCE				

SL. No.	ITEM	TEST REQUIREMENT	STANDARD	TEST TO BE SPECIFICALLY CONDUCTED	APPROVAL REQUIRED ON TEST CERTIFICATE	REMARKS
		• DIMENSIONAL CHECKS	IS 10810			
		• CROSS TALK				
		• MUTUAL CAPACITANCE	VDE 0472			
		• HV TEST	VDE 0472			
		• DRAIN WIRE CONTINUITY				
08.	PRESSURE GAUGE	• DEGREE OF PROTECTION TEST	IS-2147	NO	NO	
		• TEMPERATURE INTERFERENCE TEST	IS-3624	NO	NO	
09.	TEMPERATURE GAUGE	DEGREE OF PROTECTION TEST	IS-2147	NO	NO	
10.	PRESSURE & DIFFERENTIAL PRESSURE SWITCH	• DEGREE OF PROTECTION TEST	IS-2147	NO	NO	
		• AS PER STANDARD	BS 6134	NO	NO	
11.	LEVEL SWITCH	DEGREE OF PROTECTION TEST	IS-2147	NO	NO	
12.	CONDUCTIVITY LEVEL SWITCH	DEGREE OF PROTECTION TEST	IS-2147	NO	YES	
13.	CONTROL VALVES	CV TEST	ISA 75.02	YES	NO	
14.	FLOW NOZZLES & ORIFICE PLATE	CALIBRATION	ASME PTC, BS-1042	YES	NO	
15.	PLCs	ALL TESTS AS PER IEC-1131	IEC-1131			
16.	DCS					
	a) I/O MODULES	CMRR & NMRR VERIFICATION	Mfr. standard	NO	YES	
	b) OTHER MODULES	CMRR & NMRR VERIFICATION	Mfr. standard	NO	YES	
	c) CLCS SYSTEMS	MODEL TEST	Approved Procedure	YES	YES	
17.	LIE / LIR / JUNCTION BOX	DEGREE OF PROTECTION TEST	IS-2147	YES	YES	
18.	FLUE GAS O ₂ ANALYZER	DEGREE OF PROTECTION TEST	IS-2147	NO	YES	
19.	FLUE GAS CO ₂ ANALYZER	DEGREE OF PROTECTION TEST	IS-2147	NO	YES	

SL. No.	ITEM	TEST REQUIREMENT	STANDARD	TEST TO BE SPECIFICALLY CONDUCTED	APPROVAL REQUIRED ON TEST CERTIFICATE	REMARKS
20.	FLUE GAS SO ₂ ANALYZER	DEGREE OF PROTECTION TEST	IS-2147	NO	YES	
21.	FLUE GAS NO _x ANALYZER	DEGREE OF PROTECTION TEST	IS-2147	NO	YES	

	C&I SPECIFICATION FOR CONDENSATE POLISHING UNIT	SECTION: C SUB SECTION: C&I
<div>APPLICABLE CODES AND STANDARDS</div>		



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1x660 MW Unit No. 5, Phase - III**

5.00.00 CODES AND STANDARDS

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. Generally, the following latest edition of codes and standards prevailing at the time of award of contract shall be applicable.

- 1) Temperature Measurement
 - a) Instrument and apparatus for temperature measurement - ASME PTC 19.3 (1974).
 - b) Temperature Measurement - Thermocouples - ANSI - MC 96.1 - 1982.
 - c) Temperature Measurement by electrical resistance thermometers - IS: 2806
 - d) Thermometer-element-Platinum resistance - IS: 2848 / DIN 43760.
- 2) Pressure Measurement
 - a) Instrument and apparatus for pressure measurement - ASME PTC 19.2 (1964).
 - b) Bourdon tube pressure and vacuum gauges - IS: 3624/1996.
- 3) Flow Measurement





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- a) Instruments and apparatus for flow measurement - ASME PTC 19.5 (1972) Interim supplement, Part-II
- b) Measurements of fluid flow in closed conduit - BS 1042.
- 4) Electronic Measuring Instruments and Control Hardware
 - a) Automatic null balancing electrical measuring instruments -ANSI C 39.4 (Rev. 1973), IS 9319
 - b) Safety requirements for electrical and electronic measuring and controlling instrumentation - ANSI C 39.5 / 1974.
 - c) Compatibility of analog signals for electronic industrial process instruments - ISA-S 50.1: ANSI MC 12.1 / 1975.
 - d) Dynamic response testing of process control instrumentation - ANSI MC 4.1 (1975) - ISA -S26 (1968).
 - e) Surge withstand capability (SWC) tests - ANSI C 37.90A (1989), IEC-255.4.
 - f) Printed circuit boards - IPC TM-650, IEC 326C.
 - g) General requirements and tests for printed wiring boards - IS-7405 (Part-I)/1973.
 - h) Edge socket connectors - IEC 130-11.
 - i) Requirements and methods of testing of wire wrap terminations--DIN 41611 Part-2.
 - j) Dimensions of attachment plugs and receptacles- ANSI C73-1973.(Supplement ANSI C73a – 1980)
 - k) Direct Acting Electrical Indicating Instruments - IS - 1248 - 1968
- 5) Instrument Switches and Contacts
 - a) Contact Rating - AC services NEMA ICS Part-2 125, A-600
 - b) Contact Rating - DC services NEMA ICS Part-2 125, N-600
- 6) Enclosures
 - a) Enclosures for Industrial Controls and Systems--NEMA ICS-6-110.15 through 110.22
 - b) Racks, panels and associated equipment -EIA: RS-310-B-1983 (ANSI C83.9 - 1972) / IEC 60947 / IEC 60529
 - c) Protection Class for Enclosures , Cabinets Control Panels and Desks - IS 2147 1962





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- 7) Apparatus, Enclosures and Installation Practices in Hazardous Area
 - a) Classification of hazardous area - NEMA Article 500, Volume-6, 1978./ NFPA Article 500 , Vol.70-1984
 - b) Electrical Instruments in hazardous dust locations - ISA-RP 12.11.
 - c) Intrinsically safe apparatus - NFPA Article 493 Volume-4 1978.
 - d) Purged and pressurized enclosure for electrical equipment in hazardous location - NFPA Article 496 Volume-4, 1982.
- 8) Sampling System
 - a) Stainless Steel material of tubing and valves, for sampling system - ASTM A 269-79 GRTO-316.
 - b) Submerged helical coil heat exchangers for sample coolers -- ASTM D11-98.
 - c) Steam and water sampling ,conditioning and analysis in the power cycle - ASME PTC - 19.11
 - d) Standard methods of sampling system - ASTM D 1066-69
- 9) Annunciators
 - a) Specifications and guides for the use of general-purpose annunciators - ISA RP 18.1.
 - b) Surge withstand capability tests -ANSI C37.90 a -1971 and IEEE Standard 472-1974.
- 10) Interlocks, Protections
 - a) Relays and relay system associated with electric power apparatus - IEEE Standards 3.13.
 - b) Surge withstand capability tests - ANSI C37.90 a - 1971 and IEEE Standard 472-1974.
 - c) General requirements and tests for switching devices for control and auxiliary circuits including contactor relays - IS-6875 (Part-I)/1973.
 - d) Turbine water damage prevention - ASME-TDP-1-1980.
 - e) Boiler safety interlocks - NFPA Section 85B, 85D, 85E, 85F, 85G.
 - f) Installation and operation of Pulverized fuel system - ANSI / NFPA 8503
 - g) Functional diagramming of Instrument and control systems - SAMA PMS 22.1





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- h) Digital interface for programmable instrumentation - ANSI / IEEE 488
- 11) Control Valves
 - a) Control valve sizing (Incompressible fluids) - ISA-S39.2 / 1972.
 - b) Control valve sizing (Compressible fluids) - ISA-S39.4 / 1972.
 - c) Control Valve seat leakage – ANSI / FCI 70.2
 - d) Face to face dimensions of Control Valves - ANSI B16.10
 - e) Control Valve Capacity Test Procedure – ISA – S75.02
- 12) Process connection Piping and Tubing
 - a) Seamless Carbon Steel Pipe - ASTM-A-106.
 - b) Forged carbon steel fittings - ASTM-A-105.
 - c) Dimensions of fittings - ANSI-B16.11.
 - d) Code for pressure piping, welding, hydrostatic testing - ANSI-B 31.1.
 - e) Nomenclature for instrument tube fittings - ISA-RP 42.1 / 1982.
 - f) Seamless Stainless Steel Tube ASTM A-213 TP 316 / ASTM A-269 TP 316
 - g) Seamless Alloy Steel Pipe ASTM A 335 P22
 - h) Seamless Stainless Steel Pipe ASTM A-312 TP 316
 - i) Forged and Rolled alloy steel pipe flanges , forged fittings , valves and parts ASTM A - 182
 - j) Pipe fittings of wrought carbon steel and ally steel - ASTM A - 234
 - k) Composition bronze metal castings ASTM B - 62
 - l) Seamless copper tube , bright annealed ASTM B- 168
 - m) Valves flanged and butt welding ends ANSI B 16.34
- 13) Cables
 - a) Thermocouple extension wires / cables - ANSI MC96.1.
 - b) Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy-IPCEA S-61-402
 - c) Guide for design and installation of cable system in power generating station (insulation, jacket materials) -IEEE Standard 422.
 - d) Requirements of vertical tray flame test - IEEE 383



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Volume : II-E
Section : I
General Technical Requirements



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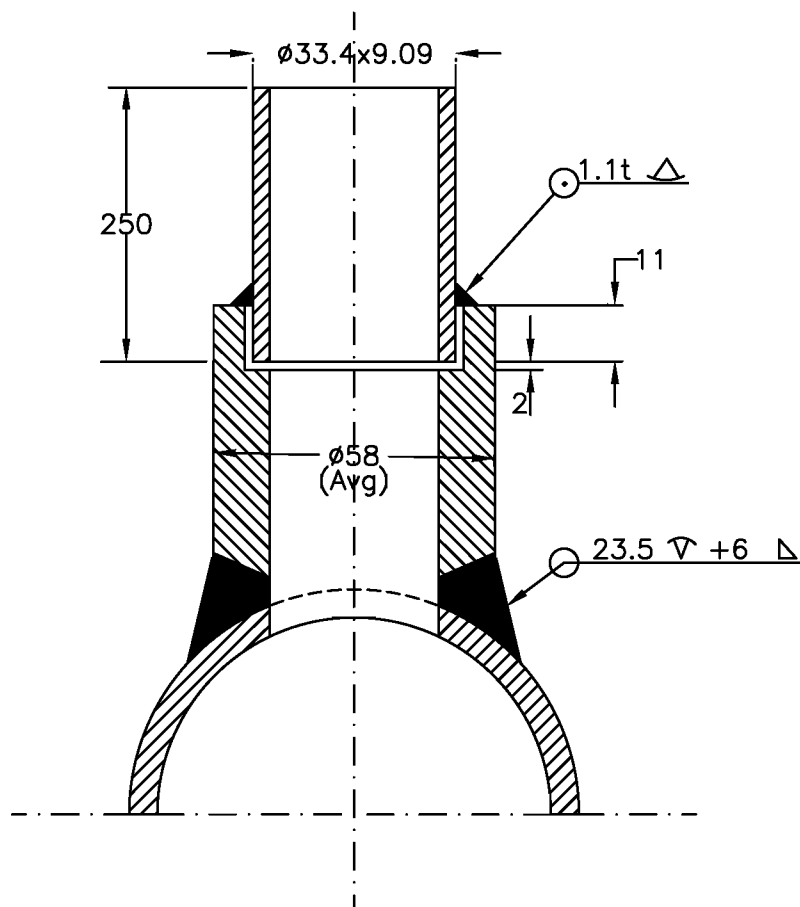
- e) Standard specification for tinned soft or annealed copper wire for electrical purpose - ASTM B33.
- 14) Electronic Cards, Subassemblies and Components
 - a) Unpackaged
 - i) Vibration : IEC-68.2.6
 - ii) Shock : IEC-68.2.27
 - iii) Drop & Topple : IEC-68.2.31
 - b) Packaged
Vibration, Drop & Static Compression - NSTA.
 - c) Electromagnetic Compatibility
 - i) Electrical Fast Transient : IEC-801.4
 - ii) Surge Withstand : IEC-255.4
 - iii) Radiated Electromagnetic Field : IEC-801.3
 - iv) Electrostatic Discharge : IEC-801.2
 - v) Electromagnetic Emissions : VDE 0871, Class-B
- 15) Cable Trays, Conduits
 - a) Guide for the design and installation of cable system in power generating station (cable trays, support systems, conduits)- IEEE Standard 422, NEMA VE-1, NEC-1981. Test Standards NEMA VE-1-1979.
 - b) Galvanizing of carbon steel cable trays - ASTM A-386.

Codes and standards as described in different sub-sections of this specification shall also be followed .

Items such as thermowells, control valves, flow elements and other in line devices in high and medium pressure steam, feed water and similar services, which fall under the purview of Indian Boiler Regulation Act shall be either certified by IBR or shall be certified by authorities acceptable to IBR. It shall be responsibility of Bidder to obtain the necessary approval of the concerned Authority / Chief Inspector of Boilers for the design and design calculations, manufacturing and erection procedure as called for under the IBR Act for all items requiring such certification.



	C&I SPECIFICATION FOR CONDENSATE POLISHING UNIT	SECTION: C SUB SECTION: C&I
<div>INSTRUMENT STUB DETAILS</div>		



NOTE :

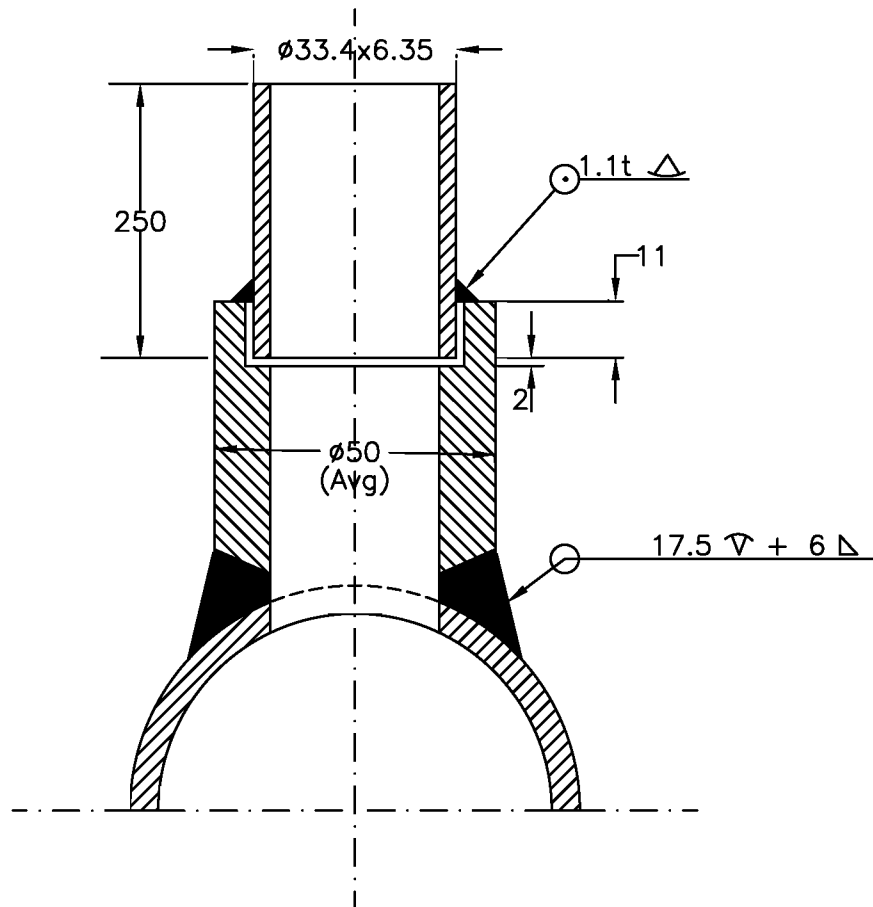
1. MATERIAL OF THE BOSS AND NIPPLE SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED AND CONFORM TO ANSI B16.11.
2. THE LENGTH OF NIPPLE SHOULD BE 250 MM.
3. STUB LENGTH SHALL BE 64mm UPTO 200Nb PIPE, 45mm ABOVE 200Nb PIPE SIZE.
4. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED.
5. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY (1/64" RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES.
6. STUB & NIPPLE SHALL HAVE IBR CERTIFICATION AS APPLICABLE, ACCORDING TO




TITLE : INSTRUMENT STUB DETAILS FOR PRESSURE MEASUREMENT

(TEMP > 500 DegC AND Nb25, CLASS 9000 #)
 OR (PRESS > 455 Kg/Cm2 AND Nb25, CLASS 9000 #)

DRG. NO.
 PE-DG-445-145-1101
 REV. 01
 SH. 2 OF 8 SHS.

~~291681/2021/PS-PEM-MAX~~**NOTE :**

1. MATERIAL OF THE BOSS AND NIPPLE SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED AND CONFORM TO ANSI B16.11.
2. THE LENGTH OF NIPPLE SHALL BE 250 MM.
3. STUB LENGTH SHALL BE 64mm UPTO 200Nb PIPE, 45mm ABOVE 200Nb PIPE SIZE.
4. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED
5. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY (1/64" RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES
6. STUB & NIPPLE SHALL HAVE IBR CERTIFICATION AS APPLICABLE, ACCORDING TO 



TITLE :
**INSTRUMENT STUB DETAILS
 FOR PRESSURE MEASUREMENT**

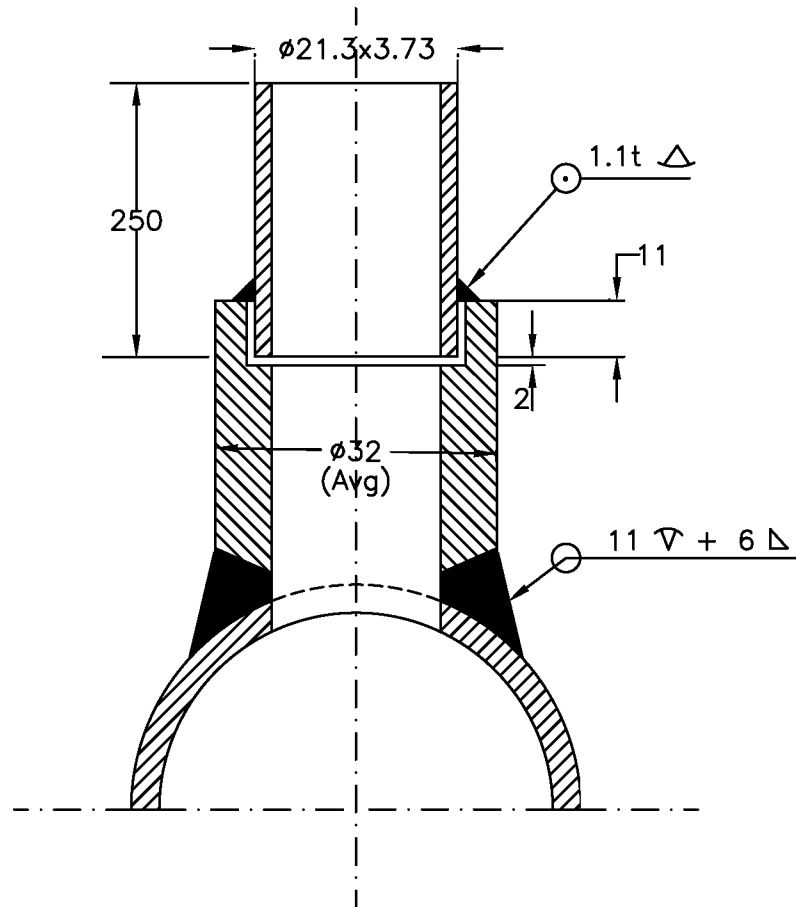
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PE-DG-445-145-I101

REV. 01

(60Kg/Cm² < PRESS ≤ 455Kg/Cm², TEMP ≤ 425 DegC & Nb25, CLASS 6000#) OR (PRESS ≤ 455Kg/Cm², 425DegC < TEMP ≤ 500 DegC & Nb25, CLASS 6000#)

SH. 3 OF 8 SHS.

~~291681/2021/PS-PEM-MAX~~**NOTE :**

1. MATERIAL OF THE BOSS AND NIPPLE SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED AND CONFORM TO ANSI B16.11.
2. THE LENGTH OF NIPPLE SHALL BE 250 MM.
3. STUB LENGTH SHALL BE 64mm UPTO 200Nb PIPE, 45mm ABOVE 200Nb PIPE SIZE.
4. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED
5. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY (1/64" RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES
6. STUB & NIPPLE SHALL HAVE IBR CERTIFICATION AS APPLICABLE, ACCORDING TO 



TITLE :
INSTRUMENT STUB DETAILS
FOR PRESSURE MEASUREMENT

(PRESS < 60Kg/Cm², TEMP < 425DegC & Nb15, CLASS 3000#)

DRG. NO.
PE-DG-445-145-1101
 REV. 01
 SH. 4 OF 8 SHS.



- 
- A triangle with the number 1 inside.

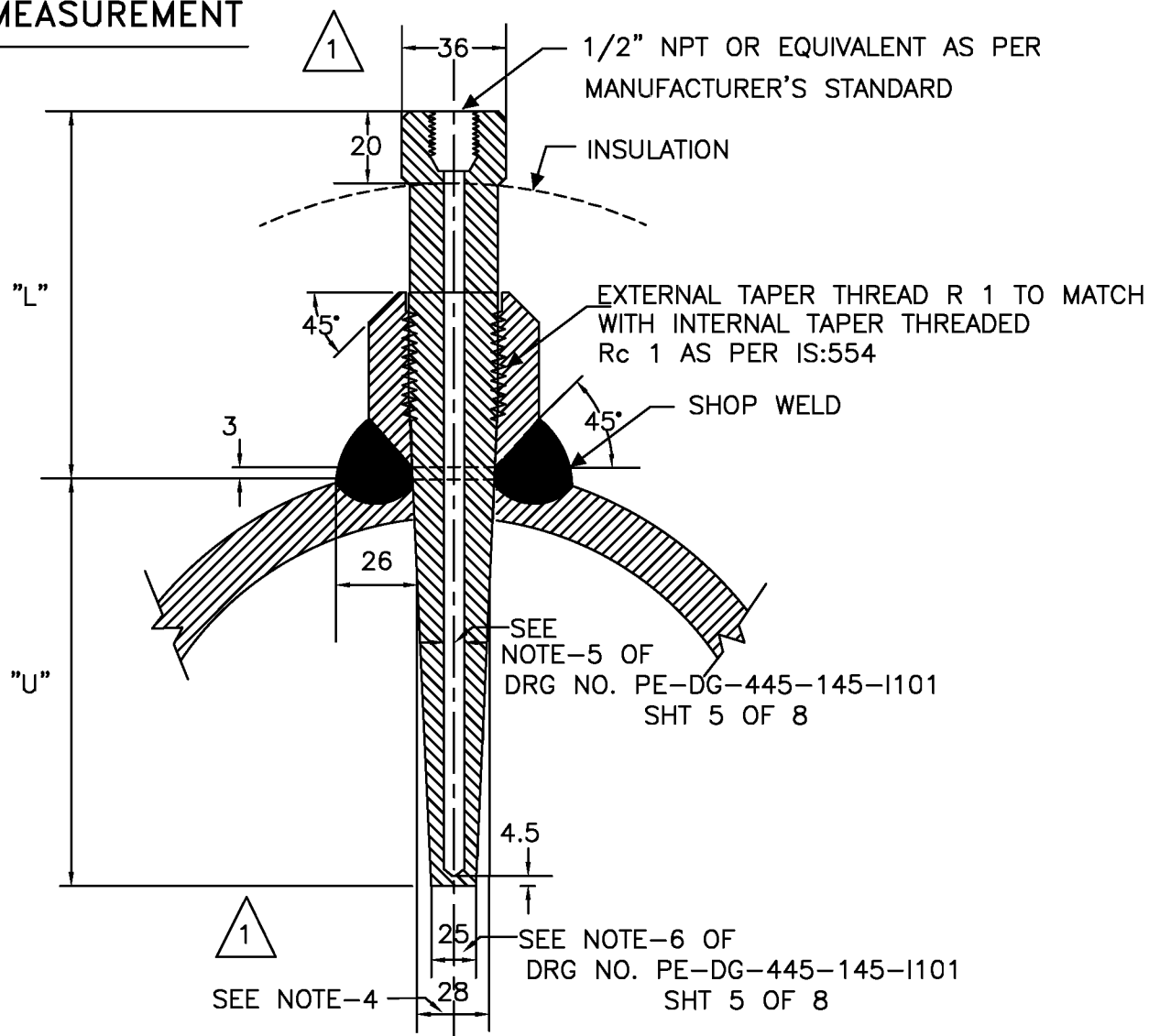


(APPLICABLE FOR PIPE SIZE ABOVE 4")
 [(i) DESIGN PRESS = /> 40 Kg/Cm2(g) OR
 (ii) DESIGN TEMP = /> 400 DegC]


SH. 5 OF 8 SHS.



TEMP. MEASUREMENT



NOTES :-

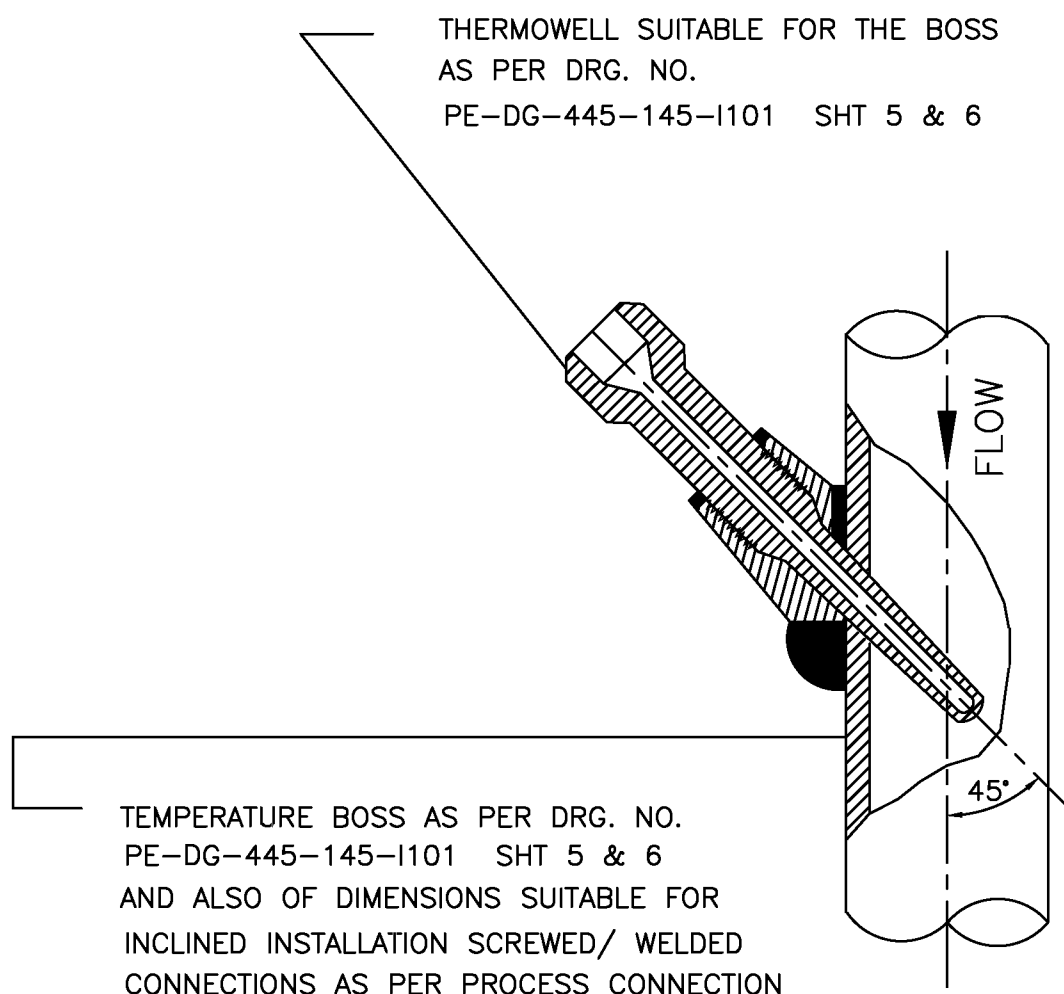
1. THIS TYPE OF TEMPERATURE BOSS IS APPLICABLE FOR THE DESIGN PRESS/ TEMP BELOW 40 KG/CM²(g)/400°C.
2. FOR PRESS. TIGHT JOINTS THE BOSS SHOULD HAVE INTERNAL TAPERED PIPE THREAD Rc 1 AS PER IS:554. THE LENGTH OF THREAD ENGAGEMENT SHOULD BE AS PER ABOVE STANDARD.
3. SEE NOTES-2 TO 10 IN SHT. 5 OF 8 OF THIS DRG. 
4. THERMOWELL SHALL BE SUITABLE TO MATCH THE STUB DIMENSIONS AS PER Rc 1.
5. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE INDICATED.



TITLE :
INSTRUMENT STUB DETAILS
FOR TEMPERATURE MEASUREMENT
 (APPLICABLE FOR PIPE SIZE ABOVE 4")

[DESIGN PRESS < 40 Kg/Cm² (g) & DESIGN TEMP < 400 C]

DRG. NO.
PE-DG-445-145-I101
 REV. 01
 SH. 6 OF 8 SHS.

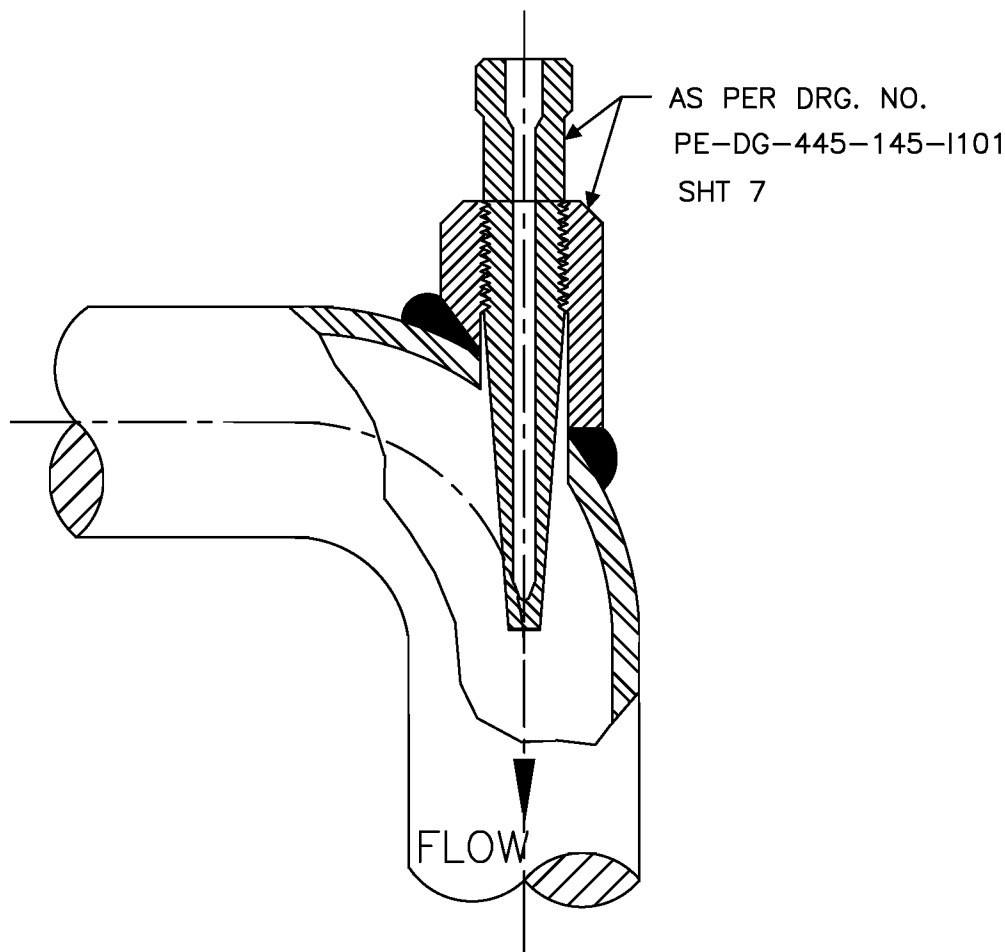
~~291681/2021/PS-PEM-MAX~~**NOTES :-**

1. INCLINED INSTALLATION OF THERMOWELL SHALL BE APPLICABLE FOR 4" AND SMALLER LINE SIZE BUT LIMITED TO MIN. 3" LINE SIZE.
2. FOR 2" AND SMALLER LINE SIZE NECESSARY EXPANDER OF MIN. 3" SIZE OF MAIN PIPING SPECIFICATION SHALL BE USED.
3. THIS TYPE OF INSTALLATION IS APPLICABLE FOR HORIZONTAL AND VERTICAL PIPE SECTION.
4. FOR STEAM SERVICES EXPANDER SECTION TO BE USED ONLY IN VERTICAL RUN.
5. THE EXPANDER SECTION SHALL BE OF ADEQUATE LENGTH (AT LEAST 3-4 TIMES DIA OF THE MAIN PROCESS PIPE AT BOTH SIDES OF THE INSTALLED THERMOWELL).



TITLE :
**INSTRUMENT STUB DETAILS
FOR TEMPERATURE MEASUREMENT
THERMOWELL INSTALLATION**

DRG. NO.
PE-DG-445-145-I101
REV. 01
SH. 7 OF 8 SHS.




NOTES :-

1. THIS INSTALLATION OF THERMOWELL SHALL BE APPLICABLE FOR 4" AND SMALLER LINE SIZE BUT LIMITED TO MINIMUM 3" LINE SIZE. THIS DETAIL IS APPLICABLE FOR THERMOWELL INSTALLATION IN BEND PIPES. △₁
2. FOR 2" AND SMALLER LINE SIZE NECESSARY EXPANDER OF ELBOW FORM (AS SHOWN) OF MINIMUM 3" SIZE SHALL BE USED.
3. ELBOW EXPANDER SECTION IN HORIZONTAL PLANE TO BE USED FOR LIQUID SERVICE. FOR STEAM SERVICES EXPANDER SECTION TO BE USED IN VERTICAL PLANE.



TITLE :
 INSTRUMENT STUB DETAILS
 FOR TEMPERATURE MEASUREMENT
 THERMOWELL INSTALLATION

DRG. NO.
 PE-DG-445-145-I101
 REV. 01
 SH. 8 OF 8 SHS.

	C&I SPECIFICATION FOR CONDENSATE POLISHING UNIT	SECTION: C SUB SECTION: C&I
<div>INSTRUMENT INSTALLATION DRAWING</div>		

12A05-DWG-I-0022-R-0-SHT-3 OF 27

PRESSURE TRANSMITTER/PRESSURE SWITCH
MOUNTED ABOVE SOURCE POINT

PRESSURE TRANSMITTER/
SWITCH

BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
24	1	UNEQUAL TEE, 1/2" SW X 1/2" NPT (F)
45	3 M	TUBE, 1/2" OD
52	2	GLOBE VALVE, 1/2" SW
64	5	MALE CONNECTOR 1/2" NPT(M) X 1/2" OD
73	15	IMPULSE PIPE, 15 NB
73a	1	NIPPLE, 1/2" SW X 1/2" NPT (F), 150 MM
92	1	2- VALVE MANIFOLD, 1/2" NPT (F)
92a	1	DRAIN PLUG, 1/2" NPT (M)
120	1	BULK HEAD UNION/COUPLING, 1/2" SW
130	2	HALF COUPLING, 1/2" SW
201	1	EQUAL TEE, 1/2" SW
205	2	90° ELBOW, 1/2" SW

SERVICE : CONDENSER PRESSURE ETC.

FOR TENDER PURPOSE ONLY

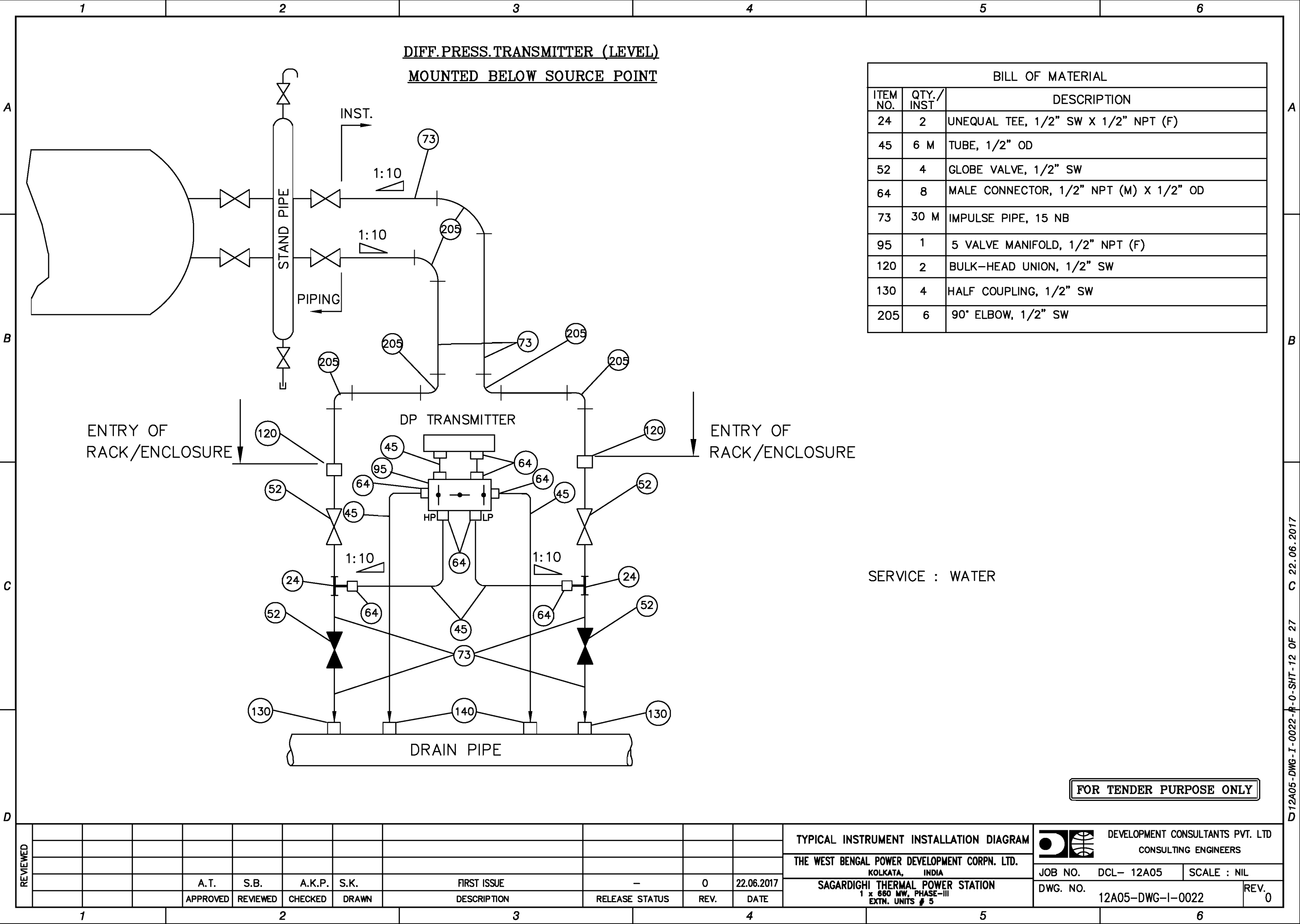
REVIEWED											
				A.T.	S.B.	A.K.P.	S.K.	FIRST ISSUE	—	0	22.06.2017
				APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM		
THE WEST BENGAL POWER DEVELOPMENT CORPN. LTD.		
KOLKATA, INDIA		
SAGARDIGHI THERMAL POWER STATION		
1 x 660 MW, PHASE-III		
EXTN. UNITS # 5		



DEVELOPMENT CONSULTANTS PVT. LTD
CONSULTING ENGINEERS

JOB NO.	DCL- 12A05	SCALE : NIL
DWG. NO.	12A05-DWG-I-0022	REV. 0





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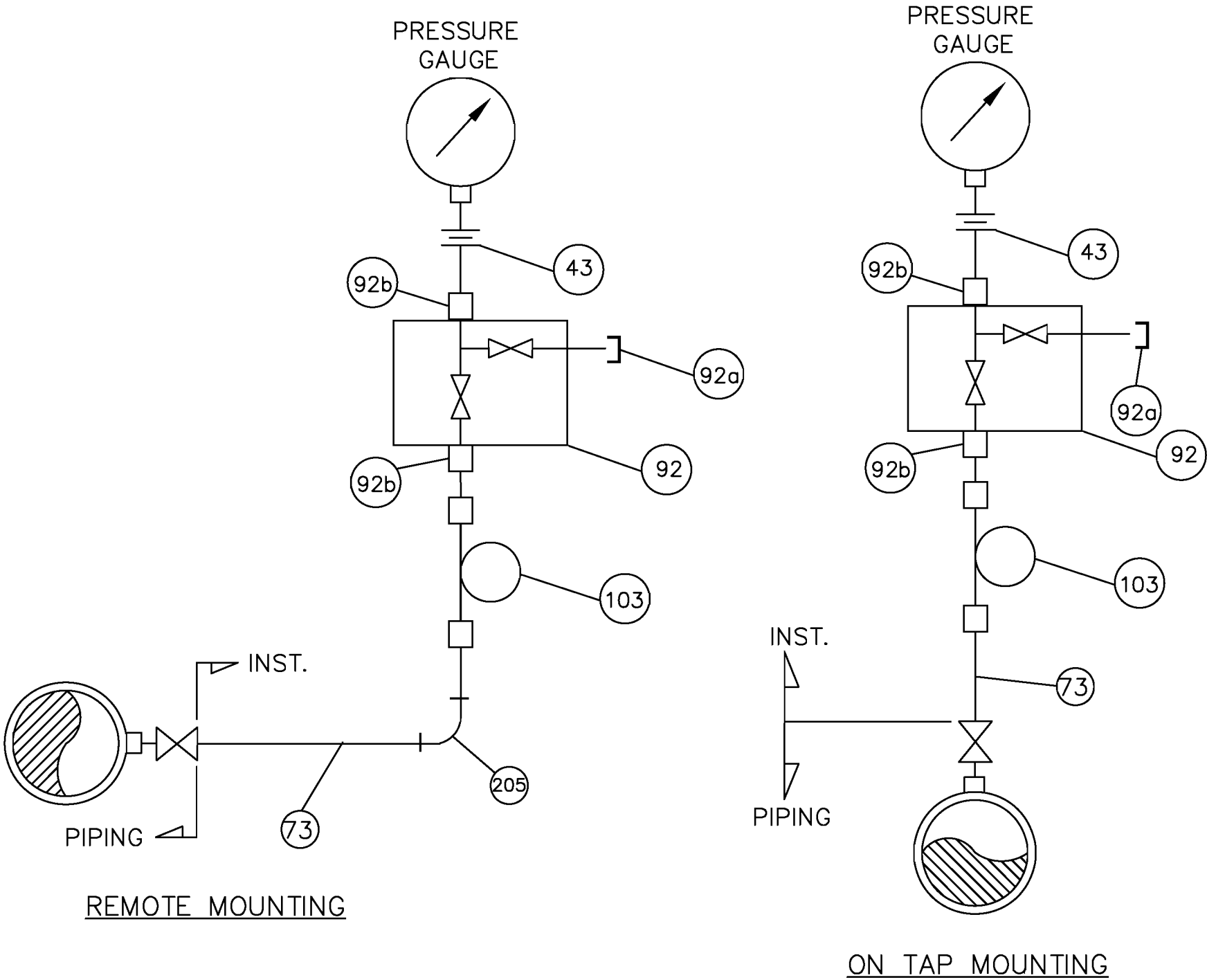
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12A05-DWG-I-0022-R-0-SHT-14 OF 27 C 22.06.2017

A3 (9-96) [420x297]



PRESSURE GAUGE



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
43	1	THREE PIECE UNION, 1/2" SW X 1/2" NPT (F)
73	15Mtrs	IMPULSE PIPE 15 NB
92	1	2 VALVE MANIFOLD, 1/2" NPT (F)
92a	1	VENT PLUG, 1/2" NPT (M)
92b	1	ADAPTOR, 1/2" SW X 1/2" NPT (M)
103	1	SYPHON 1/2" SW
205	1	90° ELBOW 1/2" SW

SERVICE : STEAM, FEED WATER


FOR TENDER PURPOSE ONLY

REVIEWED											
			A.T.	S.B.	A.K.P.	S.K.	FIRST ISSUE	-	0	22.06.2017	
			APPROVED	REVIEWED	CHECKED	DRAWN	DESCRIPTION	RELEASE STATUS	REV.	DATE	

TYPICAL INSTRUMENT INSTALLATION DIAGRAM		
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1 x 660 MW, PHASE-III		
EXTN. UNITS # 5		


DEVELOPMENT CONSULTANTS PVT. LTD		CONSULTING ENGINEERS	
JOB NO.	DCL- 12A05	SCALE :	NIL
DWG. NO.	12A05-DWG-I-0022	REV.	0

291681/2021/PS-PEM-MAX

	TITLE: 1 X 660 MW SAGARDIGHI TPS UNIT NO. 5 PHASE III	SPECIFICATION NO. PE-TS-445-155A-A001	
		SECTION : III	
	TECHNICAL SPECIFICATION FOR CONDENSATE POLISHING UNIT	SUB-SECTION:	
		REV. NO. 00	DATE : 10.05.2021

SECTION III

291681/2021/PS-PEM-MAX

	TITLE: 1 X 660 MW SAGARDIGHI TPS UNIT NO. 5 PHASE III	SPECIFICATION NO. PE-TS-445-155A-A001	
		SECTION : III	
	TECHNICAL SPECIFICATION FOR CONDENSATE POLISHING UNIT	SUB-SECTION:	
		REV. NO. 00	DATE : 10.05.2021

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

Note: Bidder to furnish all the pre-bid clarifications in the above indicated pre-bid clarification format only. General pre-bid clarifications will not be considered.

THIS IS A PART OF TENDER TECHNICAL SPECIFICATION NO. PE-TS-445-155-A001

<u>SCHEDULE OF DEVIATIONS WITH COST OF WITHDRAWAL</u>									
		PROJECT:- 2X800 MW UPPUR STPP							
<u>CONDENSATE POLISHING UNIT</u>									
<u>TENDER ENQUIRY REFERENCE:-</u>									
NAME OF VENDOR:-									
SL NO	VOLUME/ 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
<u>TECHNICAL DEVIATIONS</u>									
<u>COMMERCIAL DEVIATIONS</u>									
PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE									
NAME		DESIGNATIONS				SIGN & DATE			
<u>NOTES:</u>									
1. 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.									
2. For directly dispatchable items, cost of withdrawal of deviation will be applicable on the basic price including taxes, duties & freight.									
3. All the bidders have to list out all their Technical & Commercial Deviations (if any) in detail in the above format.									
4. Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of.									
5. 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.									
6. Bidder shall furnish price copy of above format along with price bid.									
7. The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.									
8. Bidders to note that any deviation (technical/commercial) not listed in above and asked after Part-I opening shall not be considered.									
9. 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.									
10. Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not be accepted.									
11. 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.									
12. 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.									
13. In case nature of cost of withdrawal (positive/negative) is not specified it shall be assumed as positive.									
14. In case of discrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.									

291681/2021/PS-PEM-MAX


	TITLE: 1 X 660 MW SAGARDIGHI TPS UNIT NO. 5 PHASE III	SPECIFICATION NO. PE-TS-445-155A-A001	
		SECTION : III	
	TECHNICAL SPECIFICATION FOR CONDENSATE POLISHING UNIT	SUB-SECTION:	
		REV. NO. 00	DATE : 10.05.2021

COMPLIANCE CUM CONFIRMATION SCHEDULE

The bidder shall confirm compliance with following by signing/ stamping this compliance certificate and furnishing same with the offer:

- a.) 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.
- b.) QP/ test procedures shall be submitted in the event of order based on the guidelines given in the specification & QP enclosed therein. 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.
- c.) 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.
- d.) There are no other deviations with respect to specification other than those furnished in the 'Schedule of Deviations'.
- e.) 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.
- f.) 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).
- g.) All sub vendors shall be subject to BHEL/ CUSTOMER approval.
- h.) Any special tools & tackles, if required, shall be in bidder's scope.
- i.) Demonstration parameters shall stand valid till the satisfactory completion of demonstration test and its acceptance by BHEL/ Customer.

291681/2021/PS-PEM-MAX

	TITLE: 1 X 660 MW SAGARDIGHI TPS UNIT NO. 5 PHASE III	SPECIFICATION NO. PE-TS-445-155A-A001	
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		REV. NO. 00	DATE : 10.05.2021

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.