

| CLAUSE NO. | TECHNICAL REQUIREMENTS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                              |          |                                |    |                     |                                              |
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|            | <p>The vibration monitor racks with power supplies shall be mounted in a separate self standing cabinet to be located in control room. The number of racks and power supplies shall be such that on failure of a single power supply/module, not more than four monitors shall be affected. The vibration monitoring cabinet shall be fed from redundant 24V DC feeders with auto changeover scheme.</p> <p>The power supply arrangement for monitors shall ensure that failure of one power supply shall not affect any monitoring function in the system. Also any power supply failure /earth fault in any of the monitors will be isolated without affecting other monitors/ common power supply. If 230 V AC UPS power supply is required for panel PC/ desktop PC, UPS/Mini UPS for the same shall be provided by the contractor.</p> <p>The functional requirement for vibration monitoring system shall include but not be limited to the following:</p> <ul style="list-style-type: none"><li>- Vibration monitor front face status indications shall be available for indications of healthy conditions of pick up circuit, monitor circuit and power supply. On sensor fault/wire break in the sensor circuit, the system shall have the feature of identifying the same through suitable means like the signal forced to a value less than 4 mA. In case, such a feature is not available then suitable contact shall be provided from the monitor for sensor fault.</li><li>- The facility shall be available for online functional checking of monitors.</li><li>- All vibration monitoring equipment shall be functionally tested for circuit continuity and output response. All the components &amp; interconnection cables shall be tested to ensure compliance with the specification requirements &amp; all other applicable codes &amp; standards.</li></ul> <p>In case it is the proven standard practice of a Contractor to provide vibration monitoring PC with TFT LCD monitor, instead of dedicated monitors with the signal conditioning equipment in control equipment room, the same shall also be acceptable. However, all relevant functional requirements detailed above shall be met and the system shall be subject to Employer's approval.</p> |                                              |          |                                |    |                     |                                              |
| 16.00.00   | <p><b>FIELD INSTRUMENTS BASED ON FIELDBUS</b></p> <p>The following instruments shall be connected to DDCMIS through fieldbus i.e. FOUNDATION Fieldbus/PROFIBUS PA protocol complying to IEC 61158 directly from transmitter.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                              |          |                                |    |                     |                                              |
| 16.01.00   | <p><b>Electronic Transmitter for Pressure, Differential Pressure and DP based Flow / Level measurements.</b></p> <table><tr><th>S No.</th><th>Features</th><th>Essential/Minimum Requirements</th></tr><tr><td>1.</td><td>Type of Transmitter</td><td>FOUNDATION Fieldbus/PROFIBUS PA based output</td></tr></table>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | S No.                                        | Features | Essential/Minimum Requirements | 1. | Type of Transmitter | FOUNDATION Fieldbus/PROFIBUS PA based output |
| S No.      | Features                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Essential/Minimum Requirements               |          |                                |    |                     |                                              |
| 1.         | Type of Transmitter                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | FOUNDATION Fieldbus/PROFIBUS PA based output |          |                                |    |                     |                                              |

| CLAUSE NO. | <div> <div>एनटीपीसी</div> <div>NTPC</div> </div> <b>TECHNICAL REQUIREMENTS</b>                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                                 |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|            | <p>2 Accuracy</p> <p>3. Stability</p> <p>4 Turn down</p> <p>5 Housing</p> <p>6. Electrical connection</p> <p>7. Process connection</p> <p>8. Operating Ambient temperature</p> <p>Overpressure</p> <p>9 Accessories</p> | <p>± 0.060 % of calibrated range (minimum) for calibrated range greater than 400 mmwc.</p> <p>+0.065 % of calibrated range (minimum) for calibrated range greater than 250 kg/cm<sup>2</sup>.</p> <p>± 0.10 % of calibrated range (minimum) for calibrated range less than 400 mmwc.</p> <p>0.25 % of calibrated range for 10 years for calibrated range greater than equal to 400 mmwc on standard conditions of manufacturer.</p> <p>0.2 % of calibrated range for 1 years for calibrated range less than 400 mmwc on standard conditions of manufacturer.</p> <p>0.15% of calibrated range for 5 years for DPT with static pressure greater than 250 kg/cm<sup>2</sup>.</p> <p>50:1 for greater than or equal to span of 400mmwcl.</p> <p>20:1 for span below 400mmwcl.</p> <p>10:1 for span greater than 250 kg/cm<sup>2</sup></p> <p>(Above mentioned (2,3,4) parameters/features of offered models shall be strictly as defined in standard published catalogue of the manufacturer only).</p> <p>Weather proof as per IP-67, metallic housing with durable corrosion resistant coating</p> <p>½" NPT(F) FOUNDATION Fieldbus/PROFIBUS PA compatible</p> <p>½" NPT (F)</p> <p>85 deg C without display.</p> <p>70 deg C with display.</p> <p>150% of max operating pressure</p> | <p>-Diaphragm seal, pulsation dampeners, syphon etc. as required by service and operating condition.</p> <p>-2 valve manifold for absolute &amp; gauge pressure transmitters, -3-valve for DP and 5 valve manifold for level/flow applications.</p> <p>-The valve manifold shall be non-integral type.</p> <p>-For hazardous area, enclosure as described in NEC article 5.</p> |

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|            | 10.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Mounting                      | 2 inch pipe mounting with Enclosure/Rack/Canopy.                                       |
|            | 11.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Diagnostics & display         | Self-Indicating feature and digital display on transmitter                             |
|            | Notes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                               |                                                                                        |
|            | <ul style="list-style-type: none"><li>- For primary air/ secondary air/flue gas/ furnace pressure applications, DP type transmitters shall be provided for pressure measurement below 2000 mmwc.</li><li>- LVDT type is not acceptable.</li><li>- 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.</li></ul> |                               |                                                                                        |
| 16.02.00   | Temperature Transmitter                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                               |                                                                                        |
| 16.02.01   | Single Input /Dual Input Temperature transmitter                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                               |                                                                                        |
|            | Temperature transmitter shall be provided which shall be fully compatible with thermocouples and RTDs being provided by the contractor. Temperature compensation for thermocouples shall be performed in the temperature transmitter itself. Transmitters shall be capable of withstanding ambient temperature up to 85 deg C.                                                                                                                                                                                                                               |                               |                                                                                        |
|            | Following specifications are applicable for dual input/single input temperature transmitter.                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                               |                                                                                        |
|            | S No.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Features                      | Essential/Minimum Requirements                                                         |
|            | 1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Output                        | FOUNDATION fieldbus /PROFIBUS PA                                                       |
|            | 2.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Input                         | Same transmitter shall be capable to handle Pt-100 RTD, Thermocouples –K, R & ,S types |
|            | 3.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Housing                       | Weather proof as per IP-67, metallic housing with durable corrosion resistant coating  |
|            | 4.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Electrical connection         | ½” NPT(F) FOUNDATION Fieldbus/PROFIBUS PA compatible                                   |
|            | 5.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Diagnostics display           | & Self-Indicating feature and digital display on transmitter                           |
|            | 6.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Operating Ambient temperature | 85 deg C without display.<br>70 deg C with display.                                    |

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|            | <div data-bbox="423 210 1365 541"> <div> <div>7.</div> <div>Mounting</div> <div>2 inch pipe mounting with Canopy.</div> </div> <div> <div>8.</div> <div>Accessories</div> <div>As required by service and operating condition.</div> </div> <div> <div>9.</div> <div>Composite Accuracy</div> <div>           (Refer note 2 )<br/><br/>           RTD                    <math>\leq 0.25\%</math> of 0-250 deg C span<br/>           T/C-K type           <math>\leq 0.2\%</math> of 0-600 deg C span<br/>           CJC accuracy (for thermocouples) shall be <math>\leq 1</math> deg C         </div> </div> </div> <div data-bbox="423 562 500 588">Notes:</div> <div data-bbox="423 609 1401 1276"> <ol style="list-style-type: none"> <li>In case of failure (open or burn-out) of RTD/thermocouple, transmitter shall provide low temperature output.</li> <li>Dual input temperature transmitter shall have bump less changeover facility to second sensor in case first sensor fails. This changeover is to be alarmed.</li> <li>Composite accuracy is to be calculated as summation of all applicable accuracies of temperature transmitter for converting sensor input to output (e.g., basic accuracy, digital accuracy, etc.) and temperature effect on these accuracies at ambient temperature of 50 deg C, based on the figure/ formula given in the standard product catalogue for span as specified above for various types of temperature elements specified. All such accuracy/ temperature effect figures in catalogue shall be first converted to deg C, and then percentage of this converted accuracy in specified span shall be calculated to compare with the specified composite accuracy figures. All temperature transmitters shall be interchangeable (i.e. can be used for either RTD or thermocouple) and composite accuracy shall be met for each type of input as specified above.</li> <li>Above mentioned parameters/features of offered models shall be strictly as defined in standard published catalogue of the manufacturer only.</li> <li>Dual input temperature transmitters can also be accepted in place of single input TT.</li> </ol> </div> |

## Notes (Common for a) to d) above):-

1. In case of failure (open or burn-out) of RTD/thermocouple, temp. Transmitter shall provide low temperature output.
2. Composite Accuracy is to be calculated as summation of all applicable accuracies of temp transmitter, for converting sensor input to output in 4-20 mA (e.g., basic accuracy, digital accuracy, D/A accuracy, etc.) and temperature effect on these accuracies at ambient temperature of 50 deg C, based on the figure/ formula given in the standard product catalogue for span as specified above for various types of Temperature Elements specified. All such accuracy/ temp effect figures in catalogue shall be first converted to deg C, and then percentage of this converted accuracy in specified span shall be calculated to compare with the specified composite accuracy figures. All temperature transmitters are to be interchangeable (i.e. can be used for either RTD or thermocouple) and composite accuracy shall be met for each type of input specified in (i) & (ii).

4.00.00

## SPECIFICATIONS FOR PR. GAUGE, D.P. GAUGE, TEMP. GAUGE AND LEVEL GAUGE.

| Sl. No | FEATURES                    | ESSENTIAL/MINIMUM REQUIREMENTS                           |                                                      |                                                                                          |
|--------|-----------------------------|----------------------------------------------------------|------------------------------------------------------|------------------------------------------------------------------------------------------|
|        |                             | Pr. Gauge/ DP Gauge/ gauges                              | Temperature Gauge                                    | Level Gauge                                                                              |
| 1      | Sensing Element             | Bourdon for high pressure, Diaphragm/ Bellow for low pr. | Inert gas actuated/ Liquid filled other than mercury | Tempered * toughened Borosilicate gauge glass steel armoured reflex or transparent type. |
| 2      | Material of sensing element | SS 316                                                   | SS 316                                               |                                                                                          |
| 3      | Material of movement        | SS 304                                                   | SS 304                                               |                                                                                          |
| 4      | Body material               | Die-cast aluminium                                       | Die-cast aluminium                                   | Forged carbon steel/304 SS                                                               |
| 5      | Dial size                   | 150mm                                                    | 150 mm                                               | Tubular covering entire range                                                            |
| 6      | End connection              | 1/2 inch NPT (M)                                         | 1/2 inch or 3/4 inch NPT (M).                        | Process connection as per ASME PTC and drain/vent 15 NB                                  |

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| 7                                                                                                                                                                                                                                                                                                | Accuracy             | ±1% of span                                                                                                      | ± 1% of span                            | ± 2%                                                                                                                    |
| 8                                                                                                                                                                                                                                                                                                | Scale                | Linear, 270° arc graduated in metric units                                                                       | Linear, 270° arc graduated in °C        | Linear vertical                                                                                                         |
| 9                                                                                                                                                                                                                                                                                                | Range selection      | Shall cover 125% of max. operating press                                                                         | Shall cover 125% of max. operating temp | Shall cover max. Operating level.                                                                                       |
| 10                                                                                                                                                                                                                                                                                               | Over range           | 125% of FSD                                                                                                      | 125% of FSD                             | -                                                                                                                       |
| 11                                                                                                                                                                                                                                                                                               | Housing              | Weather and dust proof as per IP-55                                                                              | Weather and dust proof as per IP-55     | CS/304 SS leak proof                                                                                                    |
| 12                                                                                                                                                                                                                                                                                               | Zero/span adjustment | Provided                                                                                                         | Provided                                | —                                                                                                                       |
| 13                                                                                                                                                                                                                                                                                               | Identification       | Engraved with service legend or laminated phenolic name plate                                                    |                                         |                                                                                                                         |
| 14                                                                                                                                                                                                                                                                                               | Accessories          | Blow out disc, siphon, snubber, pulsation dampener, chemical seal (if required by process) gauge isolation valve | SS Thermowell                           | Gasket for all KEL-F shield for transparent type vent and drain valves of Steel/SS as per CS/Alloy process Requirement. |
| Notes:-                                                                                                                                                                                                                                                                                          |                      |                                                                                                                  |                                         |                                                                                                                         |
| *Bicolour type level gauges will be provided for applications involving steam and water except for condensate and feed water services.                                                                                                                                                           |                      |                                                                                                                  |                                         |                                                                                                                         |
| Length of gauge glass shall not be more than 1400 mm. If the vessel is higher, multiple gauge glasses with 50 mm overlapping shall be provided.                                                                                                                                                  |                      |                                                                                                                  |                                         |                                                                                                                         |
| 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. |                      |                                                                                                                  |                                         |                                                                                                                         |

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| 9.05.00    | <p>The Contractor shall take full care while laying / installing cables as recommended by cable manufacturers regarding pulling tensions and cable bends. Cables damaged in any way during installation shall be replaced at the expense of the Contractor.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 10.00.00   | <p><b>FIELD MOUNTED LOCAL JUNCTION BOXES</b></p> <ul style="list-style-type: none"> <li>(i) No. of ways 12/24/36/48/64/72/96/128 with 20% spares terminals.</li> <li>(ii) Material and Thickness 4mm thick Fiberglass Reinforced Polyester (FRP).</li> <li>(iii) Type Screwed at all four corners for door. Door gasket shall be of synthetic rubber.</li> <li>(iv) Mounting clamps and accessories Suitable for mounting on walls, columns, structures etc. The brackets, bolts, nuts, screws, glands required for erection shall be of SS, included in Bidders scope of supply.</li> <li>(v) Type of terminal blocks Rail mounted cage-clamp type suitable for conductor size upto 2.5 mm<sup>2</sup>. A M6 earthing stud shall be provided.</li> <li>(vi) Protection Class IP: 55 minimum for indoor &amp; IP-65 minimum for outdoor applications.</li> <li>(vii) Grounding To be provided.</li> <li>(viii) Color RAL 7035</li> </ul> |
| 11.00.00   | <p><b>CONDUITS</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 11.01.00   | <p>Conduits shall be generally used for interconnecting cables from field instruments to Local JB's. All rigid conduits, couplings and elbows shall be hot dipped galvanised rigid mild steel in accordance with IS: 9537 Part-I (1980) and Part-II (1981). The conduit interior and exterior surfaces shall have continuous zinc coating with an overcoat of transparent enamel lacker or zinc chromate. Flexible conduit shall be heat resistant <del>terne coated steel with</del> , water leak, fire and rust proof protected for the areas of Mills, Drum, Main Steam, RH steam Air Heaters and Furnace, BFPDT's .</p> <p><i>And for remaining applications, water leak, fire and rust proof flexible GI conduits shall be provided.</i> The temperature rating of flexible conduit shall be suitable for actual application.</p>                                                                                                   |
| 11.02.00   | <p>All rigid conduit fittings shall conform to the requirements of IS: 2667, 1976. Galvanized steel fitting shall be used with steel conduit. All flexible conduit fittings shall be liquid tight, galvanized steel. The end fittings shall be compatible with the flexible conduit supplied.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 11.03.00   | <p>Conduit sealing, explosion proof, dust proof and other types of special fittings shall be provided as required by these specifications and shall be consistent with the area and equipment with which they are installed. Fittings installed outdoors and in damp locations shall be sealed and gasketed. Hazardous area fittings and conduits sealing shall conform with NEC requirements for the area classification.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 11.04.00   | <p>Contractor shall provide double locknuts on all conduit terminations not provided with threaded hubs and couplings. Water tight conduit unions and rain tight conduit hubs shall be</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |

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|            | <p>The overload capacity of the transformer and voltage stabilizer shall not be less than 300% for 200 millisecond duration. The voltage stabilizer shall employ servo-controlled circuitry and shall maintain the specified output voltage for 0-100% load with maximum input voltage variations as indicated above. The efficiency of the stabiliser shall be 95% or better.</p> <p>The type and other details shall be subject to Employer's approval.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 9.06.05    | <p><b>AC Distribution Board (ACDB)</b></p> <p>The details of the AC distribution board, i.e. exact, rating and number of feeders etc. of the 2x100% ACDB shall be designed to cater to the requirements of Contractors systems. 25% Spare feeders of each type and rating to be provided in each ACDB.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 9.06.06    | <p>The batteries shall be heavy duty Nickel-cadmium type and shall be sized for one hour of full load operation during non-availability of AC supply / chargers. The Ni-Cd batteries shall conform to IS: 10918. The batteries shall be sized as per relevant IEEE Standards. For sizing calculation, an aging factor of 0.8 and a temperature correction factor as per manufacturer's standard at 4 deg. C electrolyte temperature (Based on temperature characteristics curve to be submitted by the Contractor at a temperature of 4 deg. C). Capacity factor, Float Correction Factor, as per Battery Supplier Standard, shall be taken into consideration, if applicable and ambient temperature shall be considered as the electrolytic temperature. The sizing of the battery shall be as approved by Employer during detailed engineering. However, Contractor shall consider a suitable voltage drop from battery room to ACDB and ACDB to load, while sizing the battery.</p>                                                                      |
| 10.00.00   | <p><b>CONTROL CABINETS / PANELS / DESKS</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 10.01.00   | <p>The cabinets shall be IP-22 protection class. The Contractor shall ensure that the packaging density of equipment in these cabinets is not excessive and abnormal temperature rise, above the cabinet temperature during normal operation or air-conditioning failure, is prevented by careful design. This shall be demonstrated to the Employer during the factory testing of the system. The Contractor shall ensure that the temperature rise is limited to 10 deg. C above ambient and is well within the safe limits for system components even under the worst condition and specification requirements for remote I/O cabinets. Ventilation blowers shall be furnished as required by the equipment design and shall be sound proof to the maximum feasible extent. If blowers are required for satisfactory system operation, dual blowers with blower failure alarm shall be provided in each cabinet with proper enclosure and details shall be furnished with proposal. Suitable louvers with wire mesh shall be provided on the cabinet.</p> |
| 10.01.01   | <p>The cabinets shall be designed for front access to system modules and rear access to wiring and shall be designed for bottom entry of the cables.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
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| 10.01.02   | <p>The cabinets shall be totally enclosed, free standing type and shall be constructed with minimum 2 mm thick steel plate frame and 1.6 mm thick CRCA steel sheet or as per supplier's standard practice for similar applications, preferred height of the cabinet is 2200 mm. The cabinets shall be equipped with full height front and rear doors. The floor mounting arrangement for other cabinets shall be as required by the Employer and shall be furnished by the Contractor during detailed engineering.</p>                                                                                                |
| 10.01.03   | <p>Cabinet doors shall be hinged and shall have turned back edges and additional braking where required ensuring rigidity. Hinges shall be of concealed type. Door latches shall be of three-point type to assure tight closing. Detachable lifting eyes or angles shall be furnished at the top of each separately shipped section and all necessary provisions shall be made to facilitate handling without damage. Front and rear doors shall be provided with locking arrangements with a master key for all cabinets. If width of a cabinet is more than 800 mm, double doors shall be provided.</p>             |
| 10.01.04   | <p>Two spray coats of inhibitive epoxy primer-surface shall be applied to all exterior and interior surfaces. A minimum of 2 spray coats of final finish colour shall be applied to all surfaces. The final finished thickness of paint film on steel shall not be less than 65-75 micron for sheet thickness of 2 mm and 50 microns for sheet thickness of 1.6 mm. The finish colors for exterior and interior surfaces shall conform to following shades:</p> <p>(a.) Exterior:- As per RAL 9002 (End panel sides RAL 5012), to be finalised during detailed engineering.</p> <p>(b.) Interior:- Same as above.</p> |
| 10.01.05   | <p>Paint films which show sags, checks or other imperfections shall not be acceptable.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 10.01.05   | <p>As an alternative, single coat of anodic dipcoat primer along with single textured powder coating with epoxy polyester meeting the thickness requirement is also acceptable.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                   |

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| 11.03.00   | Facility of audio annunciation shall be provided in OWS upon the occurrence OWS alarms irrespective of whether alarms are displayed or not. Facility to disable the audio annunciation shall be provided.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 11.04.00   | At least three levels of alarm priority shall be available which will be displayed in different colour. It shall be possible to display & print alarms of any of the three levels.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 11.05.00   | Alarm boxes shall be provided in each display to alert the operator about an alarm when he is viewing some other picture. No of alarm boxes shall be finalised during detailed engineering for each process area & each priority therein.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 11.06.00   | The annunciator sequence shall conform to ISA sequence ISA-2A.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 12.00.00   | <b>SOFTWARE DOCUMENTATION AND SOFTWARE LISTINGS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 12.01.00   | All technical manuals, reference manuals, user's guide etc., in English required for modification/editing/addition/deletion of features in the software of the PLC System shall be furnished. The Contractor shall furnish a comprehensive list of all system/application software documentation after system finalization for Employer's review and approval.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 12.02.00   | All The software listings including Source code for application software, All special - to-project data files etc. shall be submitted by the Contractor.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 13.00.00   | <b>SOFTWARE LICENCES</b> <p>The Contractor shall provide software license for all software being used in Contractor's System. The software licenses shall be provided for the project (e.g. organisation or site license) and shall not be hardware/machine-specific. That is, if any hardware/machine is upgraded or changed, the same license shall hold good and it shall not be necessary for Employer to seek a new license/renew license due to upgradation/change of hardware/machine in Contractor's System at site. All licenses shall be valid for the continuous service life of the plant.</p> <p>As a customer support, the Contractor shall periodically inform the designated officer of the Employer about the software upgrades/new releases that would be taking place after the system is commissioned so that if required, same can be procured &amp; implemented at site.</p> |
|            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |

| CLAUSE NO. | <div> <div>TECHNICAL REQUIREMENTS</div> <div>एनटीपीसी<br/>NTPC</div> </div> |                                                                                            |                                                                                                                                      |                                                                                                                              |
|------------|-----------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| 5.00.00    | PROCESS ACTUATED SWITCHES                                                   |                                                                                            |                                                                                                                                      |                                                                                                                              |
|            | FEATURES                                                                    | ESSENTIAL / MINIMUM REQUIREMENTS                                                           |                                                                                                                                      |                                                                                                                              |
|            |                                                                             | Pressure/ Draft<br>Switches/ DP<br>Switches                                                | Temperature<br>switches                                                                                                              | Level switches                                                                                                               |
|            | Sensing<br>Element                                                          | Piston actuated<br>for high pressure<br>and diaphragm or<br>bellows for low<br>pr./ vacuum | Vapor pressure<br>sensing, liquid<br>filled bellow<br>type with SS<br>bulb and<br>capillary (5 m<br>minimum, to<br>suit application) | Capacitance types, float type,<br>conductivity type, RF type,<br>Ultrasonic type as per suitability to<br>the application. . |
|            | Material                                                                    | 316 SS                                                                                     | Bulb 316 SS/<br>capillary 304 SS                                                                                                     | 316 SS                                                                                                                       |
|            | End<br>connection                                                           | ½ inch NPT (F)                                                                             | ½ inch NPT (F)                                                                                                                       | Manufacturer standard                                                                                                        |
|            | Over range/<br>proof pressure                                               | 150% of<br>maximum<br>operating pr.                                                        | -                                                                                                                                    | 150% of maximum operating pr.                                                                                                |
|            | Repeatability                                                               | +/- 0.5% of full range                                                                     |                                                                                                                                      |                                                                                                                              |
|            | No. of contacts                                                             | 2 No.+2NC. SPDT snap action dry contact                                                    |                                                                                                                                      |                                                                                                                              |
|            | Rating of<br>contacts                                                       | 60 V DC, 6 VA (or more if required by DDCMIS)                                              |                                                                                                                                      |                                                                                                                              |
|            | Elect.<br>Connection                                                        | Plug in socket.                                                                            |                                                                                                                                      |                                                                                                                              |
|            | Set point<br>adjustment                                                     | Provided over full range.                                                                  |                                                                                                                                      |                                                                                                                              |
|            | Dead band<br>adjustment                                                     | Adjustable/ fixed as per requirement of application.                                       |                                                                                                                                      |                                                                                                                              |
|            | Enclosure                                                                   | Weather and dust proof as per IP-55, metallic housing.                                     |                                                                                                                                      |                                                                                                                              |
|            | Accessories                                                                 | Siphon, snubber,<br>chemical seal,<br>pulsation<br>dampeners as<br>required by<br>process  | Thermo well of<br>316 SS and<br>packing glands                                                                                       | All mounting accessories                                                                                                     |
|            | Mounting                                                                    | Suitable for<br>enclosure/ rack<br>mounting or<br>direct mounting                          | Suitable for rack<br>mounting or<br>direct mounting                                                                                  | -                                                                                                                            |

| CLAUSE NO. | TECHNICAL REQUIREMENTS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                        | <div>एनटीपीसी<br/>NTPC</div> |
|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------|------------------------------|
|            | Power Supply<br>(wherever required)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | As per Contractor's Standard practice. |                              |
|            | Notes :-<br><br>1) 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.<br><br>2) Pressure/ Diff pressure switches for very low press/ DP measurements can have sensor material other than SS316 in case of any technical limitation and the offered product is standard product of the manufacture for very low pressure applications.<br><br>3) Repeatability can be upto +/-1% of full range in case of switches with diaphragm seals or very low pressure/DP range.<br><br>4) The specifications of switches for air conditioning & ventilation system / process can be as per system manufacturer's standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. |                                        |                              |
| 6.00.00    | <b>SOLENOID VALVES</b><br><br>Solenoid valves shall fulfill the following requirements: -<br><br>a) Type 2/3/4 way SS 316/ forged brass (depending on the application subject to Employer's approval during detailed engg.)<br><br>b) Power supply 24V DC.<br><br>c) Plug in connector connection.<br><br>d) Insulation : Class "H"                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                        |                              |
| 7.00.00    | <b>Limit switches</b><br><br>e) Limit switches shall be silver plated with high conductivity and non-corrosive type. Contact rating shall be sufficient to meet the requirement of Fire alarm Control System subject to a minimum of 60V, 6VA rating. Protection class shall be IP-55.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                        |                              |

|        |                                                           |                                  |
|--------|-----------------------------------------------------------|----------------------------------|
| (e)    | <b>Flow Switch (to be provided with isolating valves)</b> |                                  |
| (i)    | Body                                                      | Forged steel                     |
| (ii)   | Extension Rod/wire                                        | SS-304                           |
| (iii)  | Sleeve and Sleeve pipe                                    | SS-304                           |
| (iv)   | Cover                                                     | Die cast aluminum                |
| (v)    | Max. working pressure                                     | 10 kg/sq.cm                      |
| (vi)   | Repeatability                                             | ± 0.5%                           |
| (vii)  | No. of contacts                                           | 2 NO + 2 NC                      |
| (viii) | Type of contact                                           | Adjustable throughout the range. |
| (ix)   | Protection class                                          | IP – 65                          |
| (f)    | <b>Level Switch</b>                                       |                                  |
| (i)    | Type                                                      | Displacer operated magnetic type |
| (ii)   | Displacer                                                 | SS – 316                         |
| (iii)  | Wire rope                                                 | SS – 316                         |
| (iv)   | Spring Housing Spring and sleeve pipe                     | SS – 316                         |
| (iv)   | Cover                                                     | Cast Aluminum                    |
| (v)    | No. of Contacts                                           | 2 NO + 2 NC                      |

8.00.00 DEW POINT METER

1. Type : Direct Mounting Capacitance type with change in output proportional to moisture present.
2. Sensing Element : Ceramic / Aluminum Oxide sensor
3. Service : Dry Air
4. Range : -90 Deg.C to 10 Deg.C Dew Point Temperature
5. Sensor Accuracy :  $\pm 2$  Deg. C Dew Point
6. Repeatability : 0.5 Deg. C Dew Point
7. Operating Ambient Temperature : -40 Deg C to 50 Deg C
8. Operating Pressure : 0- 10 kg/ Sq. cm
9. 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 : 24 VDC nominal
13. Enclosure class : IP 65
14. Interchangeability : Fully Interchangeable transmitters
15. Accessories : Sampling system, cables, sensor holder, desiccant chambers, double compression fittings,  $\frac{3}{4}$  " Cable gland, mounting fixture etc.

## SIGHT GLASS

| Sr. No. | Description          |                         |
|---------|----------------------|-------------------------|
| 1.      | Make                 |                         |
| 2.      | Type                 | Double Window           |
| 3.      | Connection           | Flanged                 |
| 4.      | Flow Directions      | Horizontal              |
| 5.      | Indicator            | Bi- Directional Flapper |
| 6.      | Body                 | A106 Gr B               |
| 7.      | Cover Plates         | IS2062                  |
| 8.      | Bolts/Studs and Nuts | GI                      |
| 9.      | Gaskets              | NON CAF                 |
| 10.     | Glass                | Toughened               |
| 11.     | Flapper              | AISI 304                |
| 12.     | Process Flanges      | IS2062 / A105           |
| 13.     | Flange rating        | 150#RF ANSI B16.5       |
| 14.     | Tag plate            | SS                      |



## SPECIFICATION FOR LOCAL PANELS

SPECIFICATION NO.: PE-SS -999- 145 -054A

VOLUME II B

SECTION D

REV. NO. 03

DATE : 16-09-2013

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### 1.0 SCOPE

This specification covers the Design, Manufacture, Inspection and Testing at the manufacturer's works, proper packing for transportation and delivery to site, **supervision, erection, and commissioning at site** of Local Panels required for control and monitoring of the Auxiliary Plant & Equipment.

### 2.0 CODES AND STANDARDS

2.1 All the equipments specified herein shall comply with the requirements of the latest issue of the relevant National and International standards.

2.2 As a minimum requirement, the following standards shall be complied with:

- a) IS-6005 : 1998 : Code of practice for phosphating of iron and steel.
- b) IS-5 : 2007 : Colors for ready mixed paints and enamels.
- c) IS-1248:2003 : Direct Acting Indicating Analog Elec Measuring Instruments.
- d) IS/IEC 60947:Part 1:2004 : Low Voltage switchgear & control gear: Part-I (General Rules)
- e) IS-8828:1996 : Circuit breaker for household and similar installations.
- f) IS-13947 (Part-I):1993 : Low Voltage switchgear & control gear : Part-I (General Rules)
- g) ISA-18.1:1979 : Annunciator Sequences and Specification
- h) NFPA-496:2003 : Purged & Pressurised Enclosure for Electrical Equipment in Hazardous Locations.

### 3.0 TECHNICAL REQUIREMENTS

#### 3.1 Panel Construction

3.1.1 The local panels shall house the secondary instruments, annunciation system, Single loop controller, Control switches / push buttons, indicating lamps/**LED cluster**, relays, timers and other devices required for operation and monitoring of the equipment locally.

3.1.2 The panels shall be of free standing type either welded construction on angle iron (minimum section of 50 x 50 x 4 mm) structure or folded construction by sheet metal formation depending upon the equipments to be mounted on it. The panels shall be robustly built and **stiffeners** as necessary shall be provided.

3.1.3 The panel shall be suitably reinforced to ensure adequate support for all instruments mounted thereon. All welds on exposed panel surfaces shall be ground smooth.

#### 3.1.4 The salient features of construction shall be:

Sheet material: Cold rolled sheet steel

Frame thickness: Not less than 3.0mm

Enclosure thickness: Not less than 2.5 mm for load bearing sections (Mounted with instruments)  
1.6 mm for doors and Not less than 2.0 mm for others

Gland plate thickness: 3.0mm

Base channel: ISMC 100 with anti-vibration mounting & foundation bolts.

3.1.5 The panel shall be provided with rear doors with integral lockable handle. The door when locked shall be held at minimum three places. The door width shall not be more than 550mm. The doors shall be provided with suitable **stiffeners** to prevent buckling. The handle shall be on the right side of the door. The door shall be removable type with concealed hinges to facilitate maintenance work. Suitable pocket inside the door shall be provided for keeping the drawings / documents. **Double door shall be provided with suitable glass windows, as per the requirement.**

3.1.6 Suitable neoprene gasket shall be provided on all doors and removable covers. Suitable ventilation **system along with louvers** shall be provided at bottom and top of the doors covered with removable wire mesh.



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- 3.1.7 The class of protection shall be in accordance with IP-42 unless otherwise specified
- 3.1.8 All steel surfaces shall be cleaned by sand / pellet blasting, treated for pickling, degreasing and phosphating etc. by seven tank method. The panel shall have a high quality finish and appearance. The panel shall be painted with two coats of primer followed by two coats of epoxy / synthetic enamel based final paint of color shade and finish. Minimum thickness of the paint shall be 85 microns for external paint and 70 microns for internal paint.
- 3.1.9 The cable glands of the required size and type shall be supplied alongwith the Panel.
- 3.1.10 All operable and indicating devices shall be mounted on the front of the panel while aux. Relays / timers MCBs etc. required for realization of control logics shall be mounted on a mounting plate inside the panel. Auxiliary relays and timers etc. shall be grouped according to the control function. No operable or indicating devices shall be mounted below 750 mm and above 1800 mm (w.r.t. finished ground level). The devices shall be located in such a way so as to ensure easy access for operation / maintenance.
- 3.1.11 Single / dual control power supply feeders of voltage class shall be provided by the purchaser. In case redundant power supply feeders are provided then auto changeover unit shall be mounted on the panel are in the panel supplier's scope. Where DC control power supply is specified an additional 240V, 50 Hz AC supply feeder for powering of space heater and lighting shall be provided by the purchaser. Suitable arrangement shall be provided inside the panel to receive and terminate the power supply feeder(s). For this purpose MCBs of suitable current rating shall be provided by the vendor. A supervisory relay along with a pilot lamp to indicate control supply 'ON' shall be provided on the panel. Any other power supply required for the operation of the devices mounted in the panel shall be arranged by the vendor.
- 3.1.12 The internal wiring shall be carried out with 1100 volt grade PVC insulated copper multi strand wire / flexible of 1.5mm<sup>2</sup> size. AC & DC wires shall be kept separate from each other. Separate coloured wires to be used for AC and DC circuits. All wires shall be properly numbered and identified with ferrules as per the Control scheme / wiring diagram. Wires shall be routed and run through PVC troughs.
- 3.1.13 Terminal blocks shall be clip on type, 1100 volts grade. Separate terminal blocks shall be used for AC & DC circuits. The terminals shall be suitable for terminating 0.5 mm<sup>2</sup> to 2.5mm<sup>2</sup> external cables. The TB points in terminal block shall be cage clamp type / screw type. The terminal for ammeters shall be provided with removable links for shorting CTs. Each terminal strip shall be provided with identification strip. The terminal shall not be mounted below 250 mm height from finished floor. The panel shall have ten (20) percent spare terminal.
- 3.1.14 The interior of each panel shall be suitably illuminated through fluorescent lamps / tube lights with shrouded cover of minimum 15W operable on 240V 50 Hz AC power supply through panel door switch. A 15 Amp. 3-pin Power receptacle shall be provided.
- 3.1.15 Suitable space heaters operable on 240 Volts 50 Hz AC power system shall be provided at the panel bottom. These shall be designed to maintain the panel temperature five (5) deg. C above the ambient temperature during maintenance shutdown. Suitable isolating and control devices comprising of MCB, thermostat etc. shall be provided for the space heater.
- 3.1.16 The panel shall be provided with a copper earth bus of 25 x 6 mm size running throughout the width of the panel. It shall be terminated internally with 10 mm bolts at extreme ends for connection to; main station earth. The panel mounted equipments / devices shall be connected to earth bus through green coloured PVC insulated stranded copper conductor of 2.5 mm<sup>2</sup> size.
- 3.1.17 Local Panel shall be provided with main name plate of 150 mm x 40 mm size having inscription of 20 mm height. The individual devices on the panels shall be as provided with separate name plate with inscription of 3 mm height. The instrument / devices shall be provided with stick on label plates inside the panel. The material of the main and individual labels shall be three (3) ply 3 mm thick Traffolyte



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Sheet / 2 mm Anodised Aluminium Plate. The inscription shall be with white letters on black background on traffolyte sheet. The labels shall be fixed by self tapping non-rusting screws.

3.1.18 Vendor shall furnish electric load and heat load list ( in case panel is to be placed in ac environment ) of each panel.

### 3.2 Hazardous Area Panel Requirement

3.2.1 The Local Panel located in hazardous area shall be pressurized as per NFPA-496 requirements to render it non-hazardous. Alarms shall be provided for local and remote annunciation when pressurisation falls below 2.5 mm of water column. Protection shall be of type Z of NFPA-496. It shall not be possible to switch ON the power of purged section unless it is purged as per the recommendation of NFPA-496. Vendor must provide a protective device on the panel to protect the panel from over pressurisation.

3.2.2 Vendor shall supply pressurisation kit consisting of valves, restriction orifices, dual filter regulation, pressure gauges, pressure switches, rotameter etc. Pressurisation kit shall be surface mounting on a metal board and located outside the local panel. Pressurisation kit shall further consist of solenoid valve flow switch, timer blow off safety device etc., so as to make purging fully automatic. However final start shall be manual. Panel protection against over pressure to be provided as per NFPA-496.

3.2.3 Pressurised local control panel pressurization kit assembly design shall provide minimum leakage flow through the Local Control Panel. Panel venting shall be as per NFPA-496.

3.2.4 All components in the local panel like indicating instruments, push buttons switches, lamps etc., which are required to be energized without panel pressurization or before completion of purge cycle shall be explosion proof as per NEMA-7 & suitable for area classification.

3.2.5 All push buttons etc. requiring frequent operation during machine running shall have good positive sealing. Weatherproof housing or cover to be provided wherever necessary. Vendor shall provide pressurisation bypass switch outside explosion proof enclosure of pressurized panel with lamp indication. This shall be used only during maintenance. All hinges, screws, other non-painted metallic parts shall be of stainless steel material.

3.2.6 Provision to switch off manually all types of power shall be provided in the panel. In addition, it shall also be possible to switch off power circuits / components which are powered from motor control centre or control room manually in case of pressurization failure. All such cables from MCC and main control room shall be terminated in explosion proof boxes (NEMA-7).

### 3.3 Control & Monitoring devices

3.3.1 Instruments like Indicators, recorders, single loop controllers etc. as applicable and specified elsewhere for the plant / equipment shall be supplied and mounted on the panel.

#### 3.3.2 Alarm Annunciator System

It shall be solid state discrete facia type having a sequence of ISA-S18.1A or as specified, opaque facia windows of 70 mm x 50 mm size, having two (2) lamps per window, and hooter of 10W, and provision for repeat group alarm at remote. The annunciator shall be provided with ten (10) percent spare windows or minimum two (2) windows along with electronics.

#### 3.3.3 Relays

The relays shall be electromagnetic type suitable for specified control supply. Its contact configuration and rating shall be suitable for the specified control function. However minimum contact rating shall be 5 Amp AC & 2 Amp DC as applicable. There shall be ten (10) percent spare contacts.

#### 3.3.4 Timers

The timers shall be electronic type suitable for specified control supply. Its contact configuration and rating shall be suitable for the specified control function. However, minimum contact rating shall be 5 Amp AC & 2 Amp DC as applicable.



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### 3.3.5 Control / Selector Switches

Switches shall be Rotary Cam type with minimum of 5 Amps AC & 2 Amp DC continuous current rating. Selector switches shall be stay put type while control switches shall be spring-return-to-neutral type. Contact configuration and rating shall be as per the control function requirement. The switches shall be lockable type wherever specified. Each switch shall be provided with engraved plates indicating the switch position / functions.

### 3.3.6 Push Buttons / Indicating Lights

The push buttons shall be momentary action self-resetting type, however stop P.B. for unidirectional drives shall be provided with manual reset facility. Its contact configuration & rating shall be as required for the control function but minimum 2 NO + 2 NC of 5 Amp. AC rating. It shall have round coloured projecting tab and engraved escutcheon plate / inscription plate. Colour coding of push buttons shall be as under:

|       |                         |        |                   |                 |
|-------|-------------------------|--------|-------------------|-----------------|
| RED   | Motor OFF / Valve CLOSE | YELLOW | Alarm acknowledge | Left Hand Side  |
| GREEN | Motor ON / Valve OPEN   | BLACK  | Lamp test         | Right Hand Side |

Indicating lights shall be suitable for direct connections across specified power supplies. It shall be fitted with built in resistance to prevent circuit tripping on shorting of lamp filament. It shall be fitted with LED cluster type lamp replaceable from front.

|       |                                    |       |                  |                 |
|-------|------------------------------------|-------|------------------|-----------------|
| GREEN | Motor OFF / Valve CLOSED condition | AMBER | Motor tripped    | Left Hand Side  |
| RED   | Motor ON / Valve OPEN condition    | WHITE | Normal / healthy | Right Hand Side |

### 3.3.7 Ammeters

Ammeter shall be 96 x 96 mm size, 90 deg. deflection, 1.5% accuracy, 1 Amp. CT operated or with 4-20mA input and Flush mounting type. Ammeters for motors shall have six (6) times folded scale at upper end to enable motor starting current indication.

### 3.3.8 Miniature Circuit Breaker (MCB)

These shall be instantaneous magnetic trip type for short circuit in addition to current time inverse delayed thermal trip feature for over current protection. The housing of MCB shall be made of non-ignitable, high impact material. It shall have minimum short circuit rating of 9 KA for AC Voltages and 4 KA for DC Voltages.

### 3.3.9 Makes of various instruments / devices shall be as given below

|    |                                 |   |                                        |
|----|---------------------------------|---|----------------------------------------|
| 1. | Alarm Annunciators              | : | Procon / IIC                           |
| 2. | Ammeters                        | : | AEP / IMP                              |
| 3. | Control / Selector Switches     | : | Alsthom / Kaycee / Siemens / L&T       |
| 4. | Push Buttons / Indicating Lamps | : | Siemens / L&T / Teknic / Alsthom       |
| 5. | Auxiliary Relays                | : | Jyoti / Siemens / L&T / OEN            |
| 6. | Timers                          | : | L&T / Alsthom / Bhartiya Cutler Hammer |
| 7. | MCBs                            | : | S&S Power Engg. / Indo Asian / MDS     |
| 8. | Terminal Blocks                 | : | Jyoti / Elmex                          |

## 4.0 TESTING AND INSPECTION

4.1 The bidder shall adopt suitable quality assurance program to ensure that the equipments offered will meet the specification requirements in full.

4.2 BHEL's standard Quality Plan for LCP is enclosed with the specification. The bidder shall furnish his acceptance to BHEL's QP and submit the signed and stamped copy of QP along with the offer.



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4.3 The vendor shall conduct the following tests as a minimum requirement:

4.3.1 Routine Tests

1. High Voltage (H.V.)
2. Insulation Resistance (I.R.)
3. Functional

4.3.2 Type Tests

1. Enclosure Class Test

Estelax



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### 5.0 SPARES AND CONSUMABLES

#### 5.1 Commissioning Spares and consumables

The bidder shall supply all commissioning spares and consumables 'as required' during Start-up, as part of the main equipment supply.

#### 5.2. Mandatory Spares

The bidder shall offer alongwith main offer, the Mandatory Spares as specified elsewhere in the specification. The Mandatory Spares offered shall be of the same make and type as the main equipment.

#### 5.3. Recommended Spares

The bidder shall furnish a list of Recommended Spares indicating the normal service expectancy period and frequency of replacement; quantities recommended for 3 years operation alongwith unit rate against each item to enable BHEL/BHEL's Customer to place a separate order later, if required.

### 6.0 DRAWINGS AND DOCUMENTS

#### 6.1 The bidder shall furnish the following documents in required number of copies along with the bid :

1. Data Sheet
2. General Arrangement Drawing.
3. Catalogue and technical information for instruments and devices.
4. Quality Plan.

#### 6.2 The vendor shall furnish the following documents in required number as agreed after the award of contract:

1. Data Shee
2. GA Drawing indicating layout of instruments, construction details, foundation details, cable gland plate alongwith cable glands and all details mentioned in this specification.
3. Control Schematic Diagram along with grouping of different terminals for various functions.
4. Catalogue and technical information for instruments and devices with selected options clearly marked.
5. O&M Manuals.
6. "As Built" Drawing.
7. CDs.

### 7.0 MARKING AND PACKING

#### 7.1 Panel with all instruments / devices mounted on it shall be suitably packed & protected for the entire period of despatch, storage and erection against impact, abrasion, corrossion, incidental damage due to vermin, sunlight, high temperature, rain moisture, humidity, dust, sea-water spray (where applicable) as well as rough handling and delays in Transit and storage in open.

|  |                                                                        |  |
|--|------------------------------------------------------------------------|--|
|  | <b>NTPC FGD PACKAGES-<br/>LOT-1A, 2 &amp; 3</b>                        |  |
|  | <b>C &amp; I TECHNICAL SPECIFICATION<br/>FOR COMPRESSED AIR SYSTEM</b> |  |

**SIGNAL EXCHANGE BETWEEN  
DRIVES & DCS**

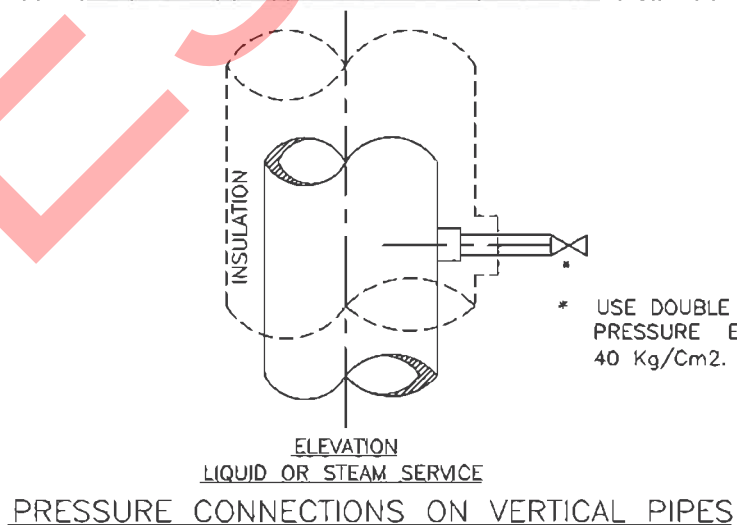
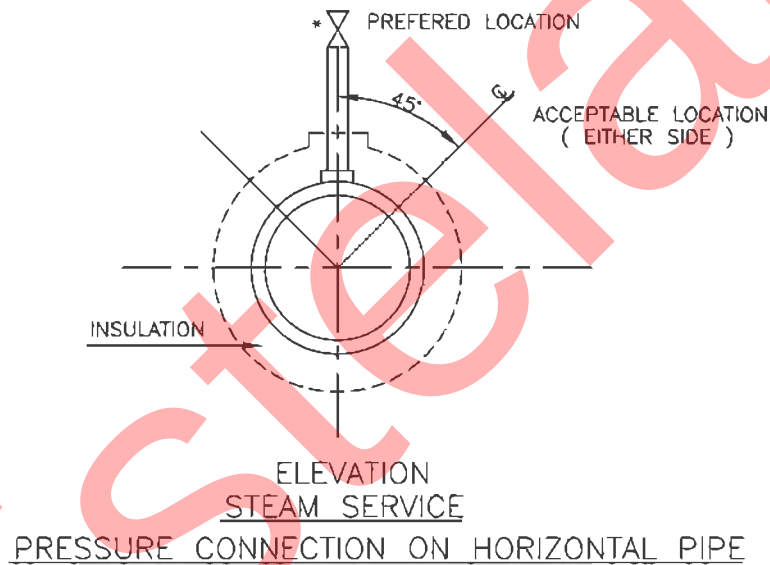
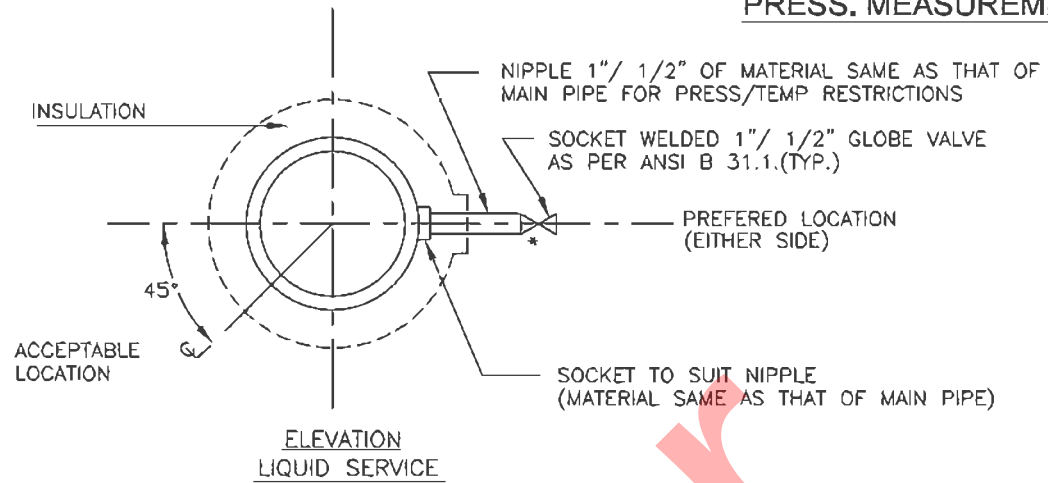


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|  |                                                                        |  |
|--|------------------------------------------------------------------------|--|
|  | <b>NTPC FGD PACKAGES-<br/>LOT-1A, 2 &amp; 3</b>                        |  |
|  | <b>C &amp; I TECHNICAL SPECIFICATION<br/>FOR COMPRESSED AIR SYSTEM</b> |  |

**INSTRUMENT STUB DETAILS**

## PRESS. MEASUREMENT



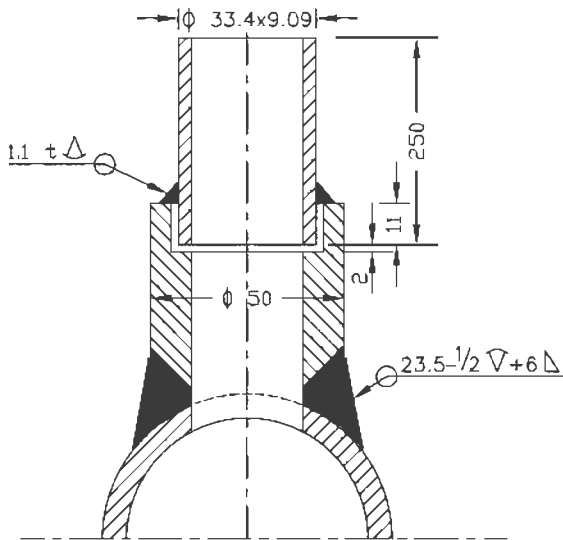
\* USE DOUBLE ISOLATION VALVES FOR PRESSURE EQUAL TO OR EXCEEDING 40 Kg/Cm2.

FOR TENDER PURPOSE ONLY

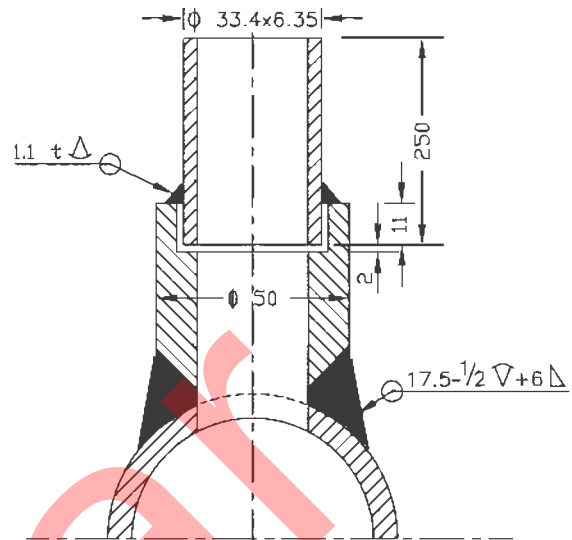
|                                                                                                                                                                                                                                                        |             |    |        |       |   |   |   |     |       |       |      |      |       |          |                    |          |   |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|----|--------|-------|---|---|---|-----|-------|-------|------|------|-------|----------|--------------------|----------|---|
| <div style="display: flex; justify-content: space-between; align-items: center;"> <div> <p>प्रा. टी. पी. सी.<br/><b>NTPC</b></p> </div> <div> <p><b>NTPC LIMITED</b><br/>(A GOVERNMENT OF INDIA ENTERPRISE)<br/>ENGINEERING DIVISION</p> </div> </div> |             |    |        |       |   |   |   |     |       |       |      |      |       |          |                    |          |   |
| PROJECT TYPICAL THERMAL POWER PROJECT                                                                                                                                                                                                                  |             |    |        |       |   |   |   |     |       |       |      |      |       |          |                    |          |   |
| TITLE INSTRUMENT SOURCE CONNECTION DETAILS                                                                                                                                                                                                             |             |    |        |       |   |   |   |     |       |       |      |      |       |          |                    |          |   |
| A                                                                                                                                                                                                                                                      | FIRST ISSUE | DR | DESIGN | CHKD. | M | E | C | CLT | ARCH. | APPD. | DATE | SIZE | SCALE | DRG. NO. | 0000-999-POI-A-035 | REV. NO. | A |
| REV. NO.                                                                                                                                                                                                                                               | DESCRIPTION | DR | DESIGN | CHKD. | M | E | C | CLT | ARCH. | APPD. | DATE | SIZE | SCALE | DRG. NO. | 0000-999-POI-A-035 | REV. NO. | A |

## PRESSURE MEASUREMENT

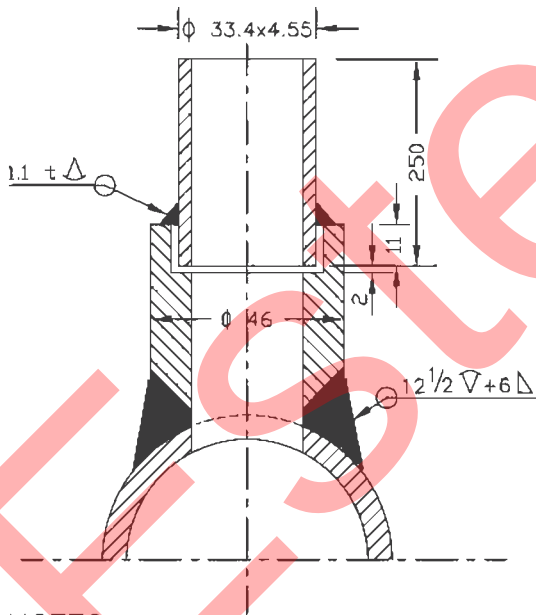
(SYSTEM PR. >40Kg/Sq Cm CL 9000)



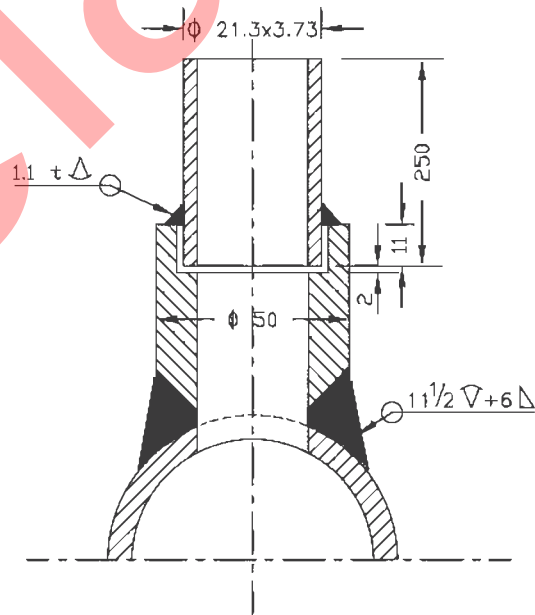
(SYSTEM PR. >40Kg/Sq Cm CL 6000)



(SYSTEM PR. <40Kg/Sq cm Nb 25 CL 3000)



(SYSTEM PR. <40Kg/Sq cm Nb 15 CL 3000)



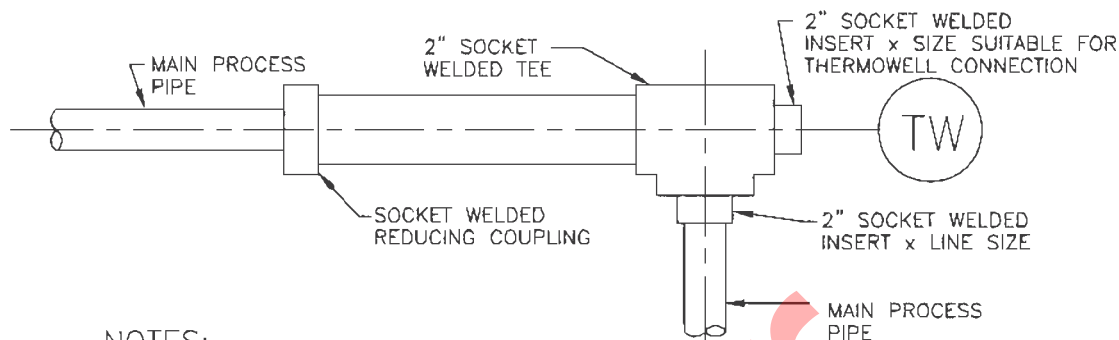
### NOTES:-

1. MATERIAL OF THE BOSS AND NIPPLE SHALL BE THE SAME AS THE PIPE INTO WHICH IT IS WELDED AND CONFIRM TO ANSI B 16.11.
2. THE LENGTH OF THE NIPPLE SHOULD BE 250mm.
3. THE OTHER END OF THE NIPPLE SHALL BE SOCKET WELDED WITH 1" GLOBE VALVE OF MATERIAL AS PER ANSI B 16.1.
4. TWO ISOLATED VALVES ARE TO BE USED FOR PRESSURE = >40 Kg/Cm2.
5. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY (1/64" RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES.
6. ORIENTATION OF TAP WILL BE VARY WITH TYPE OF PROCESS FLUID AND NATURE OF RUN OF THE PIPE.
7. ACTIVITIES TO BE COMPLETED AT THE SHOP, WELD THE COUPLING (OR BOSS) ON THE PIPE AND DRILL PRESSURE CONNECTION HOLE (SAME AS I D OF NIPPLE) IN THE PIPE IN ALIGNMENT WITH HOLE IN THE COUPLING.
8. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE STATED.

FOR TENDER PURPOSE ONLY

|                                                                                                                                                                                                                                                                                                                                                                 |             |       |        |         |            |        |                    |       |          |   |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-------|--------|---------|------------|--------|--------------------|-------|----------|---|
| <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="border: 1px solid black; padding: 2px; text-align: center;"> <b>एन टी सी</b><br/> <b>NTPC</b> </div> <div style="text-align: center;"> <b>NTPC LIMITED</b><br/> <small>( A GOVERNMENT OF INDIA ENTERPRISE )</small><br/> <b>ENGINEERING DIVISION</b> </div> </div> |             |       |        |         |            |        |                    |       |          |   |
| <b>PROJECT</b> TYPICAL THERMAL POWER PROJECT                                                                                                                                                                                                                                                                                                                    |             |       |        |         |            |        |                    |       |          |   |
| <b>TITLE</b> INSTRUMENT SOURCE CONNECTION DETAILS                                                                                                                                                                                                                                                                                                               |             |       |        |         |            |        |                    |       |          |   |
| A                                                                                                                                                                                                                                                                                                                                                               | FIRST ISSUE |       | T.G.   | 9-08-10 |            |        |                    |       |          |   |
| REV. NO.                                                                                                                                                                                                                                                                                                                                                        | DESCRIPTION | DRAWN | DESIGN | CHKD.   | M          | E      | C                  | C&I   | ARCH.    |   |
|                                                                                                                                                                                                                                                                                                                                                                 |             |       |        |         | APPD.      | DATE   | SIZE               | SCALE | DRG. NO. |   |
|                                                                                                                                                                                                                                                                                                                                                                 |             |       |        |         | 400 A4     | N.T.S. | 0000-999-POI-A-035 |       | REV. NO. |   |
|                                                                                                                                                                                                                                                                                                                                                                 |             |       |        |         | Sh-2 Of 14 |        |                    |       |          | A |

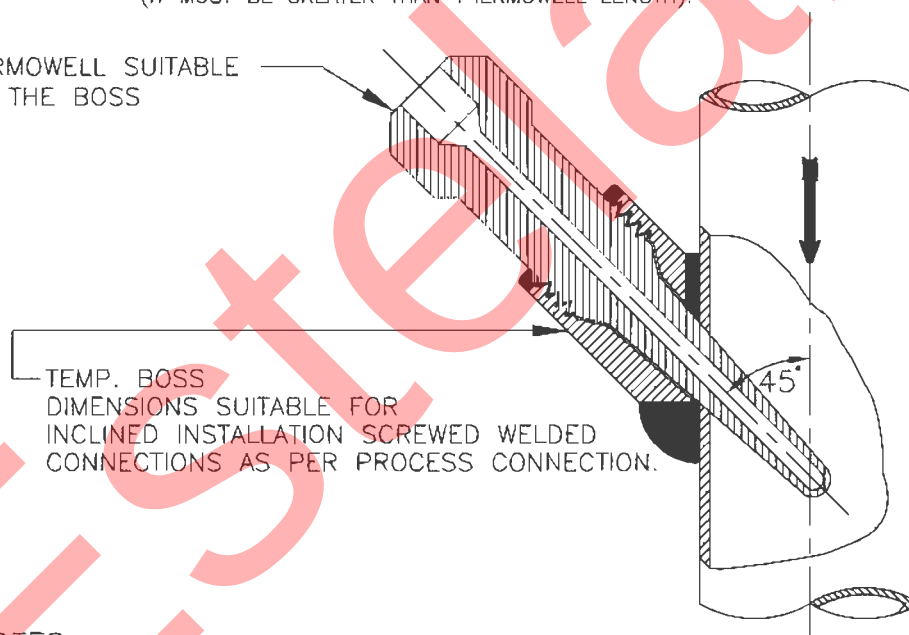
## TEMP. MEASUREMENT



### NOTES:-

1. THIS TYPE OF THERMOWELL INSTALLATION IS SUITABLE FOR THE PROCESS PIPE OF 2" NPS AND SMALLER.
2. FOR STEAM SERVICE THIS TYPE OF THERMOWELL INSTALLATION 90° BEND MAY BE USED ONLY IN VERTICAL PLANE.
3. THE LENGTH OF THE LARGER PIPE SECTION SHALL BE MINIMUM 150mm (IT MUST BE GREATER THAN THERMOWELL LENGTH).

THERMOWELL SUITABLE FOR THE BOSS



TEMP. BOSS DIMENSIONS SUITABLE FOR INCLINED INSTALLATION SCREWED WELDED CONNECTIONS AS PER PROCESS CONNECTION.

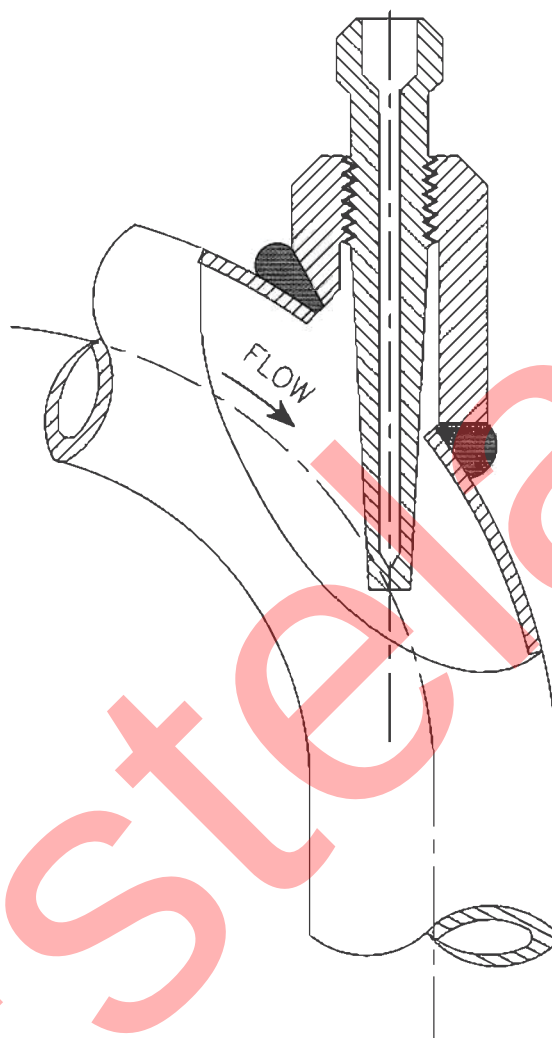
### NOTES:-

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 MAY BE USED ONLY IN VERTICAL RUN.
5. THE EXPANDER SECTION SHALL BE OF ADEQUATE LENGTH (ATLEAST 3-4 TIMES DIA OF THE MAIN PROCESS PIPE AT BOTH SIDE OF THE INSTALLED THERMOWELL).

FOR TENDER PURPOSE ONLY

|                                                                                                                                                                                                                                                                                                                                   |             |       |        |       |   |   |   |     |       |       |      |        |        |                        |          |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------|-------|--------|-------|---|---|---|-----|-------|-------|------|--------|--------|------------------------|----------|
| <div style="display: flex; justify-content: space-between; align-items: center;"> <div> <p><b>NTPC LIMITED</b><br/>( A GOVERNMENT OF INDIA ENTERPRISE )<br/>ENGINEERING DIVISION</p> </div> <div> <p>PROJECT: TYPICAL THERMAL POWER PROJECT<br/>(SG PACKAGE)</p> <p>TITLE: INSTRUMENT SOURCE CONNECTION DETAILS</p> </div> </div> |             |       |        |       |   |   |   |     |       |       |      |        |        |                        |          |
| REV. NO.                                                                                                                                                                                                                                                                                                                          | DESCRIPTION | DRAWN | DESIGN | CHKD. | M | E | C | CBT | ARCH. | APPD. | DATE | SIZE   | SCALE  | DRG. NO.               | REV. NO. |
| A                                                                                                                                                                                                                                                                                                                                 | FIRST ISSUE |       |        |       |   |   |   |     |       |       |      | 400 A4 | N.T.S. | 0000-999/102-POI-A-035 | A        |

# TEMP. MEASUREMENT



## NOTES:-

1. FLOW INSTALLATION OF THERMOWELL SHALL BE APPLICABLE FOR 4" AND SMALLER LINE SIZE BUT LIMITED TO MINIMUM 3" LINE SIZE.
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 MAY BE USED FOR LIQUID SERVICES. ONLY STEAM SERVICES EXPANDER SECTION MAY BE USED IN VERTICAL PLAN.

FOR TENDER PURPOSE ONLY

|                                                                                                                                                                                                                                                                                                                                                                                 |             |                             |        |            |   |            |   |     |                  |
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| <div style="display: flex; justify-content: space-between; align-items: center;"> <div style="text-align: center;">  <p><b>NTPC</b></p> </div> <div style="text-align: center;"> <p><b>NTPC LIMITED</b><br/>( A GOVERNMENT OF INDIA ENTERPRISE )<br/>ENGINEERING DIVISION</p> </div> </div> |             |                             |        |            |   |            |   |     |                  |
| PROJECT TYPICAL THERMAL POWER PROJECT                                                                                                                                                                                                                                                                                                                                           |             |                             |        |            |   |            |   |     |                  |
| TITLE INSTRUMENT SOURCE CONNECTION DETAILS                                                                                                                                                                                                                                                                                                                                      |             |                             |        |            |   |            |   |     |                  |
| A                                                                                                                                                                                                                                                                                                                                                                               | FIRST ISSUE |                             |        |            |   |            |   |     |                  |
| REV. NO.                                                                                                                                                                                                                                                                                                                                                                        | DESCRIPTION | DRAWN                       | DESIGN | CHKD.      | M | E          | C | CLT | ARCH. APPD. DATE |
|                                                                                                                                                                                                                                                                                                                                                                                 |             |                             |        |            |   |            |   |     |                  |
| Cleared by Page 269 of 400 A4                                                                                                                                                                                                                                                                                                                                                   |             |                             |        |            |   |            |   |     |                  |
| SCALE N.T.S.                                                                                                                                                                                                                                                                                                                                                                    |             | DRG. NO. 0000-999-POI-A-035 |        | REV. NO. A |   | Sh-5 of 14 |   |     |                  |

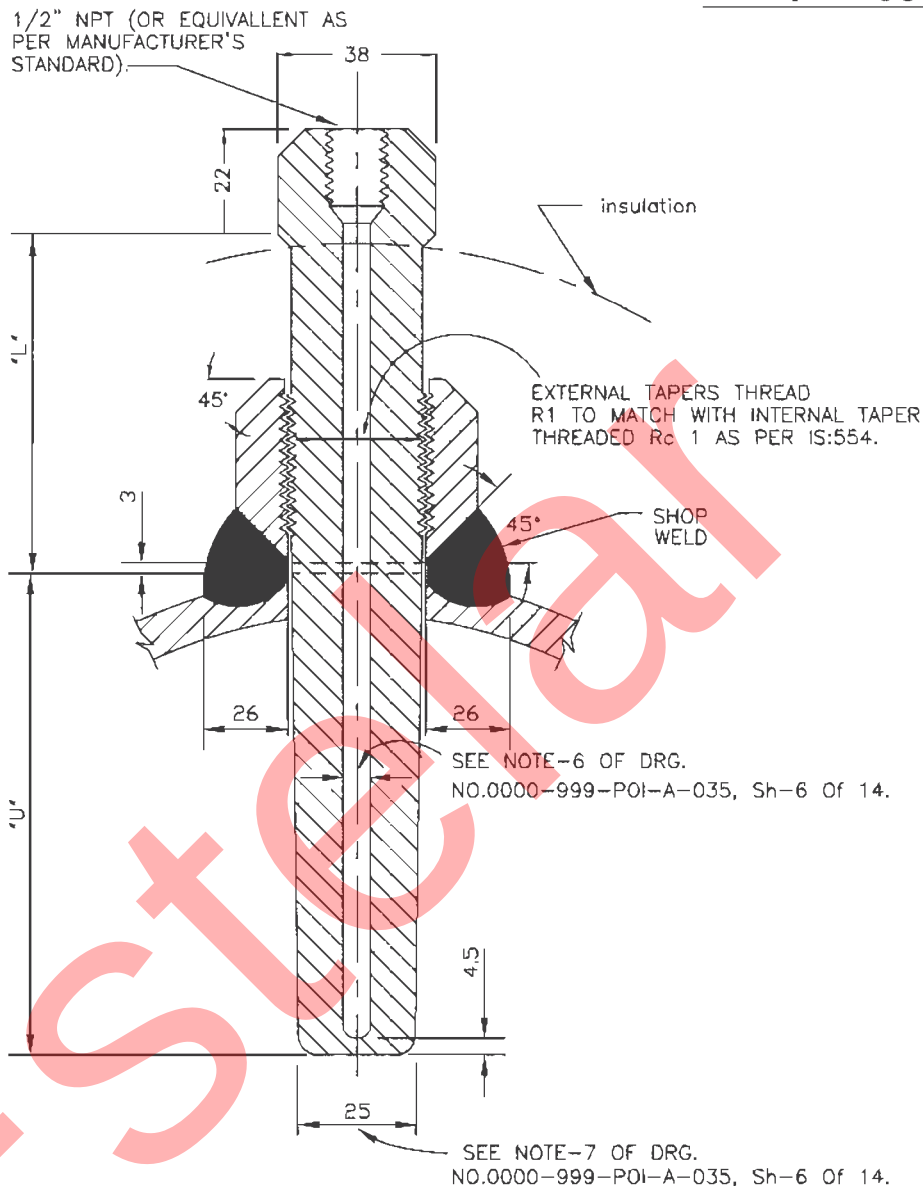


1. THIS TYPE OF TEMPERATURE BOSS SHALL BE USED FOR THE PROCESS PRESS EQUAL/ABOVE 40 Kg/Cm2(g).
2. THE MATERIAL OF THE BOSS SHOULD BE SIMILAR TO THAT OF PIPING MATERIAL OF SPECIFICATION.
3. ALL WELD TO BE TESTED IN ACCORDANCE WITH APPLICABLE CODES BY MANUFACTURER.
4. MATERIAL OF THE THERMOWELL SHALL BE OF 316SS.
5. THERMOWELL SHALL BE DRILLED BARSTOCK TYPE.
6. INTERNAL BORE OF THE THERMOWELL SHALL BE SELECTED BASED ON THE NORMAL SIZE OF THE SENSING ELEMENT AS PER ASME,PTC-19.3.
7. THE BOTTOM DIAMETER OF THE THERMOWELL TYPICALLY SHOWN HERE SHALL BE SUBJECT TO VARIATION BASED ON THE INTERNAL BORE OF THERMOWELL AND THICKNESS OF THERMOWELL MATERIAL TO WITHSTAND THE PROCESS PRESS.AND TEMP.,AS PER ASME,PTC-19.3
8. THE TYPE OF TAPERED THERMOWELL SHALL BE USED FOR LIQUID VELOCITIES UP TO 92M.P.S.(300F.T.P.S.).
9. THERMOWELL WITH THE INSULATION LAG EXTENSIONS SHALL BE USED WHEREVER APPLICABLE.
10. ACTIVITIES TO BE COMPLETED AT THE SHOP. WELD THE BOSS ON THE PIPE AND DRILL THE HOLE IN THE PIPE IN ALIGNMENT WITH HOLE IN THE BOSS. PROVIDE INTERNAL THREAD AS PER IS:554 TO MATCH WITH THE THERMOWELL EXTERNAL THREAD.
11. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE STATED.
12. WILL BE SUITABLE TO MATCH THE STUB DIMENSIONS AS PER RC 1 1/2
13. THE "U" & "L" DIMENSIONS SHALL BE SELECTED BASED ON PARTICULAR APPLICATION AND THE SAME SHALL BE SUBJECT TO OWNER'S APPROVAL DURING DETAILED ENGINEERING.
14. ALL DIMENSIONS ARE INDICATIVE ONLY.

FOR TENDER PURPOSE ONLY

|          |             |  |  |                                                                                     |        |       |   |      |   |                                                                                                                                                                                 |       |                                      |       |            |                    |          |   |
|----------|-------------|--|--|-------------------------------------------------------------------------------------|--------|-------|---|------|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|--------------------------------------|-------|------------|--------------------|----------|---|
|          |             |  |  |                                                                                     |        |       |   |      |   |  <b>NTPC LIMITED</b><br>( A GOVERNMENT OF INDIA ENTERPRISE )<br><b>ENGINEERING DIVISION</b> |       |                                      |       |            |                    |          |   |
|          |             |  |  |                                                                                     |        |       |   |      |   | PROJECT                                                                                                                                                                         |       | TYPICAL THERMAL POWER PROJECT        |       |            |                    |          |   |
|          |             |  |  |                                                                                     |        |       |   |      |   | TITLE                                                                                                                                                                           |       | INSTRUMENT SOURCE CONNECTION DETAILS |       |            |                    |          |   |
| A        | FIRST ISSUE |  |  |  |        |       |   | T.G. |   | 31.08.15                                                                                                                                                                        |       |                                      |       |            |                    |          |   |
| REV. NO. | DESCRIPTION |  |  | DRAWN                                                                               | DESIGN | CHKD. | M | E    | C | CMT                                                                                                                                                                             | ARCH. | APFD.                                | DATE  |            |                    |          |   |
| Cleared  |             |  |  |                                                                                     |        |       |   |      |   | Page 270 of 400 A4                                                                                                                                                              |       | SIZE                                 | SCALE | DRG. NO.   | 0000-999-POI-A-035 | REV. NO. | A |
|          |             |  |  |                                                                                     |        |       |   |      |   |                                                                                                                                                                                 |       | N.T.S.                               |       | Sh-6 of 14 |                    |          |   |

# TEMP. MEASUREMENT

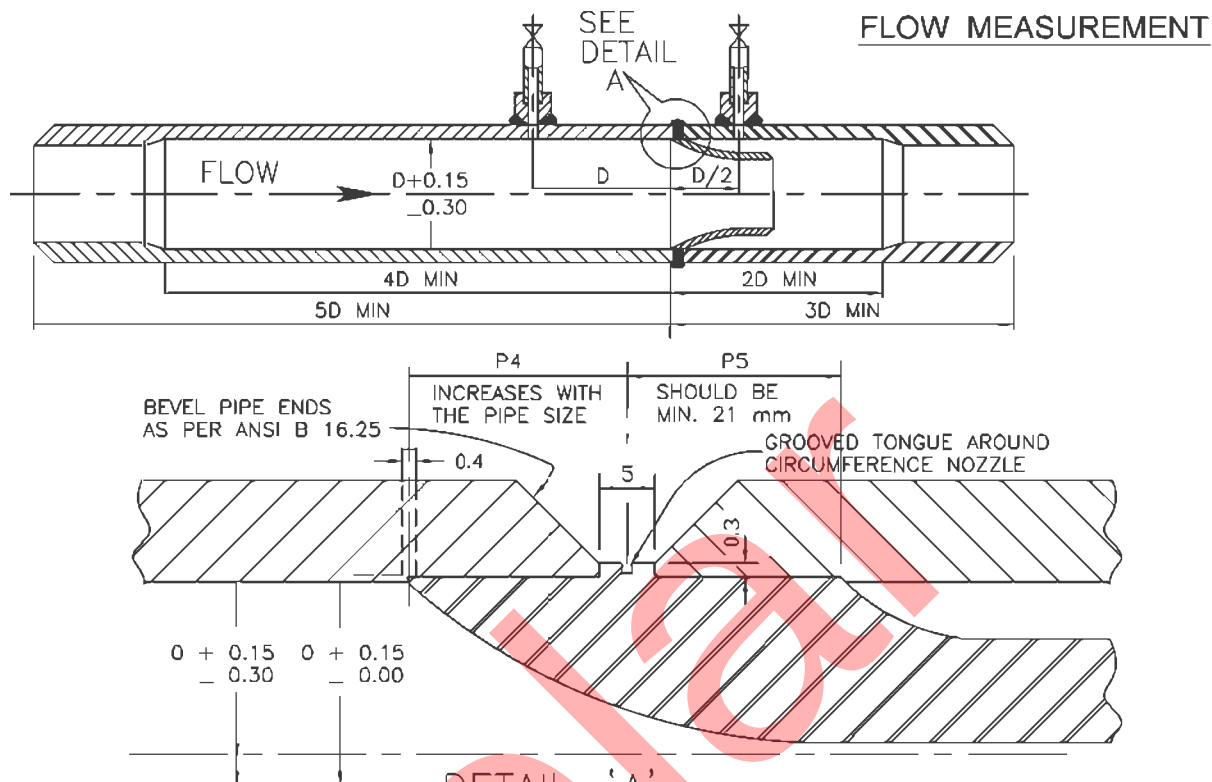


## NOTES:-

1. THIS TYPE OF TEMPERATURE BOSS IS APPLICABLE FOR THE PROCESS PRESSURE/TEMPERATURE BELOW 40 Kg/Cm2(g)/400°C
2. FOR PRESSURE 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. PIPES HAVING PROBABILITY OF PROLONGED VIBRATION SEAL WELDING MAY BE DONE ALL AROUND AFTER TIGHTENING THERMOWELL WITHIN THE BOSS.
4. SEE NOTES-2 TO 14 OF DRG. NO. 0000-999-POI-A-035, Sh-6 Of 14.

FOR TENDER PURPOSE ONLY

|                                                                                                                                                                                                                                                                   |             |       |        |       |   |   |   |     |       |       |      |        |        |                    |          |
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| <div style="display: flex; justify-content: space-between; align-items: center;"> <div> <p>एन टी पी सी लिमिटेड</p> <p><b>NTPC</b></p> </div> <div> <p><b>NTPC LIMITED</b></p> <p>(A GOVERNMENT OF INDIA ENTERPRISE)</p> <p>ENGINEERING DIVISION</p> </div> </div> |             |       |        |       |   |   |   |     |       |       |      |        |        |                    |          |
| PROJECT TYPICAL THERMAL POWER PROJECT                                                                                                                                                                                                                             |             |       |        |       |   |   |   |     |       |       |      |        |        |                    |          |
| TITLE INSTRUMENT SOURCE CONNECTION DETAILS                                                                                                                                                                                                                        |             |       |        |       |   |   |   |     |       |       |      |        |        |                    |          |
| REV. NO.                                                                                                                                                                                                                                                          | DESCRIPTION | DRAWN | DESIGN | CHKD. | M | E | C | CBT | ARCH. | APPD. | DATE | SIZE   | SCALE  | DRG. NO.           | REV. NO. |
| A                                                                                                                                                                                                                                                                 | FIRST ISSUE |       |        |       |   |   |   |     |       |       |      | 400 A4 | N.T.S. | 0000-999-POI-A-035 | A        |



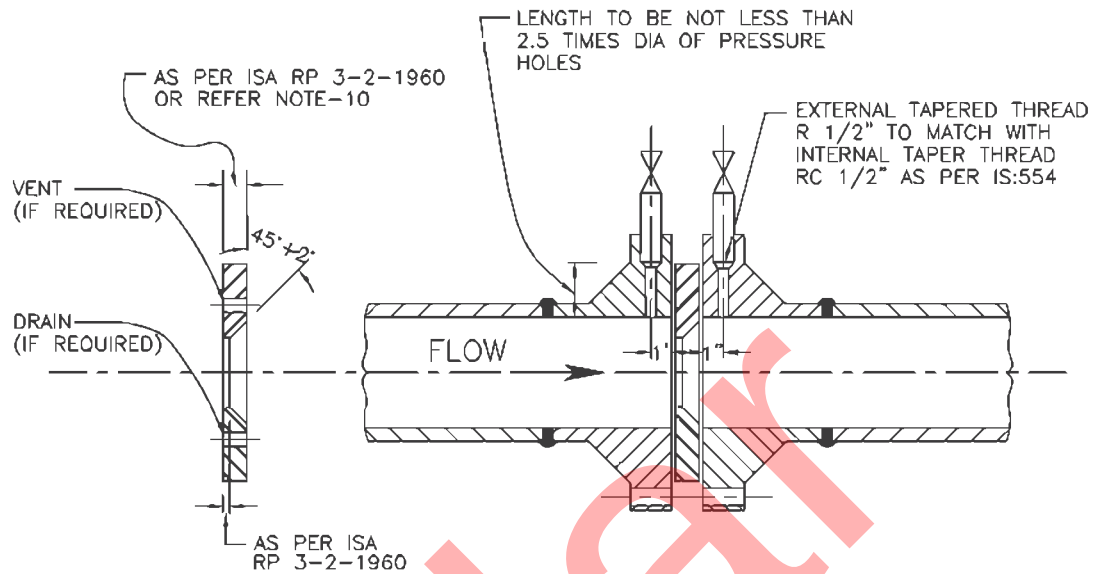
**NOTES:—**

1. COMPLETE FLOW NOZZLE BRANCH ASSEMBLY ALONG WITH NIPPLES AND SOURCE ISOLATION VALVES SHALL BE SUPPLIED BY THE BIDDER. THE BIDDER ALSO TO INSTALL FLOW NOZZLE WITHIN THE MACHINED BRANCH, PRESSURE STUBS ON THE BRANCH PIPE (FOR ORIENTATION OF PRESSURE TAP REF. NOTE-3) ALONG WITH NIPPLE AND SOURCE ISOLATION VALVES.
2. THE MACHINING OF BRANCH PIPE SHOULD BE DONE AFTER PRESSURE CONNECTIONS HAVE BEEN WELDED TO PIPE AND ALSO EXTEND FOR ATLEAST 4D IN THE INLET SECTION, 2D IN THE OUTLET SECTION, MEASURED FROM THE INLET FACE OF FLOW NOZZLE. TOTAL BRANCH PIPE ASSEMBLY SHOULD BE ATLEAST A LENGTH OF 8D/5D IN THE INLET SECTION AND 3D IN THE OUTLET SECTION, MEASURED FROM THE INLET FACE OF THE FLOW NOZZLE AS SHOWN ABOVE.
3. ON HORIZONTAL PIPE RUN PRESSURE CONNECTIONS ARE TO BE LOCATED ON SIDES OF THE PIPE FOR LIQUID AND STEAM SERVICE AND ON THE TOP FOR DRY GAS SERVICE FOR PROCESS LIQUIDS, INSTALLATION OF PRESS. TAPS MAY BE ALLOWED WITHIN AN ANGLE OF 45° ELBOW HORIZONTAL FOR SPECIAL CASES BUT NO BOTTOM CONNECTIONS ARE ALLOWED.
4. THE LOCATION OF PRESSURE TAPS MUST BE WITHIN 1.5 mm (1/16") OF DISTANCE SPECIFIED AND NUMBER OF PAIRS OF PRESSURE TAPS TO BE PROVIDED WILL BE AS PER FLOW MEASUREMENT DATA SHEET.
5. PRESSURE TAPS SHOULD BE DRILLED RADIALLY WITH RESPECT TO PIPE AND THIS DRILLING SHOULD BE DONE AFTER ANY COUPLING FOR ATTACHING THE PRESSURE TUBING HAS BEEN WELDED TO THE PIPE. THE HOLE WHERE IT BREAKS THROUGH THE INNER SURFACE OF THE PIPE MUST BE FREE OF BURRS OR WIRE EDGE AND CORNER OF EDGE HOLE LEFT ROUNDED VERY SLIGHTLY (1/64" RADIUS).
6. RECOMMENDED MAXIMUM DIAMETERS OF PRESSURE TAP HOLES IN THE BRANCH PIPES WILL BE AS PER EN ISO 5167:2003. THE DIAMETER FOR HOLE SHOULD REMAIN SAME FOR DISTANCE NOT LESS THAN 2.5 TIME OF DIA FROM THE INNER SURFACE OF THE PIPE.
7. FLOW NOZZLE SHALL BE CENTRED IN THE PIPE WITHIN 0.8 mm (1/32") OF THE PIPE AXIS. INSIDE DIAMETER MEASURED AT FOUR POINTS AT ANY CROSS SECTION SHALL NOT DIFFER BY MORE THAN 1%.
8. BRANCH PIPE SHALL BE AS PER MAIN PIPING MATERIAL SPECIFICATION. INTERNAL SURFACE OF BORED SECTIONS MUST BE SMOOTH AND STRAIGHT, FREE FROM SCALES, PITS, BURRS OR ANY IRREGULARITIES.
9. FLOW NOZZLE MATERIAL SHALL BE 316 SS AND THE DESIGN AS PER ASME.
10. MAXIMUM UPSTREAM AND DOWN STREAM STRAIGHT LENGTH REQUIRED FROM INLET FACE OF FLOW NOZZLE SHALL BE AS PER EN ISO 5167:2003.

**FOR TENDER PURPOSE ONLY**

|                                                                                   |             |       |        |      |   |   |   |     |            |
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| <b>NTPC LIMITED</b><br>(A GOVERNMENT OF INDIA ENTERPRISE)<br>ENGINEERING DIVISION |             |       |        |      |   |   |   |     |            |
| <b>PROJECT</b> TYPICAL THERMAL POWER PROJECT                                      |             |       |        |      |   |   |   |     |            |
| <b>TITLE</b> INSTRUMENT SOURCE CONNECTION DETAILS                                 |             |       |        |      |   |   |   |     |            |
| REV. NO.                                                                          | DESCRIPTION | DRAWN | DESIGN | CHD. | M | C | G | CHK | APPD. DATE |
| A                                                                                 | FIRST ISSUE |       |        |      |   |   |   |     | 21-06-19   |
| SIZE 400 A4 SCALE N.T.S. DRG. NO. 0000-999-POI-A-035 REV. NO. A                   |             |       |        |      |   |   |   |     |            |

## FLOW MEASUREMENT

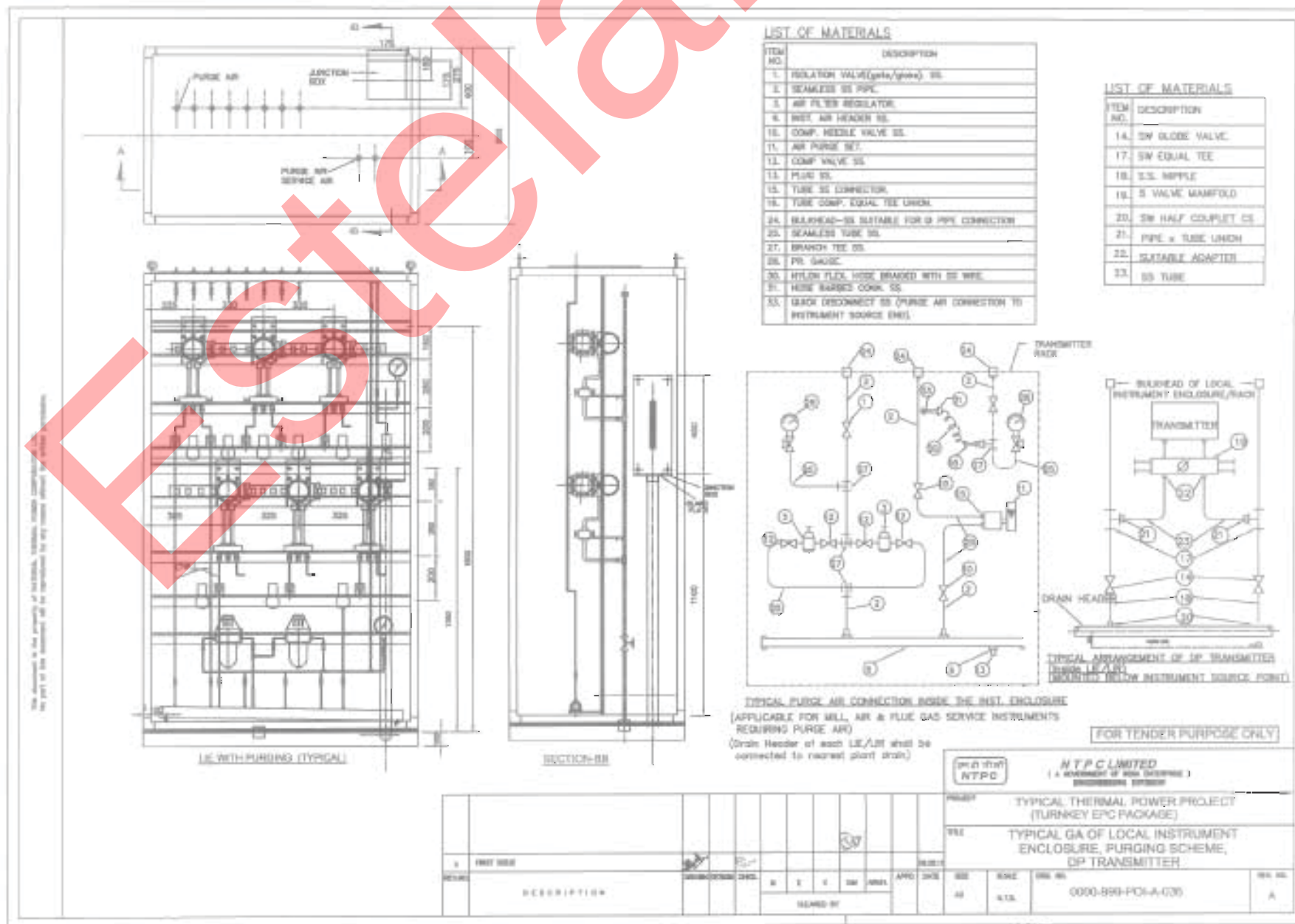


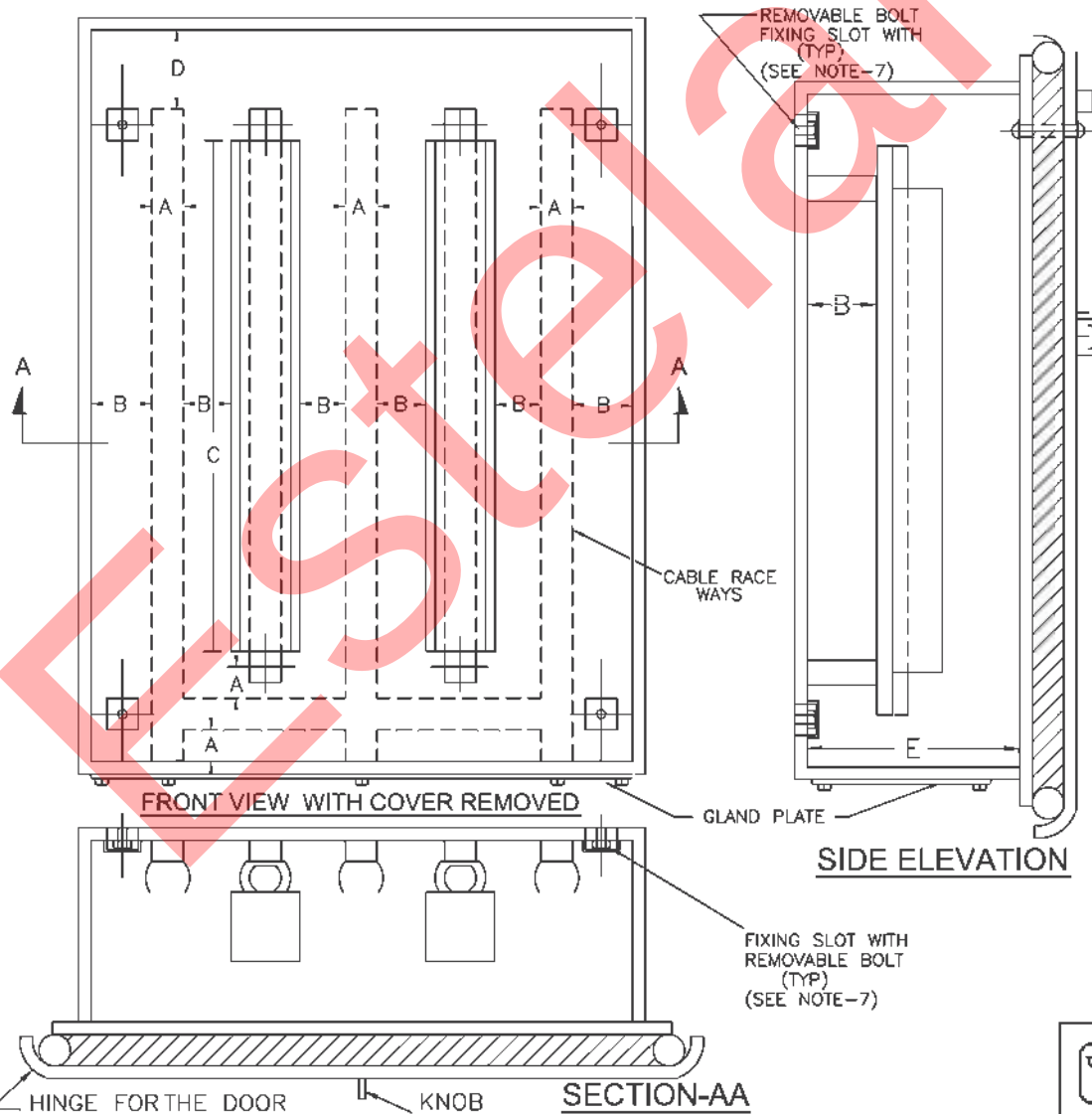
### NOTES:-

- ORIFICE PLATE MOUNTED BETWEEN FLANGES WITH FLANGE TAPPING (AS SHOWN ABOVE) SHOULD BE LIMITED TO PIPE SIZES OF 2" OR LARGER.
- ORIFICE PLATE SHALL BE MOUNTED BETWEEN PIPING FLANGES WITH THE SHARP EDGE FACING UPSTREAM SUCH THAT CENTRE OF THE CONCENTRIC ORIFICE SHOULD BE WITHIN 0.79 mm (1/32") OF THE AXIS OF THE PIPE.
- TWO GASKETS SHALL BE INSERTED BETWEEN THE PLATE AND THE FLANGES AND INSIDE DIAMETER OF THE GASKETS SHOULD BE ATLEAST 1.5 mm (1/16") GREATER THAN THE INSIDE DIAMETER OF THE PIPE SO THAT THEY DO NOT PROTRUDE INTO THE PIPE.
- PIPING FLANGES SHALL BE ANSI WELD NECK, RAISED FACE TYPE. THE FLANGE IS TO BE ALIGNED WITH THE FACE PERPENDICULAR TO THE FLOW AXIS.
- BIDDER TO SUPPLY ORIFICE PLATE SPECIAL TYPE (HAVING PRESS. CONNECTIONS) OF FLANGES ALONG WITH GASKETS, NIPPLES AND SOURCE VALVES.
- ON HORIZONTAL PIPE RUN PRESSURE CONNECTIONS ARE TO BE TAKEN FROM SIDES FOR LIQUID AND STEAM SERVICE AND FROM TOP FOR DRY GAS SERVICE. FOR PROCESS LIQUIDS INSTALLATION OF PRESSURE TAPS MAY BE ALLOWED WITHIN AN ANGLE OF 45° ELBOW THE HORIZONTAL IN SPECIAL CASES BUT NO BOTTOM CONNECTIONS ARE ALLOWED. THE LOCATION OF PRESSURE TAPS MUST BE WITHIN 1.5 mm (1/16") OF THE DISTANCE SPECIFIED.
- MAXIMUM DIAMETER OF PRESS. CONNECTION HOLES SHALL BE AS PER RECOMMENDATIONS OF ASME PTC 19.5. THE DIAMETER OF THE HOLE SHOULD REMAIN THE SAME FOR A DISTANCE NOT LESS THAN 2.5 TIMES OF THE DIAMETER BEFORE EXPANDING INTO THE PRESSURE PIPE.
- THERE MUST BE NO BURRS WIRE EDGES OR OTHER IRREGULARITIES ALONG THE EDGE OF THE HOLE AND IT MUST BE SQUARE AND ROUNDED SLIGHTLY (1/64" RADIUS).
- ORIFICE PLATE SHOULD BE FLAT WITHIN 0.02 mm (0.001") AND THE SURFACE ROUGHNESS SHOULD NOT EXCEED 20 MICRO INCH. THE THICKNESS OF THE ORIFICE PLATE SHOULD BE AS PER EN ISO 5167:2003.
- FOR HORIZONTAL PIPE RUN DRAIN HOLES IN ORIFICE PLATES ARE AT THE BOTTOM (APPROX. TANGENT TO INSIDE DIA OF PIPE) FOR STEAM OR GAS SERVICE. VENT HOLES SHOULD BE LOCATED ON UPPER SIDE FOR INCOMPRESSIBLE FLUID.
- ORIFICE PLATE SHOULD BE OF 316 SS (ASTM A167-54 GRADE-II).
- RECOMMENDED MINIMUM LENGTHS OF STRAIGHT PIPE PRECEDING AND FOLLOWING ORIFICES SHALL BE AS PER EN ISO 5167:2003.
- THREE PAIRS OF PRESSURE TAPS SHALL BE PROVIDED WITH NIPPLES OF REQUIRED LENGTH AND SOURCE VALVES AND THE UN-USED TAPS ARE PLUGGED.
- THE INTERNAL TAPERED CONNECTION WITHIN THE FLANGE FOR PRESSURE TAPS SHOULD BE RC 1/2" AND THE NIPPLE SHOULD ALSO OF EXTERNAL THREADED R 1/2" AS PER IS:554. THE LENGTH OF THREADED ENGAGEMENT SHALL BE AS PER ABOVE STANDARD.

FOR TENDER PURPOSE ONLY

|                                                                                                                                                                                                                                                  |             |       |        |      |   |   |   |     |            |
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| <div style="display: flex; justify-content: space-between; align-items: center;"> <div> <p>एन टी पी सी<br/><b>NTPC</b></p> </div> <div> <p><b>NTPC LIMITED</b><br/>(A GOVERNMENT OF INDIA ENTERPRISE)<br/>ENGINEERING DIVISION</p> </div> </div> |             |       |        |      |   |   |   |     |            |
| PROJECT <b>TYPICAL THERMAL POWER PROJECT</b>                                                                                                                                                                                                     |             |       |        |      |   |   |   |     |            |
| TITLE <b>INSTRUMENT SOURCE CONNECTION DETAILS</b>                                                                                                                                                                                                |             |       |        |      |   |   |   |     |            |
| A                                                                                                                                                                                                                                                | FIRST ISSUE |       |        |      |   |   |   |     |            |
| REV. NO.                                                                                                                                                                                                                                         | DESCRIPTION | DRAWN | DESIGN | CHD. | M | C | C | CHK | APPD. DATE |
| <div style="display: flex; justify-content: space-between;"> <div> <p>SIZE <b>400 A4</b></p> <p>SCALE <b>N.T.S.</b></p> </div> <div> <p>DWG. NO. <b>0000-999-POI-A-035</b></p> </div> <div> <p>REV. NO. <b>A</b></p> </div> </div>               |             |       |        |      |   |   |   |     |            |





FOR TENDER PURPOSE ONLY



**NTPC LIMITED**  
( A GOVERNMENT OF INDIA ENTERPRISE )  
ENGINEERING DIVISION

|                             |  |  |  |        |  |  |  |                    |  |  |  |          |  |  |  |
|-----------------------------|--|--|--|--------|--|--|--|--------------------|--|--|--|----------|--|--|--|
| PROJECT                     |  |  |  |        |  |  |  |                    |  |  |  |          |  |  |  |
| TYPICAL THERMAL POWER PLANT |  |  |  |        |  |  |  |                    |  |  |  |          |  |  |  |
| TITLE                       |  |  |  |        |  |  |  |                    |  |  |  |          |  |  |  |
| G.A. OF JUNCTION BOX        |  |  |  |        |  |  |  |                    |  |  |  |          |  |  |  |
|                             |  |  |  |        |  |  |  |                    |  |  |  |          |  |  |  |
| SIZE                        |  |  |  | SCALE  |  |  |  | DRG. NO.           |  |  |  | REV. NO. |  |  |  |
| A4                          |  |  |  | N.T.S. |  |  |  | 0000-999-POI-A-017 |  |  |  | D        |  |  |  |

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|--|------------------------------------------------------------------------|--|
|  | <b>NTPC FGD PACKAGES-<br/>LOT-1A, 2 &amp; 3</b>                        |  |
|  | <b>C &amp; I TECHNICAL SPECIFICATION<br/>FOR COMPRESSED AIR SYSTEM</b> |  |

**QUALITY ASSURANCE FOR  
INSTRUMENTS**

| CLAUSE NO. | TECHNICAL REQUIREMENTS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|            | <p style="text-align: center;"><b>TYPE TEST REQUIREMENTS</b></p> <p><b>1.00.00 TYPE TEST REQUIREMENTS</b></p> <p><b>1.01.00 General Requirements</b></p> <p><b>1.01.01</b> The 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&amp;I SYSTEMS' at the end of this chapter and under the item Special Requirement for Solid State Equipments/Systems. For the balance equipment instrument, type tests may be conducted as per manufactures standard or if required by relevant standard.</p> <p>(a) Out of the tests listed, the Bidder/ sub-vendor/ manufacturer is required to conduct certain type tests specifically for this contract (and witnessed by Employer or his authorized representative) even if the same had been conducted earlier, as clearly indicated subsequently against such tests.</p> <p>(b) For the rest, submission of type test results and certificate shall be acceptable provided.</p> <p>i. The same has been carried out by the Bidder/ sub-vendor on exactly the same model /rating of equipment.</p> <p>ii. There has been no change in the components from the offered equipment &amp; tested equipment.</p> <p>iii. The test has been carried out as per the latest standards alongwith amendments as on the date of Bid opening but not more than five (5) year back.</p> <p>(c) In case the approved equipment is different from the one on which the type test had been conducted earlier or any of the above grounds, then the tests have to be repeated and the cost of such tests shall be borne by the Bidder/ sub-vendor within the quoted price and no extra cost will be payable by the Employer on this account.</p> <p><b>1.01.02</b> As mentioned against certain items, the test certificates for some of the items shall be reviewed and approved by the main Bidder or his authorized representative and the balance have to be approved by the Employer.</p> <p><b>1.01.03</b> The schedule of conduction of type tests/ submission of reports shall be submitted and finalized during pre-award discussion.</p> |

| CLAUSE NO. | <div data-bbox="623 100 1013 132" data-label="Page-Header">           TECHNICAL REQUIREMENTS         </div> <div data-bbox="1273 86 1414 155" data-label="Page-Header">  </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1.01.04    | <p>For the type tests to be conducted, Contractor shall submit detailed test procedure for approval by Employer. 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.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 1.01.05    | <p>The Bidder shall indicate in the relevant BPS schedule, the cost of the type test for each item only for which type tests are to be conducted specifically for this project. The cost shall only be payable after conduction of the respective test in presence of authorize representative of Employer. If a test is waived off, then the cost shall not be payable.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 2.00.00    | <p><b>SPECIAL REQUIREMENT FOR SOLID STATE EQUIPMENTS/ SYSTEMS</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 2.01.00    | <p>The minimum type test reports, over and above the requirements of above clause, which are to be submitted for each of the major C&amp;I systems Analyzer instruments, various PLCs etc. shall be as indicated below:</p> <ul style="list-style-type: none"> <li>i) Surge Protections for Solid State Equipments/ Systems           <p>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 &amp; output modules, Binary input &amp; 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 alongwith the proposal. As an alternative to above, suitable class of IEC-60255-4 which is equivalent to ANSI 37.90a/ IEEE-472 may also be adopted for SWC test.</p> </li> <li>ii) Dry Heat test as per IEC-68-2-2 or equivalent.</li> <li>iii) Damp Heat test as per IEC-68-2-3 or equivalent.</li> <li>iv) Vibration test as per IEC-68-2-6 or equivalent.</li> <li>v) Electrostatic discharge tests as per IEC 61000-4-2 or equivalent.</li> <li>vi) Radio frequency immunity test as per EN 50082-2 or equivalent.</li> </ul> |

| CLAUSE NO. | TECHNICAL REQUIREMENTS                                                                                        |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|            | <p>vii) Electromagnetic immunity as per EN 61131-2 or equivalent.</p> <p>Test listed at item no. v, vi, vii, above are applicable for front end cards only as defined under item (i) above.</p> |

## 3.00.00

## TYPE TEST REQUIREMENT FOR C&amp;I SYSTEMS

| Sl No | Item                                      | Test requirement          | Standard            | Test to be specifically conducted | NTPC's approval req. On test certificate | Remarks |
|-------|-------------------------------------------|---------------------------|---------------------|-----------------------------------|------------------------------------------|---------|
| Col 1 | Col 2                                     | Col 3                     | Col 4               | Col 5                             | Col 6                                    | Col 7   |
| 1     | Elect. Metering instruments               | As per standard (col 4)   | IS-1248             | No                                | Yes                                      |         |
| 2     | Electronic transmitter                    | As per standard (col 4)   | BS-6447 / IEC-60770 | No                                | Yes                                      |         |
| 3     | INSTRUMENTATION CABLES TWISTED & SHIELDED |                           |                     | No                                | Yes                                      |         |
| 4     | Pressure gauge                            | Degree of protection test | IS-2147             | No                                | No                                       |         |
|       |                                           | Temp interference test    | IS -3624            | No                                | No                                       |         |
| 5     | Temperature gauge                         | Degree of protection test | IS-2147             | No                                | No                                       |         |
| 6     | Pressure & DP switch                      | Degree of protection test | IS-2147             | No                                | No                                       |         |
|       |                                           | As per standard (col 4)   | BS 6134             | No                                | No                                       |         |
| 7     | Level switch                              | Degree of protection test | IS-2147             | No                                | No                                       |         |
| 8     | Control valves                            | CV Test                   | ISA 75.02           | No                                | Yes                                      |         |
| 9     | Flow Nozzles & Orifice plate              | Calibration               | ASME PTC , BS 1042  | No                                | Yes                                      |         |
| 10    | PLCs                                      | All tests as per IEC-1131 | IEC-601131          | No                                | Yes                                      |         |

| Sl No | Item                                                | Test requirement                      | Standard                        | Test to be specifically conducted | NTPC's approval req. On test certificate | Remarks |
|-------|-----------------------------------------------------|---------------------------------------|---------------------------------|-----------------------------------|------------------------------------------|---------|
| Col 1 | Col 2                                               | Col 3                                 | Col 4                           | Col 5                             | Col 6                                    | Col 7   |
| 11    | Junction Box                                        | Degree of protection test             | IS-13947                        | No                                | Yes                                      |         |
| 12    | Battery charger (Not required for inbuilt chargers) | Degree of protection test             | IS-13947                        | No                                | No                                       |         |
|       |                                                     | Short circuit current capability      | IEC-60146-2                     | No                                | Yes                                      |         |
|       |                                                     | Temp rise test without redundant fans | Approved procedure, IEC 60146-2 | No                                | Yes                                      |         |
|       |                                                     | SWC test                              | Approved procedure              | No                                | Yes                                      |         |
|       |                                                     | Burn-in-test                          | Approved procedure              | No                                | Yes                                      |         |
|       |                                                     | Efficiency                            | IEC-60146-2,                    | No                                | Yes                                      |         |
|       |                                                     | Audible Noise Test                    | IEC 60146-2                     | No                                | Yes                                      |         |
|       |                                                     | Fuse Clearing Capability              | Approved procedure              | No                                | Yes                                      |         |
|       |                                                     | Relative harmonic content             | Approved procedure              | No                                | Yes                                      |         |

| Sl No | Item                | Test requirement                     | Standard                                                      | Test to be specifically conducted | NTPC's approval req. On test certificate | Remarks |
|-------|---------------------|--------------------------------------|---------------------------------------------------------------|-----------------------------------|------------------------------------------|---------|
| Col 1 | Col 2               | Col 3                                | Col 4                                                         | Col 5                             | Col 6                                    | Col 7   |
|       |                     | ESD immunity test                    | IEC-61000-4-2-9(1)                                            | No                                | Yes                                      |         |
|       |                     | Radio interference                   | IEC 60146-2                                                   | No                                | Yes                                      |         |
|       |                     | Over Load Test on Inverter & charger | Approved procedure                                            | No                                | Yes                                      |         |
|       |                     | Restart Test                         | IEC 60146-2                                                   | No                                | Yes                                      |         |
|       |                     | Output voltage tolerance             | Approved                                                      | No                                | Yes                                      |         |
|       |                     | Output voltage Harmonic content      | Approved procedure                                            | No                                | Yes                                      |         |
|       |                     | Insulation test                      | IEC 60146                                                     | No                                | Yes                                      |         |
|       |                     | Load Tests                           | Approved procedure                                            | No                                | Yes                                      |         |
|       |                     | Preliminary light load test          | IEC 60146                                                     | No                                | Yes                                      |         |
|       |                     | Current division / Voltage division  | IEC 60146-2                                                   | No                                | Yes                                      |         |
| 13    | Battery             | As per standard (col 4)              | IEC -623 / IS 10918 for Ni-Cd<br>IS-1652 for Plante Lead Acid | No                                | Yes                                      |         |
| 14    | Voltage stabilizers | Over Load Test                       | Approved procedure                                            | No                                | Yes                                      |         |

| Sl No | Item  | Test requirement                      | Standard           | Test to be specifically conducted | NTPC's approval req. On test certificate | Remarks |
|-------|-------|---------------------------------------|--------------------|-----------------------------------|------------------------------------------|---------|
| Col 1 | Col 2 | Col 3                                 | Col 4              | Col 5                             | Col 6                                    | Col 7   |
|       |       | Temp rise test without redundant fans | Approved procedure | No                                | Yes                                      |         |

## MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)

| ITEMS                                                                                                                                                                                                                                                                                                                                                                                                                                | TESTS          |                               |                                     |                 |                          |                           |                                       |                |                             |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|-------------------------------|-------------------------------------|-----------------|--------------------------|---------------------------|---------------------------------------|----------------|-----------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                      | Dimensions (R) | Make, Model, Type, Rating (R) | Process / Electrical connection (R) | Calibration (R) | Test as per standard (R) | Insulation Resistance (R) | IBR Certification (if applicable) (R) | Hydro Test (R) | Material Test certificate ® |
| 1. PR Gauge (IS-3624)                                                                                                                                                                                                                                                                                                                                                                                                                | Y              | Y                             | Y                                   | Y               | Y                        |                           |                                       |                |                             |
| 2. Temp. Gauge (BS-5235)                                                                                                                                                                                                                                                                                                                                                                                                             | Y              | Y                             | Y                                   | Y               | Y                        |                           |                                       |                |                             |
| 3. Pr./D.P.Switch (BS-6134)                                                                                                                                                                                                                                                                                                                                                                                                          | Y              | Y                             | Y                                   | Y               | Y                        | Y                         |                                       |                |                             |
| 4. Electronic Transmitter (IEC-60770)                                                                                                                                                                                                                                                                                                                                                                                                | Y              | Y                             | Y                                   | Y               | Y                        | Y                         |                                       |                |                             |
| 5. Temp. Switch                                                                                                                                                                                                                                                                                                                                                                                                                      | Y              | Y                             | Y                                   | Y               | Y                        | Y                         |                                       |                |                             |
| 6. Recorder (IS-9319/ANSI C-39.4)                                                                                                                                                                                                                                                                                                                                                                                                    | Y              | Y                             | Y                                   | Y               | Y                        | Y                         |                                       |                |                             |
| 7. Vertical indicators                                                                                                                                                                                                                                                                                                                                                                                                               | Y              | Y                             | Y                                   | Y               |                          | Y                         |                                       |                |                             |
| 8. Digital Indicators                                                                                                                                                                                                                                                                                                                                                                                                                | Y              | Y                             | Y                                   | Y               |                          | Y                         |                                       |                |                             |
| 9. Integrators                                                                                                                                                                                                                                                                                                                                                                                                                       | Y              | Y                             | Y                                   | Y               |                          |                           |                                       |                |                             |
| 10. Electrical Metering Instrument (IS-1248)                                                                                                                                                                                                                                                                                                                                                                                         | Y              | Y                             | Y                                   | Y               | Y                        | Y                         |                                       |                |                             |
| 11. Transducer (IEC-688)                                                                                                                                                                                                                                                                                                                                                                                                             | Y              | Y                             | Y                                   | Y               | Y                        | Y                         |                                       |                |                             |
| 12. Thermocouples (IEC – 754 / ANSI-MC-96.1)                                                                                                                                                                                                                                                                                                                                                                                         | Y              | Y                             | Y                                   | Y               | Y                        | Y                         |                                       |                |                             |
| 13. RTD (IEC-751)                                                                                                                                                                                                                                                                                                                                                                                                                    | Y              | Y                             | Y                                   | Y               | Y                        | Y                         |                                       |                |                             |
| 14. Thermowell                                                                                                                                                                                                                                                                                                                                                                                                                       | Y              |                               | Y                                   |                 |                          |                           | Y                                     | Y              | Y                           |
| R-Routine Test    A- Acceptance Test    Y – Test applicable                                                                                                                                                                                                                                                                                                                                                                          |                |                               |                                     |                 |                          |                           |                                       |                |                             |
| <b>Note: 1) Detailed procedure of Environmental Stress Screening shall be as per Quality Assurance Programme in General Technical Conditions. Requirement of test and procedure (if required) finalized during QP finalization</b><br>2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted along with relevant supporting documents. |                |                               |                                     |                 |                          |                           |                                       |                |                             |

| MEASURING INSTRUMENTS (PRIMARY AND SECONDARY)                                                                                                                                                                                                                                                                                                                                                                                      |       |                |                               |                                     |                 |                                 |                  |                             |                              |                           |                                     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|----------------|-------------------------------|-------------------------------------|-----------------|---------------------------------|------------------|-----------------------------|------------------------------|---------------------------|-------------------------------------|
| ITEMS                                                                                                                                                                                                                                                                                                                                                                                                                              | TESTS | Dimensions (R) | Make, Model, Type, Rating (R) | Process / Electrical connection (R) | Calibration (R) | Requirement as per standard (R) | WPS approval (A) | Non-destructive testing (R) | Calculation for accuracy (R) | Insulation Resistance (R) | IBR Certification as applicable (R) |
|                                                                                                                                                                                                                                                                                                                                                                                                                                    |       |                |                               |                                     |                 |                                 |                  |                             |                              |                           | Hydro test (R)                      |
| 15. Cold junction compensation box                                                                                                                                                                                                                                                                                                                                                                                                 |       | Y              | Y                             | Y                                   | Y               |                                 |                  |                             |                              | Y                         |                                     |
| 16. Orifice plate(BS-1042)                                                                                                                                                                                                                                                                                                                                                                                                         |       | Y              | Y                             | Y                                   | Y               | Y                               | Y                | Y                           |                              |                           | Y                                   |
| 17. Flow nozzle(BS-1042)                                                                                                                                                                                                                                                                                                                                                                                                           |       | Y              | Y                             | Y                                   | Y               | Y                               | Y                | Y                           |                              |                           | Y                                   |
| 18. Impact head type element                                                                                                                                                                                                                                                                                                                                                                                                       |       | Y              | Y                             | Y                                   | Y               |                                 |                  |                             | Y                            |                           | Y                                   |
| 19. Level transmitter/float type switch                                                                                                                                                                                                                                                                                                                                                                                            |       | Y              | Y                             | Y                                   | Y               |                                 |                  |                             |                              | Y                         | Y                                   |
| 20. Analysers                                                                                                                                                                                                                                                                                                                                                                                                                      |       | Y              | Y                             | Y                                   | Y               |                                 |                  |                             |                              |                           |                                     |
| 21. Dust emission monitors                                                                                                                                                                                                                                                                                                                                                                                                         |       | Y              | Y                             | Y                                   | Y               |                                 |                  |                             |                              |                           |                                     |
| *Calibration to be carried out on one flow element of each type and size if calibration carried out as type test same shall not be repeated.                                                                                                                                                                                                                                                                                       |       |                |                               |                                     |                 |                                 |                  |                             |                              |                           |                                     |
| ** If applicable                                                                                                                                                                                                                                                                                                                                                                                                                   |       |                |                               |                                     |                 |                                 |                  |                             |                              |                           |                                     |
| R-Routine Test      A- Acceptance Test      Y – Test applicable                                                                                                                                                                                                                                                                                                                                                                    |       |                |                               |                                     |                 |                                 |                  |                             |                              |                           |                                     |
| Note: 1) Detailed procedure of Environmental Stress screening test shall be as per Quality Assurance Programme in General Technical Conditions. Requirement of test and procedure (if required) finalized during QP finalization<br>2) This is an indicative list of tests/checks. The manufacturer is to furnish a detailed quality plan indicating the Practices and Procedure adopted along with relevant supporting documents. |       |                |                               |                                     |                 |                                 |                  |                             |                              |                           |                                     |

## Process, Connection &amp; piping FOR C&amp;I SYSTEMS

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

\*-applicable for painted junction boxes.

Note: R-Routine Test

A- Acceptance Test

Y – Test applicable

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

## INSTRUMENTATION CABLE

| ITEMS                                           | TESTS                        |                      |                               |                                       |                                            |                         |                              |                                |                        |                                 |                                          |                    |
|-------------------------------------------------|------------------------------|----------------------|-------------------------------|---------------------------------------|--------------------------------------------|-------------------------|------------------------------|--------------------------------|------------------------|---------------------------------|------------------------------------------|--------------------|
|                                                 | Conductor Resistance ® & (A) | High Voltage ® & (A) | Insulation Resistance ® & (A) | Constructional detail, dimensions (A) | Outer-Sheath/core marking, end sealing (A) | Thermal Stability (A) + | Visual, Surface finish (A) + | Electrical Parameters ** (A) + | Persulphate Test (A) + | Overall/Coverage/Continuity (A) | Swidesh chimney Test (SS-4241475) (A) ++ | FRLS Test * (A) ++ |
| <b>1. Instrument cable twisted and shielded</b> |                              |                      |                               |                                       |                                            |                         |                              |                                |                        |                                 |                                          |                    |
| Conductor(IS-8130)                              | Y                            |                      |                               | Y                                     |                                            |                         | Y                            |                                |                        |                                 |                                          |                    |
| Insulation(VDE-207)                             |                              |                      |                               | Y                                     | Y                                          | Y                       | Y                            |                                |                        |                                 |                                          | Y                  |
| Pairing/Twisting                                |                              |                      |                               | Y                                     | Y                                          |                         | Y                            |                                |                        |                                 |                                          |                    |
| Shielding                                       |                              |                      |                               | Y                                     |                                            |                         | Y                            |                                |                        | Y                               |                                          |                    |
| Drain wire                                      | Y                            |                      |                               | Y                                     |                                            |                         | Y                            |                                | Y                      | Y                               |                                          |                    |
| Inner Sheath                                    |                              |                      |                               | Y                                     | Y                                          | Y                       | Y                            |                                |                        |                                 |                                          | Y                  |
| Outer Sheath                                    |                              |                      |                               | Y                                     | Y                                          | Y                       | Y                            |                                |                        |                                 |                                          | Y                  |
| Over all cable                                  | Y                            | Y                    | Y                             | Y                                     | Y                                          |                         | Y                            | Y                              |                        |                                 | Y                                        |                    |
| Cable Drums(IS-10418)                           |                              |                      |                               | Y                                     |                                            |                         | Y                            |                                |                        |                                 |                                          |                    |

**Note :** High Temp. cables shall be subjected to tests as per VDE-207(Part-6) Compensating cables shall be checked for Thermal EMF/Endurance test as per IS 8784.

**Note :** This is an indicative list of tests/checks. The manufacture is to furnish a detailed Quality Plan indicating his practice & Procedure along with relevant supporting documents during QP finalization for all items.

**Note :** ® - Routine Test A - Acceptance Test Y - Test Applicable

**Note :** Sampling Plan for Acceptance test shall be as per IS 8784 (As applicable)

- \* FRLS Tests: Oxygen / Temp Index ( ASTM D-2863), Smoke Density Rating ( ASTM – D 2843), HCL Emission ( IEC-754-1)

- \*\* Characteristic Impedance, Attenuation, Mutual Capacitance, Cross Talk ( As applicable)

+ Sample size will be One No. of each size/type per lot.

++ Sample size will be One No. sample for complete lot offered irrespective of size/type.

|  |                                                                        |  |
|--|------------------------------------------------------------------------|--|
|  | <b>NTPC FGD PACKAGES-<br/>LOT-1A, 2 &amp; 3</b>                        |  |
|  | <b>C &amp; I TECHNICAL SPECIFICATION<br/>FOR COMPRESSED AIR SYSTEM</b> |  |

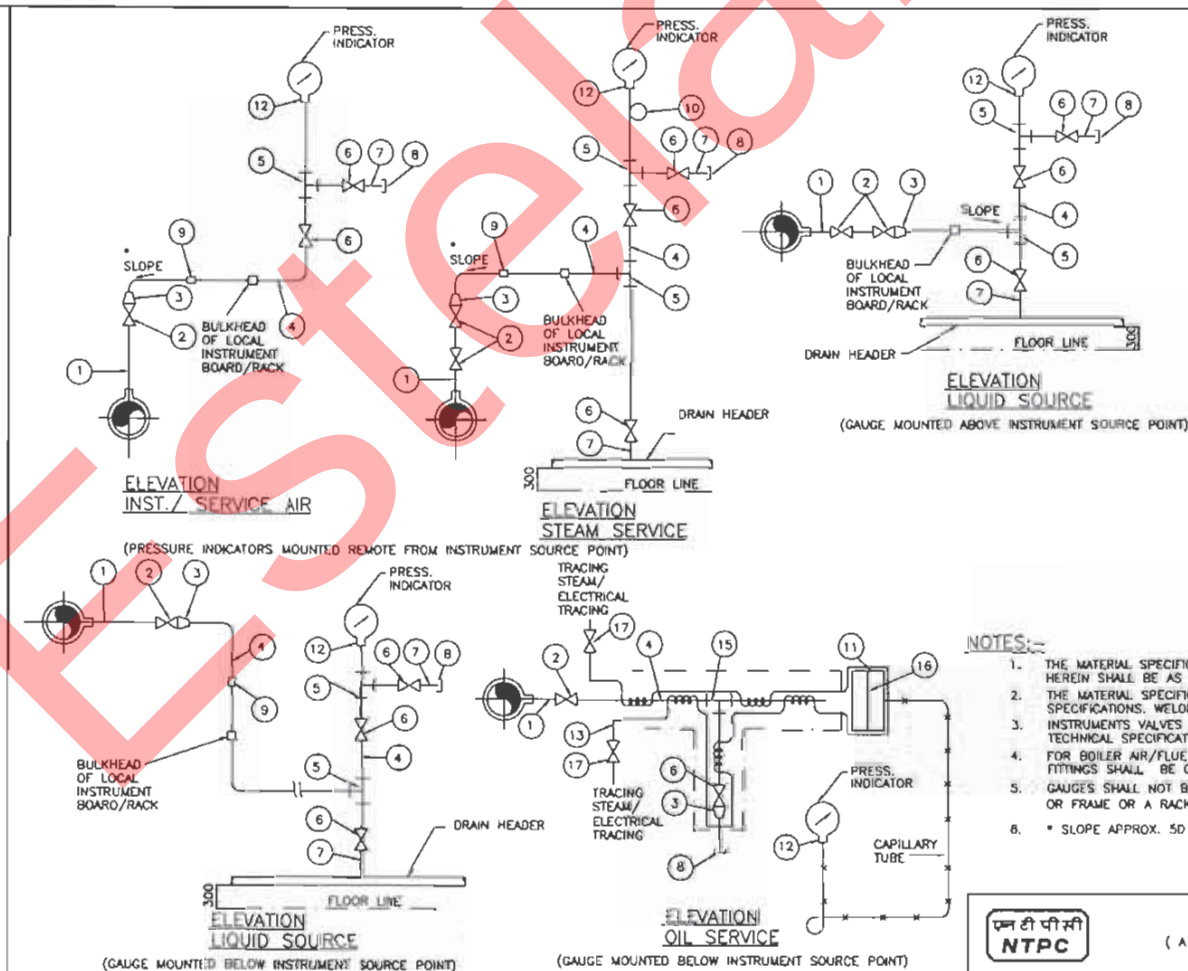
**INSTRUMENT INSTALLATION  
DRAWING**

| CLAUSE NO.                              | <div data-bbox="634 128 1024 155" data-label="Section-Header"> <p>TECHNICAL REQUIREMENTS</p> </div> <div data-bbox="1284 113 1437 184" data-label="Image"> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            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--------------------------------------------------------------------|---------|-------------------------------------------------------------------------|---------|----------------------------------------------------|
|                                         | <div data-bbox="678 212 1131 239" data-label="Section-Header"> <p>PROCESS CONNECTION AND PIPING</p> </div> <div data-bbox="207 459 297 487" data-label="Text"> <p>1.01.01</p> </div> <div data-bbox="386 459 1253 487" data-label="Section-Header"> <p><b>IMPULSE PIPING, TUBING, FITTINGS, VALVES AND VALVE MANIFOLDS</b></p> </div> <div data-bbox="207 518 297 546" data-label="Text"> <p>1.01.02</p> </div> <div data-bbox="386 518 1425 634" data-label="Text"> <p>All impulse pipes shall be of seamless type conforming to ANSI B36.10 for schedule numbers. The size of impulse pipe shall be ½" for Steam &amp; Water Application and ¾" for Air &amp; Flue Gas applications. The rating of material of impulse pipes, tubes, fittings, valves and their installation thereof shall conform to the latest edition of standards as per following table:</p> </div> <div data-bbox="375 646 1414 798" data-label="Table"> <table> <tr> <td>Impulse Pipes, Tubes (Material, Rating)</td><td>ANSI B31.1, ANSI B31.1a, ANSI/ISA 77.70</td></tr> <tr> <td>Valves (Material, Pr. Class, Size)</td><td>ASTM A182/ASTM A105 as per ASME 16.34</td></tr> <tr> <td>Fittings (Size, Rating, Material)</td><td>ANSI B31.1, ANSI B31.1a, ASME B16.11-2009</td></tr> <tr> <td>Installation Schemes</td><td>BS 6739-2009, ANSI/ISA 77.70</td></tr> </table> </div> <div data-bbox="386 821 1425 1050" data-label="Text"> <p>Stainless steel tube shall be provided inside enclosures &amp; racks from tee connection to valve manifold and then to instrument. The source shut-off (primary process root valve) and blow down valve shall be of 1/2 inch size globe valve type for all applications except for air and flue gas service wherein no source shut-off valves are to be provided. Two root valves are to be used wherever pressure is more than 40 Kg/cm<sup>2</sup> or Temp&gt;280 °C. The end connections of valves shall be of socket welded type. Typical installation scheme of DP Transmitter (inside LIE/LIR) mounted below instrument source point is indicated in Drg. No. 0000-999-POI-A-036. Same scheme with necessary changes shall be applied for other instruments.</p> </div> <div data-bbox="207 1079 297 1106" data-label="Text"> <p>1.01.03</p> </div> <div data-bbox="386 1079 1425 1138" data-label="Text"> <p>The valve manifolds of 316 SS with pressure rating suitable for intended application shall be provided as given below:</p> </div> <div data-bbox="375 1150 1435 1270" data-label="Table"> <table> <tr> <th>Manifold</th><th>Application/Measurement</th></tr> <tr> <td>2 Valve</td><td>Pressure measurements using pressure transmitters/pressure switches</td></tr> <tr> <td>3 Valve</td><td>Pressure measurements using differential pressure transmitter/ switches</td></tr> <tr> <td>5 Valve</td><td>Differential Pressure, Flow and Level Measurements</td></tr> </table> </div> <div data-bbox="386 1293 1425 1352" data-label="Text"> <p>For Pr./D.P gauges, two-way globe/gate valve shall be provided on each impulse line to the instrument in Fluid/Air &amp; Flue Gas applications respectively .</p> </div> <div data-bbox="207 1388 297 1415" data-label="Text"> <p>2.00.00</p> </div> <div data-bbox="386 1388 634 1415" data-label="Section-Header"> <p><b>AIR SUPPLY PIPING</b></p> </div> <div data-bbox="207 1442 297 1470" data-label="Text"> <p>2.01.01</p> </div> <div data-bbox="386 1442 1425 1556" data-label="Text"> <p>All pneumatic piping, fittings, valves, air filter cum regulator, purge rotameter and other accessories required for instrument air for the various pneumatic devices/ instruments shall be provided. This will include as a minimum air supply to pneumatically operated control valves, actuators, instruments, continuous and intermittent purging requirements etc.</p> </div> <div data-bbox="207 1591 297 1619" data-label="Text"> <p>2.02.00</p> </div> <div data-bbox="386 1591 1425 1680" data-label="Text"> <p>Instrument air and Service air supply shall be provided for continuous and intermittent purging respectively for all transmitters of mill, dirty air and flue gas applications. Purging Scheme shall be as per Drg. No. 0000-999-POI-A-036.</p> </div> <div data-bbox="207 1701 297 1728" data-label="Text"> <p>2.03.00</p> </div> <div data-bbox="386 1701 1425 1816" data-label="Text"> <p>The Contractor shall also provide SS Tubing and associated fittings (screwed type) of suitable sizes for all pneumatic equipments/actuators (including supply air, signal air and output to actuators) conforming to ANSI 31.1 and 31.3 standard. All other air supply lines shall be of mild steel hot dipped galvanized inside and outside as per IS-1239, heavy duty</p> </div> | Impulse Pipes, Tubes (Material, Rating) | ANSI B31.1, ANSI B31.1a, ANSI/ISA 77.70 | Valves (Material, Pr. Class, Size) | ASTM A182/ASTM A105 as per ASME 16.34 | Fittings (Size, Rating, Material) | ANSI B31.1, ANSI B31.1a, ASME B16.11-2009 | Installation Schemes | BS 6739-2009, ANSI/ISA 77.70 | Manifold | Application/Measurement | 2 Valve | Pressure measurements using pressure transmitters/pressure switches | 3 Valve | Pressure measurements using differential pressure transmitter/ switches | 5 Valve | Differential Pressure, Flow and Level Measurements |
| Impulse Pipes, Tubes (Material, Rating) | ANSI B31.1, ANSI B31.1a, ANSI/ISA 77.70                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      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| Valves (Material, Pr. Class, Size)      | ASTM A182/ASTM A105 as per ASME 16.34                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                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                                       |         |                                                                         |         |                                                    |
| Fittings (Size, Rating, Material)       | ANSI B31.1, ANSI B31.1a, ASME B16.11-2009                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    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                                                               |         |                                                                         |         |                                                    |
| Installation Schemes                    | BS 6739-2009, ANSI/ISA 77.70                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 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| Manifold                                | Application/Measurement                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      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| 2 Valve                                 | Pressure measurements using pressure transmitters/pressure switches                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          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                                                               |         |                                                                         |         |                                                    |
| 3 Valve                                 | Pressure measurements using differential pressure transmitter/ switches                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      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| 5 Valve                                 | Differential Pressure, Flow and Level Measurements                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           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| CLAUSE NO. | TECHNICAL REQUIREMENTS                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|            | <p>with threaded ends. Fittings for air supply line shall be of forged carbon steel A234 Gr. WPB galvanized inside and outside, screwed as per ASA B2.1. Dimensions of fittings shall be as per ASA B16.11 of rating 3000 lbs. Air supply piping shall be adequately sloped to prevent accumulation of condensed water within the pipe. The air supply headers, sub-headers and branch pipes shall be supported properly by clamps or supports.</p>                                                                                                                        |
| 2.04.00    | <p>The instrument/service air supply to each equipment/devices requiring air supply shall be provided by a well designed air distribution scheme comprising of 2" GI Pipe Header feeding 1" GI Pipe sub-header feeding ½" pipe at each equipment/device. Instrument air filters cum regulator set with mounting accessories shall be provided for each pneumatic device requiring air supply except for Ash Handling System wherein it shall be provided on instrument air header at each location.</p>                                                                    |
| 2.05.00    | <p>All the isolation valves in the air supply line shall be gate valves as per ASTM B62 inside screw rising stem, screwed female ends as per ASA B2.1. Valve bonnet shall be union type &amp; trim material shall be stainless steel, body rating 150 pounds ASA. The valve sizes shall be ½ inch to 2 inch.</p>                                                                                                                                                                                                                                                           |
| 2.06.00    | <p>Instrument air filters cum regulator set with mounting accessories shall be provided for pneumatic device requiring air supply. The filter regulators shall be suitable for 10-kg/ sq.cm max. Inlet pressure. The filter shall be of size 5 microns and of material sintered bronze. The air set shall have 2-inch size pressure gauge and built in filter housing blowdown valve. The end connection shall be as per the requirement to be finalized during detailed engineering.</p>                                                                                  |
| 3.00.00    | <p><b>INSTALLATION AND ROUTING</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| 3.01.01    | <p>All instrument piping, tubing and its accessories shall be supported in a safe manner to prevent excessive vibrations and anchored sufficiently to prevent undue strain on connected equipment. Impulse piping shall be supported at an interval not exceeding 1.5 meters. The slope of the impulse pipe from the process connection to the instrument shall be as per ANSI/ISA 77.70 latest edition and BS 6739-2009. All impulse piping shall be installed to permit free movement due to thermal expansion. Wherever required expansion loops shall be provided.</p> |
|            | <p>Condensate pots shall be provided for all level measurements in steam and water services, all flow measurement in steam services and for flow measurements in water services above 120 Deg. C. Colour coding of all impulse pipes shall be done by the Contractor in line with the colour coding being followed for the parent pipes.</p>                                                                                                                                                                                                                               |
| 4.00.00    | <p><b>SHOP AND SITE TESTS</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| 4.01.01    | <p>The equipment and work performed as per this Sub-section shall be subject to shop and site test as per requirements of Sub-section-III E-04 (Quality Assurance &amp; Inspection) other applicable clauses of this Sub-section and Employer approved quality assurance plan.</p>                                                                                                                                                                                                                                                                                         |
| 4.01.02    | <p>Hydrostatic and Pneumatic leakage tests shall be performed on all pipes, tubing and systems and shall conform to ANSI B31.1.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 5.00.00    | <p><b>LOCAL INSTRUMENT ENCLOSURE AND RACKS</b></p> <p>All transmitters, switches etc. for FGD system and other system being provided under the contract shall be suitably grouped together and mounted inside (i) local instruments enclosures in case of open areas of the plant and (ii) In local instrument racks in case of covered areas. The GA of LIE with purging indicated in the Drg. No. 0000-999-POI-A-036 is to be followed by contractor. The GA of LIR shall be similar to LIE except for front/rear doors and side panels.</p>                             |

| CLAUSE NO. | TECHNICAL REQUIREMENTS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 5.01.00    | <p>The internal layout shall be such that the impulse piping/ blow down lines are accessible from back side of the enclosure / rack and the transmitters etc. are accessible from front side for easy maintenance. Bulkheads, especially designed to provide isolation from process line vibration shall be installed on instrument enclosures/racks to meet the process sensing line connection requirement. Vibration dampeners shall be installed for each enclosure / rack. The Degree of Protection of LIE and JB of LIE/LIR shall be IP-55.</p> <p>The enclosures shall be constructed of 3 mm sheet plate and shall be of modular construction with one or more modules and two end assemblies bolted together to form an enclosure. Double inter locking doors shall be provided. The doors shall be the three-point locking type constructed of not less than 1.6 mm thick steel. Doors shall have concealed quick removal type pinned hinges and locking handles. Door locks shall accept the same key.</p> <p>The instrument racks shall be free standing type constructed of suitable 5 mm thick channel frame of steel and shall be provided with a canopy to protect the equipment mounted in racks from falling objects, water etc. The canopy shall not be less than 3 mm thick steel, and extended beyond the ends of the rack.</p> <p>Enclosures/Racks shall be reinforced as required to ensure true surface and to provide adequate support for instruments and equipment mounted therein. Centre posts or any member which would reduce access shall not be provided.</p> <p>Contractor shall provide not more than three variants for LIE/LIR with respect to max. no. transmitters mounted in each LIE/LIR.</p> <p><b>ENCLOSURE / RACKS FOR DUAL I/P TEMPERATURE TRANSMITTERS</b></p> <p>All Dual Input temperature transmitters for FGD system and other system being provided under the contract shall be suitably grouped together and mounted inside (i) Enclosures in case of open areas of the plant and (ii) Racks in case of covered areas. Integral JB shall be provided with each Enclosure and Rack.</p> <p>The internal layout shall be such that the transmitters are accessible from both front and back side of the enclosure / rack for easy maintenance.</p> <p>Enclosure/ Racks shall be of robust and rugged design. Vibration dampeners shall be installed for each enclosure / rack. The Degree of Protection of Enclosure and JB shall be IP-55.</p> <p>Enclosure and Racks shall be free standing type.</p> <p>Enclosures/Racks shall be reinforced as required to ensure true surface and to provide adequate support for instruments and equipment mounted therein.</p> <p>Contractor shall provide not more than five variants for Enclosure/ Rack with respect to max. no. transmitters mounted in each Enclosure/ Rack. However, the maximum number of Transmitters that can be grouped in one Enclosure/ Rack shall be decided during detail Engineering.</p> |

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# LIST OF MATERIALS

| ITEM NO. | DESCRIPTION                                                                                                         |
|----------|---------------------------------------------------------------------------------------------------------------------|
| 1.       | 1/2" / 3/4" 1" NPS SCH 40/80/160/XXS/P91 (AS PER PROCESS REQUIREMENT) NIPPLE OF MATERIAL SAME AS THAT OF MAIN PIPE. |
| 2.       | 1/2"/3/4"/1" SW GLOBE VALVE/GATE VALVE                                                                              |
| 3.       | 3/4" / 1" x 1/2" SW REDUCING INSERT                                                                                 |
| 4.       | 1/2" / 3/4" PIPE                                                                                                    |
| 5.       | 1/2" / 3/4" SW EQUAL TEE                                                                                            |
| 6.       | 1/2" / 3/4" SW GLOBE VALVE.                                                                                         |
| 7.       | 1/2" / 3/4" NPS SW x 1/2" / 3/4" NPT(M) CARBON/ALLOY STEEL NIPPLE.                                                  |
| 8.       | 1/2" / 3/4" NPT(F) CAP.                                                                                             |
| 9.       | 1/2" / 3/4" PIPE UNION.                                                                                             |
| 10.      | 6" SS SYPHON                                                                                                        |
| 11.      | 1/2" BLIND 300lbs RF ANSI FLANGE DRILLED AND TAPED FOR 1" NPT PIPE.                                                 |
| 12.      | SUITABLE ADAPTER.                                                                                                   |
| 13.      | 1/4" CHROME MOLY STEEL TUBE.                                                                                        |
| 14.      |                                                                                                                     |
| 15.      | 1 1/2" / 3/4" SW EQUAL TEE.                                                                                         |
| 16.      | DIAPHRAGM(WAFER ELEMENT)                                                                                            |
| 17.      | ISOLATION VALVE 316 SS, 1/4"SW                                                                                      |

## NOTES:-

1. THE MATERIAL SPECIFICATION AND SCHEDULE NO. OF IMPULSE PIPE & NIPPLE AS LISTED HEREIN SHALL BE AS PER TECHNICAL SPECIFICATIONS.
2. THE MATERIAL SPECIFICATION AND RATING OF FITTINGS AS LISTED SHALL BE AS PER SPECIFICATIONS. WELDED/THREADED FITTINGS SHALL CONFORM TO ANSI-B.16-11.
3. INSTRUMENTS VALVES BODY STEM MATERIAL AND PRESSURE CLASS SHALL BE AS PER TECHNICAL SPECIFICATIONS.
4. FOR BOILER AIR/FLUE GAS SERVICES SOURCE CONNECTIONS IMPULSE PIPING AND ALL FITTINGS SHALL BE OF 3/4" NB SIZE.
5. GAUGES SHALL NOT BE MOUNTED ON THE PIPE. IT WILL BE MOUNTED ON A CHANNEL OR FRAME OR A RACK..
6. \* SLOPE APPROX. 50 MM / METRE.

FOR TENDER PURPOSE ONLY

एन टी पी सी  
NTPC

**NTPC LIMITED**  
( A GOVERNMENT OF INDIA ENTERPRISE )  
ENGINEERING DIVISION

PROJECT **TYPICAL THERMAL POWER PROJECT**

TITLE **INSTRUMENT INSTALLATION DIAGRAM  
(FOR PRESSURE GAUGE)**

REV. NO. **A** FIRST ISSUE

DESCRIPTION

DRAWN

DESIGN

CHKD.

M

E

C

C&I

ARCH.

APPRO

DATE

21.08.12

CLEARED BY

SIZE

A3

SCALE

N.T.S.

DRG. NO.

0000-999-POI-A-022

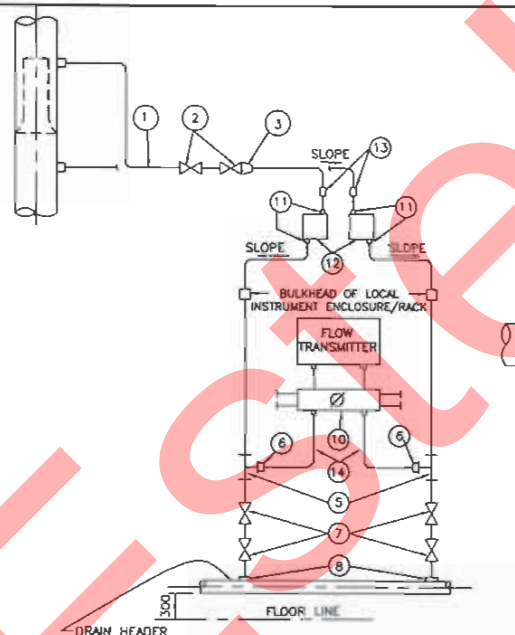
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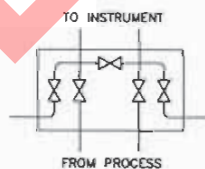


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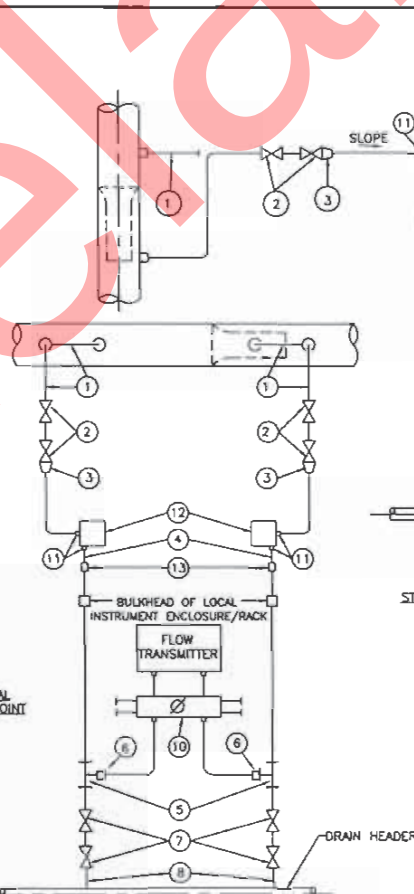


ELEVATION

FEED/ATTEMPERATION WATER FLOW MEASUREMENT IN VERTICAL  
PIPE-TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT

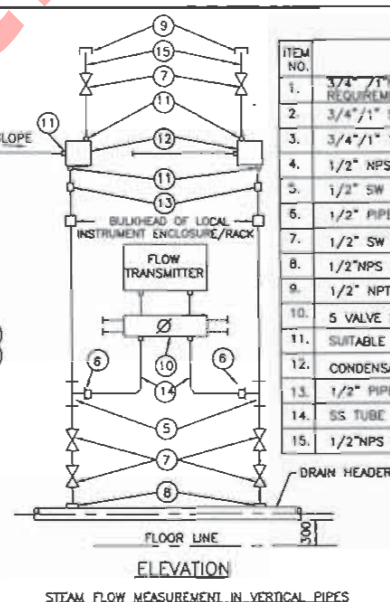


DETAIL OF 5 VALVE MANIFOLD  
(ITEM NO. 10)



ELEVATION

FEED/ATTEMPERATION WATER FLOW MEASUREMENT IN HORIZONTAL  
PIPE-TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT



ELEVATION

STEAM FLOW MEASUREMENT IN VERTICAL PIPES

# LIST OF MATERIALS

| ITEM NO. | DESCRIPTION                                                                                                 |
|----------|-------------------------------------------------------------------------------------------------------------|
| 1.       | 3/4" / 1" NPS SCH. 80/160 XS/P91 (AS PER PROCESS REQUIREMENT) NIPPLE OF MATERIAL SAME AS THAT OF MAIN PIPE. |
| 2.       | 3/4" / 1" SW GLOBE VALVE.                                                                                   |
| 3.       | 3/4" / 1" TO 1/2" REDUCING INSERT                                                                           |
| 4.       | 1/2" NPS PIPE                                                                                               |
| 5.       | 1/2" SW EQUAL TEE                                                                                           |
| 6.       | 1/2" PIPE x 1/2" TUBE UNION                                                                                 |
| 7.       | 1/2" SW GLOBE VALVE.                                                                                        |
| 8.       | 1/2" NPS SCH. 80/160 SWx1/2" SW CS/AS COUPLER                                                               |
| 9.       | 1/2" NPT (F) CAP                                                                                            |
| 10.      | 5 VALVE MANIFOLD                                                                                            |
| 11.      | SUITABLE ADAPTER                                                                                            |
| 12.      | CONDENSATE POT (RESERVOIR)                                                                                  |
| 13.      | 1/2" PIPE UNION                                                                                             |
| 14.      | SS TUBE                                                                                                     |
| 15.      | 1/2" NPS SCH. 80/160 SWx1/2" NPT (M) CS/AS NIPPLE                                                           |

## NOTES:-

1. SAME NOTES UNDER DRG. NO. 0000-999-POI-A-023.
2. CONDENSATE POTS SHALL BE PROVIDED FOR ALL STEAM SERVICES.
3. FOR WATER SERVICES CONDENSATE POTS SHALL BE PROVIDED ONLY IN THOSE CASES WHERE TEMP. > 120°C

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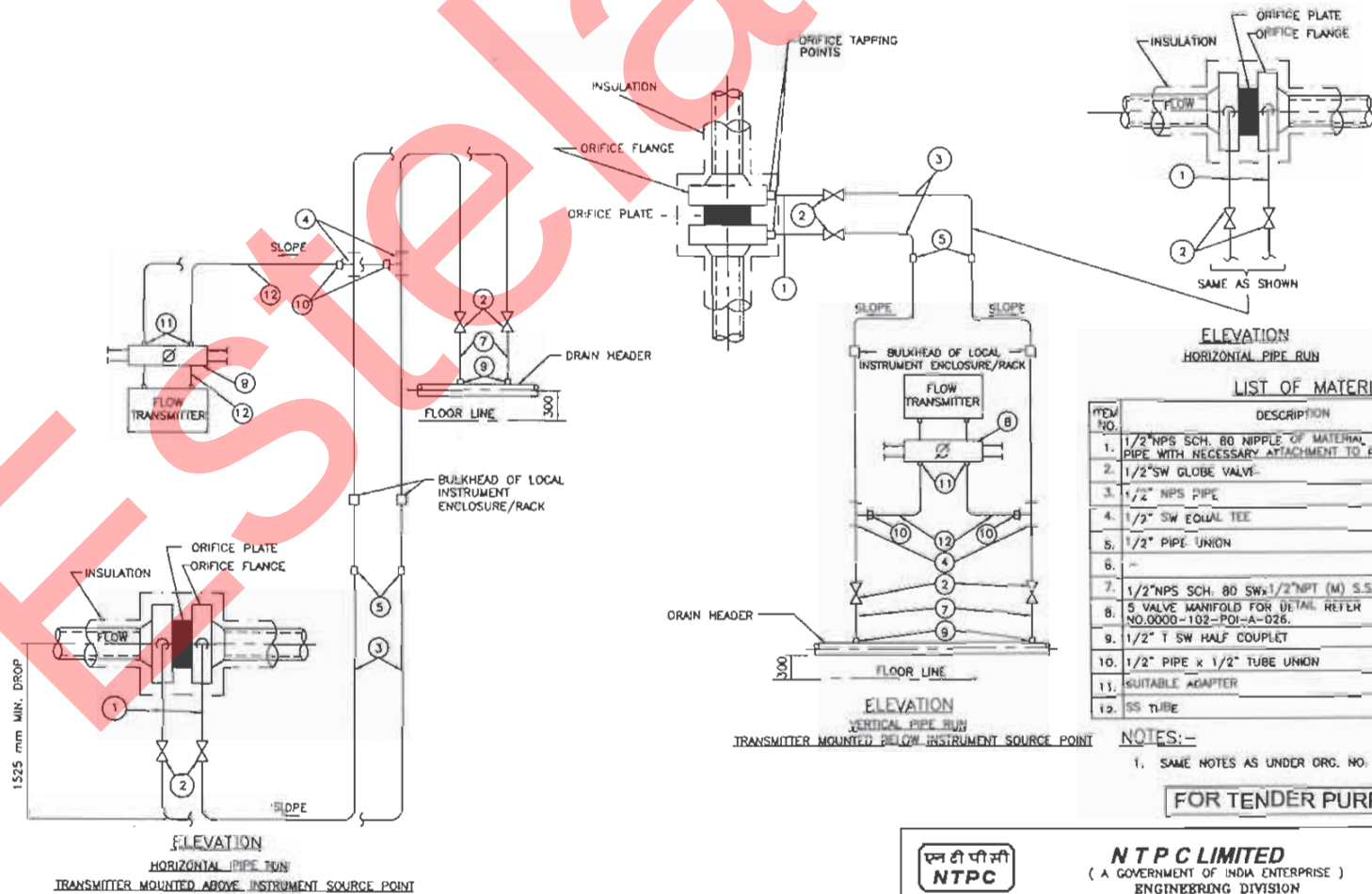
PROJECT TYPICAL THERMAL POWER PROJECT

TITLE INSTRUMENT INSTALLATION DIAGRAM  
FLOW MEASUREMENT (USING FLOW NOZZLES)  
STEAM & FEEDWATER

| REV. NO.   | DESCRIPTION | DRAWN | DESIGN | CHKD. | M | E | C | C&I | ARCH. | APPO | DATE     |
|------------|-------------|-------|--------|-------|---|---|---|-----|-------|------|----------|
| A          | FIRST ISSUE |       |        |       |   |   |   |     |       |      | 21.08.12 |
| Cleared By |             |       |        |       |   |   |   |     |       |      |          |

| SIZE | SCALE  | DRG. NO.           | REV. NO. |
|------|--------|--------------------|----------|
| A3   | N.T.S. | 0000-999-POI-A-026 | A        |

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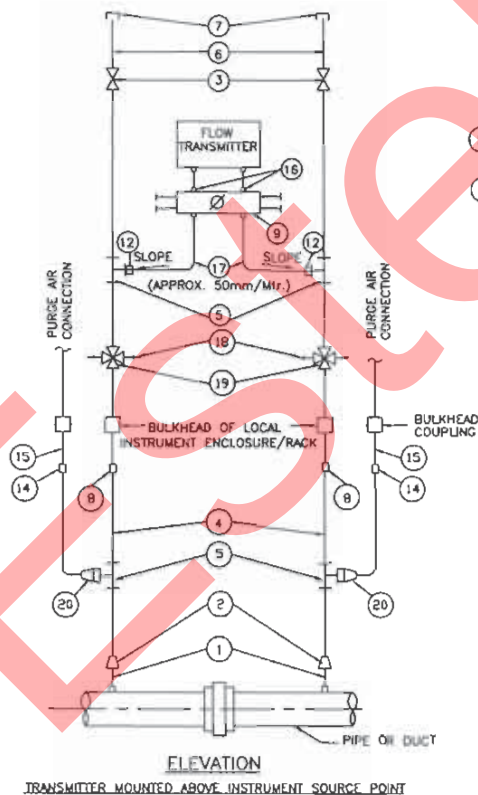
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PROJECT TYPICAL THERMAL POWER PROJECT

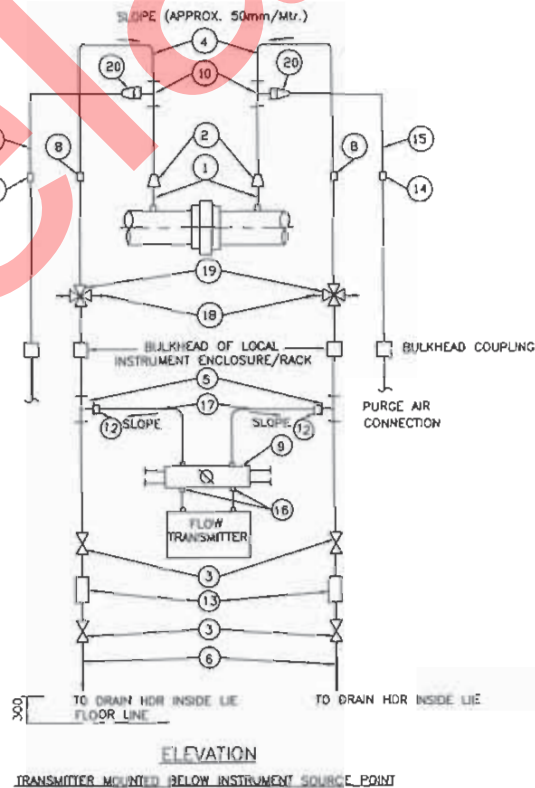
TITLE INSTRUMENT INSTALLATION DIAGRAM  
FLOW MEASUREMENT (USING ORIFICE PLATES)  
CONDENSATE & SERVICE WATER

| REV. NO. | DESCRIPTION | DRAWN | DESIGN | CHKD. | M | E | C | C&I | ARCH. | APPD. | DATE     | SIZE | SCALE  | DRG. NO.           | REV. NO. |
|----------|-------------|-------|--------|-------|---|---|---|-----|-------|-------|----------|------|--------|--------------------|----------|
| A        | FIRST ISSUE |       |        |       |   |   |   |     |       |       | 21.08.12 | A3   | N.T.S. | 0000-999-POI-A-027 | A        |

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AIR/GAS FLOW MEASUREMENT USING HEAD TYPE PRIMARY ELEMENT



# LIST OF MATERIALS

| ITEM NO. | DESCRIPTION                                                      |
|----------|------------------------------------------------------------------|
| 1.       | 42x4.00mm U.S. BLACK PIPE                                        |
| 2.       | M 42x2 TO 3/4"SW REDUCING INSERT.                                |
| 3.       | 3/4" SW GLOBE VALVE                                              |
| 4.       | 3/4" PIPE                                                        |
| 5.       | 3/4" SW EQUAL TEE                                                |
| 6.       | 3/4" SCH. 80 SWx3/4" NPT (M) CS/AS NIPPLE                        |
| 7.       | 3/4" NPT (F) CAP.                                                |
| 8.       | 3/4" PIPE UNION                                                  |
| 9.       | 5 VALVE MANIFOLD FOR DETAIL REFER DRAWING NO.0000-999-POI-A-028. |
| 10.      | 3/4" SW EQUAL TEE                                                |
| 11.      | 3/4" SW GATE VALVE                                               |
| 12.      | 3/4" PIPE x 1/2" TUBE UNION                                      |
| 13.      | DRAIN POT.                                                       |
| 14.      | 1/2" GI FITTING                                                  |
| 15.      | 1/2" IN. O.D. PIPE                                               |
| 16.      | SUITABLE ADAPTER                                                 |
| 17.      | SS TUBE                                                          |
| 18.      | QUICK DISCONNECT FITTINGS.                                       |
| 19.      | 3/4" SW 4 WAY VALVE                                              |
| 20.      | 3/4" x 1/2" REDUCER.                                             |

## NOTES:-

1. SAME NOTES AS UNDER DRG. NO. 0000-999-POI-A-023.

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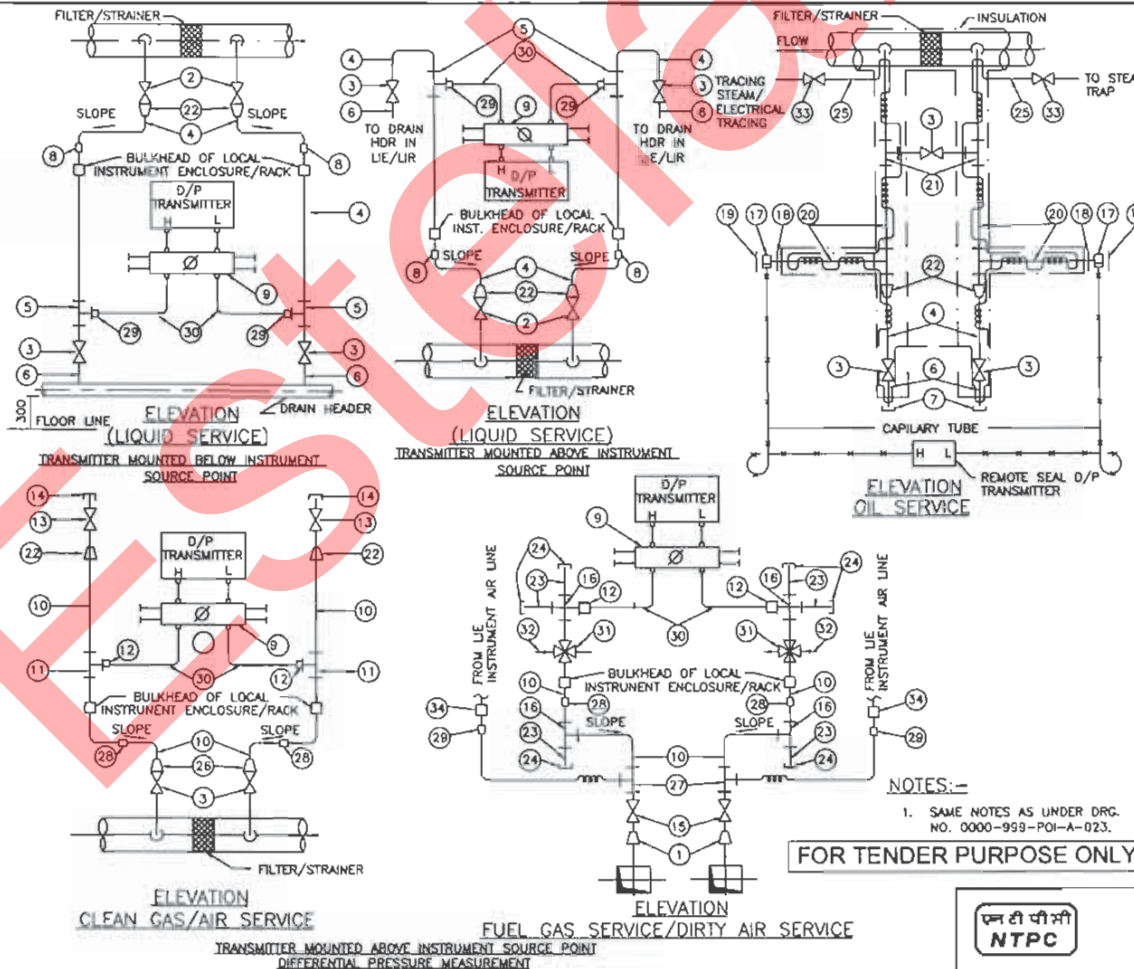
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PROJECT TYPICAL THERMAL POWER PROJECT

TITLE INSTRUMENT INSTALLATION DIAGRAM  
(FLOW MEASUREMENT AIR/GAS)

|          |   |             |             |       |        |       |   |   |   |     |       |      |      |          |      |    |       |        |          |                    |          |   |
|----------|---|-------------|-------------|-------|--------|-------|---|---|---|-----|-------|------|------|----------|------|----|-------|--------|----------|--------------------|----------|---|
| REV. NO. | A | DESCRIPTION | FIRST ISSUE | DRAWN | DESIGN | CHKD. | M | E | C | C&I | ARCH. | APPD | DATE | 21.08.12 | SIZE | A3 | SCALE | INT.S. | DRG. NO. | 0000-999-POI-A-028 | REV. NO. | B |
|----------|---|-------------|-------------|-------|--------|-------|---|---|---|-----|-------|------|------|----------|------|----|-------|--------|----------|--------------------|----------|---|

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NOTES:-  
1. SAME NOTES AS UNDER DRG. NO. 0000-999-POI-A-023.

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| LIST OF MATERIALS |                                                                                           |
|-------------------|-------------------------------------------------------------------------------------------|
| ITEM NO.          | DESCRIPTION                                                                               |
| 1.                | 42x2 TO 3/4" SW REDUCING INSERT.                                                          |
| 2.                | 3/4" SW GLOBE VALVE.                                                                      |
| 3.                | 1/2" SW GLOBE VALVE FOR LIQUID APPLICATION & 3/4"/1" IN GAS/AIR APPLICATION               |
| 4.                | 1/2" NPS 40/80/160 (AS PER PROCESS REQUIREMENT) CARBON/ALLOY STEEL PIPE                   |
| 5.                | 1/2" SW EQUAL TEE.                                                                        |
| 6.                | 1/2" NPS SW x 1/2" NPT (M) NIPPLE.                                                        |
| 7.                | 1/2" NPT (F) CAP.                                                                         |
| 8.                | 1/2" PIPE x 1/2" PIPE UNION.                                                              |
| 9.                | 5 VALVE MANIFOLD (FOR DETAIL REFER DRAWING NO.0000-999-POI-A-028.                         |
| 10.               | 3/4" SCH 80 CARBON/ALLOY STEEL PIPE.                                                      |
| 11.               | 3/4"/1/2" SW EQUAL TEE.                                                                   |
| 12.               | 3/4"x1/2" TUBE UNION.                                                                     |
| 13.               | 1/2" SCREWED GLOBE VALVE.                                                                 |
| 14.               | 1/2" NPT (M) PLUG.                                                                        |
| 15.               | 3/4" SW GATE VALVE.                                                                       |
| 16.               | 3/4" SW EQUAL CROSS.                                                                      |
| 17.               | WAFER ELEMENT FOR USE WITH 3"ANSI R.F. VALVE.                                             |
| 18.               | 3"BLIND 300lbs R.F. WELD NECK FLANGE DRILLED FOR 1" SCH. 40/80 PIPE                       |
| 19.               | 3" BLIND FLANGE.                                                                          |
| 20.               | 1"NPS SCH. 40/80 (AS PER PROCESS REQUIREMENT) CS PIPE.                                    |
| 21.               | 1" SW EQUAL TEE.                                                                          |
| 22.               | 3/4" x 1/2"SW REDUCING INSERT.                                                            |
| 23.               | 3/4" SW x 3/4" NPT (M) CS/AS NIPPLE                                                       |
| 24.               | 3/4" NPT (F) CS/AS CAP.                                                                   |
| 25.               | 1/4" NPS ALLOY STEEL PIPE.                                                                |
| 26.               | 1" x 3/4" SW REDUCING INSERT.                                                             |
| 27.               | 3/4" SW x 1/2" PSW BRANCH TEE.                                                            |
| 28.               | 3/4" PIPE UNION                                                                           |
| 29.               | 1/2" CLAMP UNION (THREADED) SUITABLE FOR FLEXIBLE CONNECTION OF NYLON REINFORCED PVC TUBE |
| 30.               | SS TUBE                                                                                   |
| 31.               | 3/4" SW 4 WAY VALVE.                                                                      |
| 32.               | QUICK DISCONNECT FITTINGS.                                                                |
| 33.               | 1/4" SW ISOLATION VALVE 316SS                                                             |
| 34.               | 1/2" x 1/2" SS PIPE UNION.                                                                |



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| REV.NO.    | DESCRIPTION | DRAWN | DESIGN | CHKD. | M | E | C | C&I | ARCH. | APPD | DATE     |
|------------|-------------|-------|--------|-------|---|---|---|-----|-------|------|----------|
| A          | FIRST ISSUE |       |        |       |   |   |   |     |       |      | 21.08.12 |
| Cleared by |             |       |        |       |   |   |   |     |       |      |          |

|          |                                                                                           |       |        |          |                    |
|----------|-------------------------------------------------------------------------------------------|-------|--------|----------|--------------------|
| PROJECT  | TYPICAL THERMAL POWER PROJECT                                                             |       |        |          |                    |
| TITLE    | INSTRUMENT INSTALLATION DIAGRAM<br>DIFF. PRESS.MEASUREMENT (LIQUID, OIL, AIR/GAS SERVICE) |       |        |          |                    |
| SIZE     | A3                                                                                        | SCALE | N.T.S. | DRG. NO. | 0000-999-POI-A-030 |
| REV. NO. | A                                                                                         |       |        |          |                    |

|  |                                                                        |  |
|--|------------------------------------------------------------------------|--|
|  | <b>NTPC FGD PACKAGES-<br/>LOT-1A, 2 &amp; 3</b>                        |  |
|  | <b>C &amp; I TECHNICAL SPECIFICATION<br/>FOR COMPRESSED AIR SYSTEM</b> |  |

**CABLE INTERCONNECTION AND  
TERMINATION PHILOSOPHY**

## 5.00.00

**INSTRUMENTATION CABLE INTERCONNECTION AND TERMINATION PHILOSOPHY**

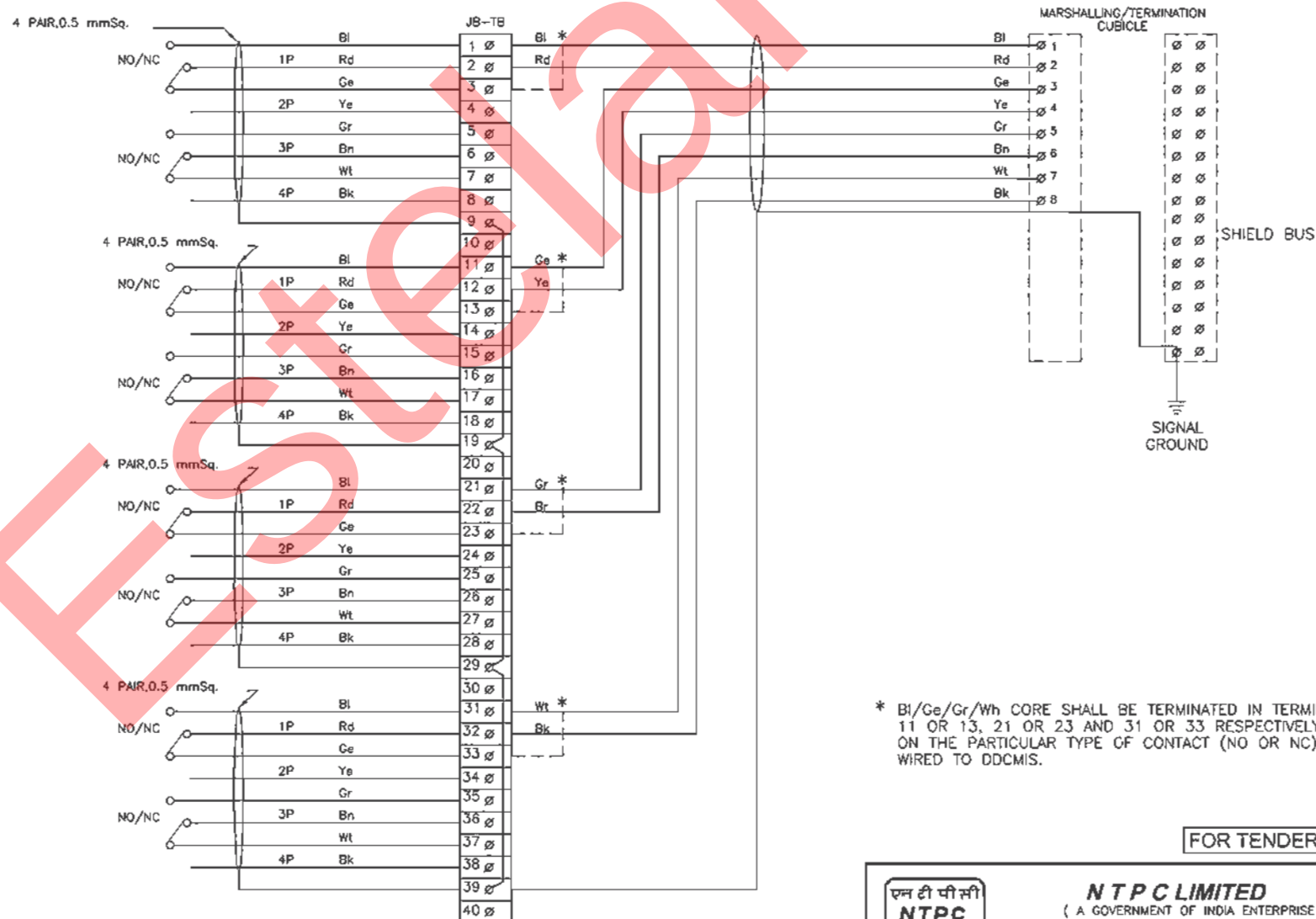
The cable interconnection philosophy to be adopted shall be such that extensive grouping of signals by large scale use of field mounted Group Junction Boxes (JBs) at strategic locations (where large concentration of signals are available, e.g. valves limit & torque switches, switchgear) is done and consequently cable with higher number of pairs are extensively used. The details of termination to be followed are mentioned in the given Table A.

TABLE A: CABLE TERMINATION TO BE FOLLOWED

| Application                                                                          |                                                                      | Type Of Termination           |                               | Type Of Cable |
|--------------------------------------------------------------------------------------|----------------------------------------------------------------------|-------------------------------|-------------------------------|---------------|
| FROM (A)                                                                             | TO (B)                                                               | END A                         | END B                         |               |
| Valves/dampers drives (Integral Junction box)                                        | Marshalling / Marshalling – cum Termination Cubicle / local group JB | Plug in connector             | Post mount cage clamp type.   | G             |
| Transmitters, Process Actuated switches mounted in LIE/LIR                           | Integral Junction box of LIE/LIR                                     | Plug in connector             | Cage clamp (Rail mount) type. | F,G           |
| RTD heads                                                                            | Local junction box                                                   | Plug in connector             | Cage clamp (Rail mount) type. | F             |
| Thermocouple                                                                         | Local junction box / CJC box (if applicable)                         | Plug in connector             | Cage clamp (Rail mount) type. | A, B, C*      |
| Other Field mounted Instrument                                                       | Local JB / Group JB                                                  | Plug in connector             | Cage clamp (Rail mount) type. | F,G           |
| RTD                                                                                  | Temperature transmitter                                              | Plug in connector             | Screwed, Cage clamp type      | F             |
| Thermocouple                                                                         | Temperature transmitter                                              | Plug in connector             | Screwed, Cage clamp type      | A, B, C*      |
| Local Junction box, Temperature Transmitter, Int. Junction box of LIE/ LIR/ MCC/SWGR | Group JB                                                             | Cage clamp (Rail mount) type. | Cage clamp (Rail mount) type. | F,G           |

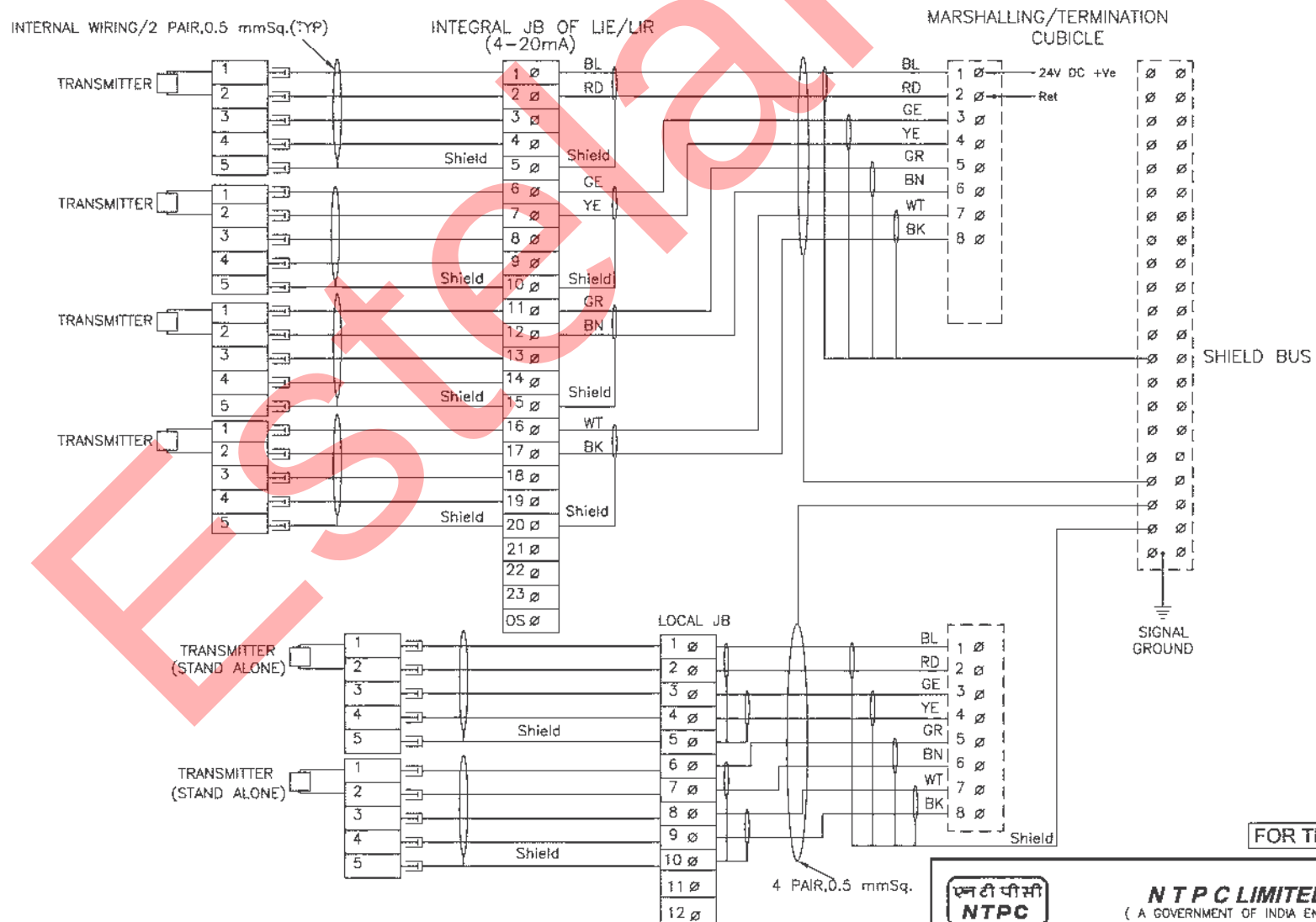
| CLAUSE NO. | TECHNICAL REQUIREMENTS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                     |                                 |                                                         |  |
|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|---------------------------------|---------------------------------------------------------|-------------------------------------------------------------------------------------|
|            | Application                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                     | Type Of Termination             |                                                         | Type Of Cable                                                                       |
|            | FROM (A)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | TO (B)                                              | END A                           | END B                                                   |                                                                                     |
|            | Local Junction box, Temperature Transmitter, Int. Junction box of LIE/ LIR/ Group JB / MCC/SWGR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Marshalling / Marshalling – cum Termination Cubicle | Cage clamp (Rail mount) type.   | Cage clamp (Post mounted) type.                         | F,G                                                                                 |
|            | Marshalling cubicle/ Termination Cabinet                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Electronic system cabinet                           | Cage clamp (Post mounted) type. | Plug-in connector / other system as per Mfr.'s Standard | Internal wiring                                                                     |
|            | Marshalling/ Termination System Cabinets                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | UCD mounted equipments                              | Cage clamp (Post mounted) type. | Plug in connector / Cage clamp type (rail mounted).     | F,G (with plug-in connect or at one end)                                            |
|            | DDCMIS/PLC cabinets                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | PC, Printers etc.                                   | Plug in connector               | Plug in connector                                       | Mfr.'s Standard                                                                     |
|            | <p><b>Notes</b></p> <p>1 Normally 10% spare cores shall be provided when the numbers of pairs of cables are more than four pairs, except for pre-fabricated cables which shall be as per manufacturer's standard.</p> <p>2 For analog signals, individual pair shielding &amp; overall shielding &amp; for Binary signals, only overall shielding of instrumentation cables shall be provided.</p> <p>3 * For high temperature applications only.</p> <p>4 . For connection between field/JB and DDCMIS marshalling cabinet<br/>Minimum 4 pair instrumentation cable shall be used.</p> <p>5 All the spare cores of instrumentation cable have to be terminated in Marshalling cabinets/ DCS panel end.</p> <p>6 Not used.</p> |                                                     |                                 |                                                         |                                                                                     |
| 6.00.00    | <b>TERMINAL BLOCKS</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                     |                                 |                                                         |                                                                                     |
| 6.01.00    | All terminal blocks shall be rail mounted/post mounted, cage clamp type with high quality non-flammable insulating material of melamine suitable for working temperature of 105 deg. C. The terminal blocks in field mounted junction boxes, temperature transmitters, instrument enclosures/racks, etc., shall be suitable for cage clamp connections. The terminal blocks in Control Equipment Room logic/termination/marshalling cubicles shall be suitable for post                                                                                                                                                                                                                                                        |                                                     |                                 |                                                         |                                                                                     |

| CLAUSE NO. | TECHNICAL REQUIREMENTS                                                                                                                                                                                                                                                                                                                                                                                                       |      |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
|            | mounted cage clamp connection at the field input end. The exact type of terminal blocks to be provided by the Bidder and the technical details of the same including width etc. shall be subject to Employer's approval.                                                                                                                                                                                                     |                                                                                         |
| 6.02.00    | All the terminal blocks shall be provided complete with all required accessories including assembly rail, locking pin and section, end brackets, partitions, small partitions, transparent covers, support brackets, distance sleeves, warning label, marking, etc.                                                                                                                                                          |                                                                                         |
| 6.03.00    | The marking on terminal strips shall correspond to the terminal numbering on wiring diagrams. At least 20% spare unused terminals shall be provided everywhere including local junction boxes, instrument racks/enclosures, termination/marshalling cabinets, etc. All terminal blocks shall be numbered for identification and grouped according to the function. Engraved labels shall be provided on the terminal blocks. |                                                                                         |
| 6.04.00    | For terminating each process actuated switches, drive actuators, control valves, Thermocouple, RTD, etc. in Local Junction Boxes, etc, refer Drg no. 0000-999-POI-A-065.                                                                                                                                                                                                                                                     |                                                                                         |
| 6.05.00    | The terminal blocks shall be arranged with at least 100 mm clearance between two sets of terminal blocks and between terminal blocks and junction box walls.                                                                                                                                                                                                                                                                 |                                                                                         |
| 7.00.00    | <b>INTERNAL PANELS/ SYSTEM CABINETS WIRING</b>                                                                                                                                                                                                                                                                                                                                                                               |                                                                                         |
| 7.01.00    | Internal panel/cabinet wiring shall be of multi-stranded copper conductor with FRLS PVC insulation without shield and outer sheath meeting the requirements of VDE 0815.                                                                                                                                                                                                                                                     |                                                                                         |
| 7.02.00    | All internal wires shall be provided with tag and identification nos. etched on tightly fitted ferules at both ends. All wires directly connected to trip devices shall be distinguished by one additional red colour ferule.                                                                                                                                                                                                |                                                                                         |
| 7.03.00    | All external connection shall be made with one wire per termination point. Wires shall not be tapped or spliced between terminal points.                                                                                                                                                                                                                                                                                     |                                                                                         |
| 7.04.00    | All floor slots of desk/panels/cabinets used for cable entrance shall be provided with removable gasketed gland plates and sealing material. Split type grommets shall be used for prefabricated cables.                                                                                                                                                                                                                     |                                                                                         |
| 7.05.00    | All the special tools as may be required for solder less connections shall be provided by Bidder.                                                                                                                                                                                                                                                                                                                            |                                                                                         |
| 7.06.00    | Wire sizes to be utilised for internal wiring.<br><br>(i) Current (4-20 mA), low voltage signals (48V);<br>Ammeter/Voltmeter circuit, control switches etc.<br>for electrical system.<br><br>(ii) Power supply and internal illumination.                                                                                                                                                                                    | 0.5 Sq.mm.<br><br><br><br><br><br>2.5Sq.mm. minimum (shall be as per load requirement.) |
| 8.00.00    | <b>INSTRUMENTATION CABLE INSTALLATION AND ROUTING</b>                                                                                                                                                                                                                                                                                                                                                                        |                                                                                         |
| 8.01.00    | All cables assigned to a particular duct/conduit shall be grouped and pulled in simultaneously using cable grips and suitable lubricants. Cables removed from one duct/conduit shall not be reused without approval of Employer.                                                                                                                                                                                             |                                                                                         |



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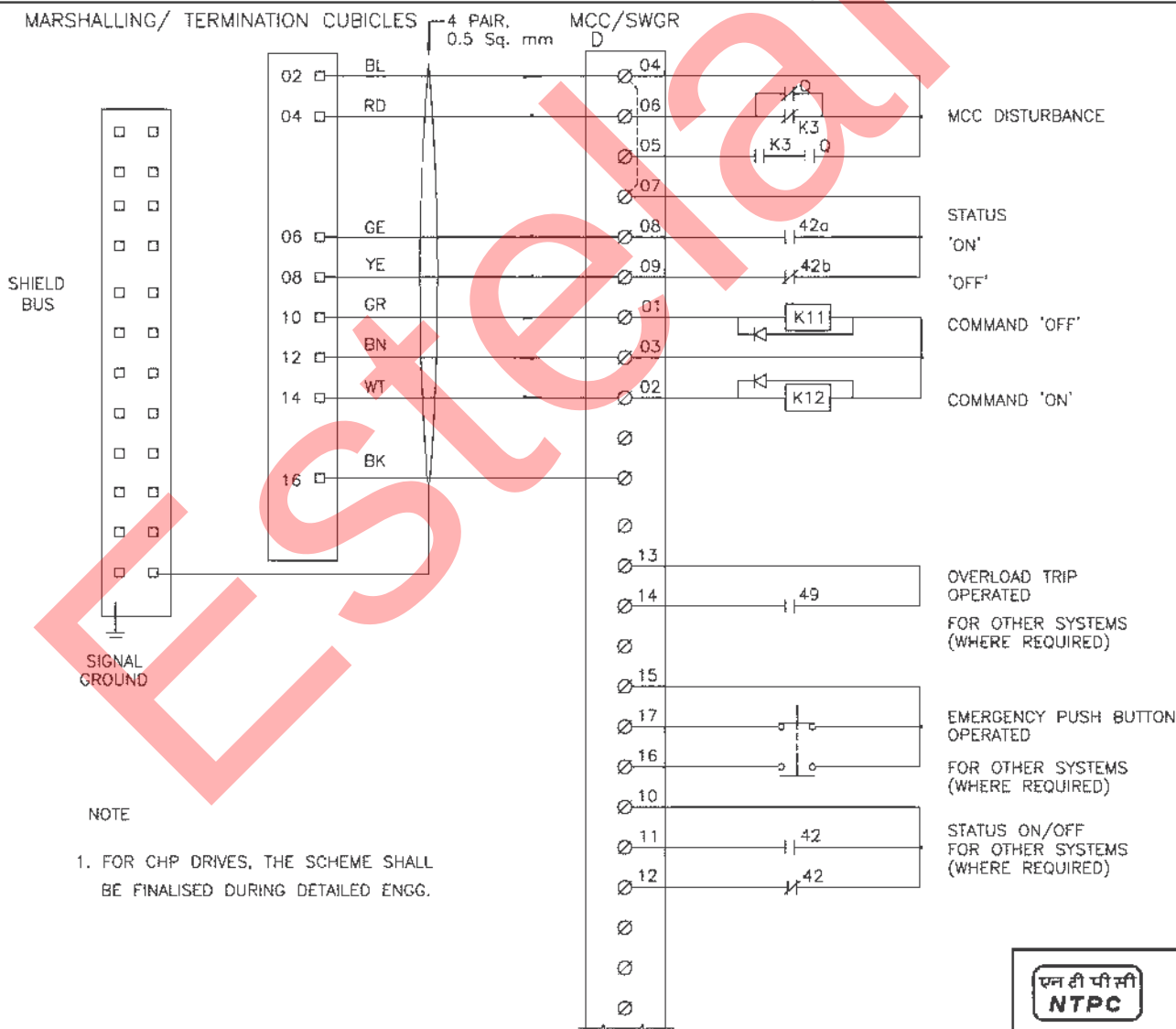
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|------------|-------------|-------------------------------------------------------------------------------------|-------|
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| PROJECT    |             | TYPICAL THERMAL POWER PROJECT                                                       |       |
| TITLE      |             | INTERFACING OF FIELD INSTRUMENTS<br>SWITCH TERMINATION DETAILS<br>NO/NC             |       |
| REV. NO.   | DESCRIPTION | SIZE                                                                                | SCALE |
| A          | FIRST ISSUE | A3                                                                                  | NTS   |
| DRAWN      |             | DRG. NO.                                                                            |       |
| DESIGN     |             | 0000-999-POI-A-065                                                                  |       |
| CHKD.      |             | REV. NO.                                                                            |       |
| M          |             | A                                                                                   |       |
| E          |             |                                                                                     |       |
| C          |             |                                                                                     |       |
| C&I        |             |                                                                                     |       |
| ARCH.      |             |                                                                                     |       |
| APPD       |             |                                                                                     |       |
| DATE       |             | 21.08.12                                                                            |       |
| CLEARED BY |             | SH 02 OF 15                                                                         |       |



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|             |       |                                            |        |
|-------------|-------|--------------------------------------------|--------|
| PROJECT     |       | TYPICAL THERMAL POWER PROJECT              |        |
| TITLE       |       | INTERFACING OF FIELD INSTRUMENTS<br>4-20mA |        |
| SIZE        | SCALE | DRG. NO.                                   | REV NO |
| A3          | NTS   | 0000-999-POI-A-065                         | B      |
| SH 04 OF 15 |       |                                            |        |

|         |                                                                               |       |        |       |            |   |   |     |       |      |          |
|---------|-------------------------------------------------------------------------------|-------|--------|-------|------------|---|---|-----|-------|------|----------|
|         |                                                                               |       |        |       |            |   |   |     |       |      |          |
| B       | INTERNAL WIRING FOR LIE/LIR MOUNTED SHOWN<br>WIRING OF STAND ALONE TXTR SHOWN |       |        |       |            |   |   |     |       |      | 21.08.12 |
| A       | FIRST ISSUE                                                                   |       |        |       |            |   |   |     |       |      | 12.1.05  |
| REV.NO. | DESCRIPTION                                                                   | DRAWN | DESIGN | CHKD. | M          | E | C | C&I | ARCH. | APPD | DATE     |
|         |                                                                               |       |        |       | CLEARED BY |   |   |     |       |      |          |

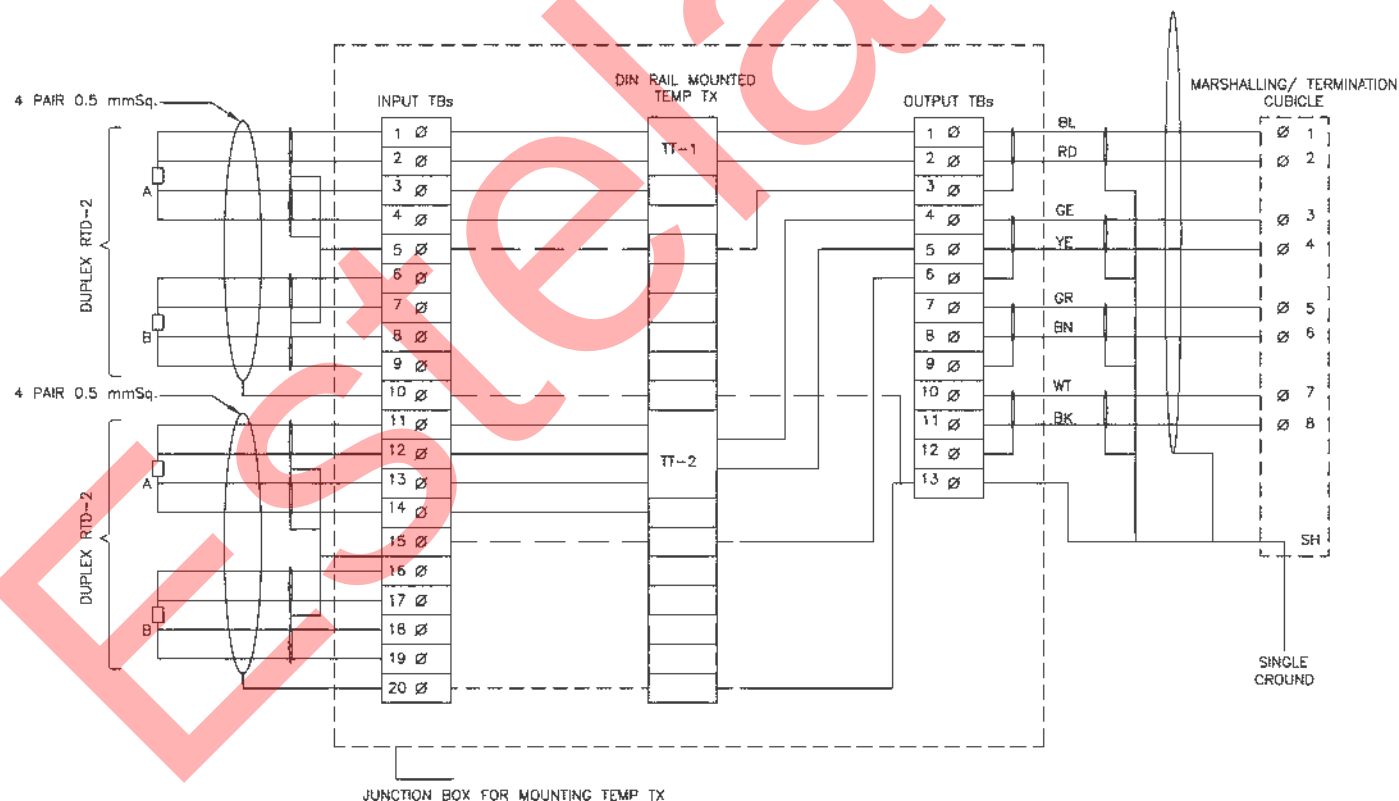


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|         |             |                                                                                     |        |       |            |   |   |     |       |      |          |                                                                                                        |              |                                |             |
|---------|-------------|-------------------------------------------------------------------------------------|--------|-------|------------|---|---|-----|-------|------|----------|--------------------------------------------------------------------------------------------------------|--------------|--------------------------------|-------------|
|         |             |                                                                                     |        |       |            |   |   |     |       |      |          | PROJECT<br>TYPICAL THERMAL POWER PROJECT                                                               |              |                                |             |
|         |             |                                                                                     |        |       |            |   |   |     |       |      |          | TITLE<br>INTERFACING OF FIELD INSTRUMENTS<br>INTERFACE OF DDCMIS WITH MCC/SWGR/ACTUATOR<br>(LT MOTORS) |              |                                |             |
| A       | FIRST ISSUE |  |        |       |            |   |   |     |       |      | 21.08.12 |                                                                                                        |              |                                |             |
| REV.NO. | DESCRIPTION | DRAWN                                                                               | DESIGN | CHKD. | M          | E | C | C&I | ARCH. | APPD | DATE     | SIZE<br>A3                                                                                             | SCALE<br>NTS | DRG. NO.<br>0000-999-POI-A-065 | REV NO<br>A |
|         |             |                                                                                     |        |       | CLEARED BY |   |   |     |       |      |          |                                                                                                        |              |                                | SH 05 OF 15 |



- NOTE :- 1) ABOVE IS THE TYP. DRG. MOUNTED TEMP TRANSMITTER FRO T/C APPLICATION. EXACT TYPE OF TEMP TRANSMITTERS SHALL BE AS PER PART-A OF SPECIFICATION.
- 2) THE EXACT GROUPING OF TEMP TXs SHALL BE FINISHED DURING DERAILED ENGG. STAGE.
- 3) PLEASE NOTE THAT THIS CONFIGURATION IS SHOWN FOR SINGLE INPUT DIN MOUNTED TT. FOR DUAL INPUT TT BOTH THE ELEMENTS OF RTD SHALL BE CONNECTED TO TT THROUGH INPUT TBs.

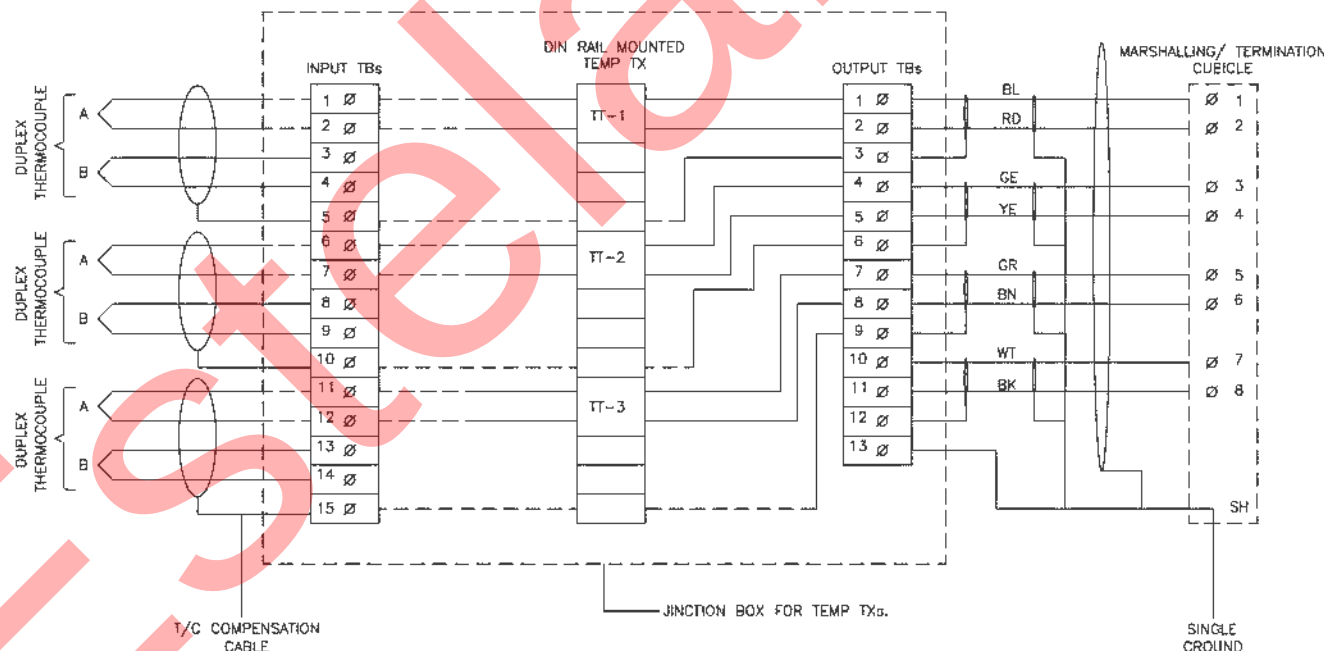
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|             |       |                                                                                           |        |
|-------------|-------|-------------------------------------------------------------------------------------------|--------|
| PROJECT     |       | TYPICAL THERMAL POWER PROJECT                                                             |        |
| TITLE       |       | INTERFACING OF FIELD INSTRUMENTS<br>TYPICAL RTD CONNECTION WITH TEMP TRANSMITTERS IN JB's |        |
| SIZE        | SCALE | DRG. NO.                                                                                  | REV NO |
| A3          | NTS   | 0000-999-POI-A-065                                                                        | A      |
| SH 06 OF 15 |       |                                                                                           |        |

|            |             |       |        |       |   |   |   |     |       |      |          |
|------------|-------------|-------|--------|-------|---|---|---|-----|-------|------|----------|
| REV.NO.    | DESCRIPTION | DRAWN | DESIGN | CHKD. | M | E | C | C&I | ARCH. | APPD | DATE     |
| A          | FIRST ISSUE |       |        |       |   |   |   |     |       |      | 21.08.12 |
| Cleared by |             |       |        |       |   |   |   |     |       |      |          |



- NOTE :-
- 1) ABOVE IS THE TYP. DRG. MOUNTED TEMP TRANSMITTER FRO T/C APPLICATION. EXACT TYPE OF TEMP TRANSMITTERS SHALL BE AS PER PART-A OF SPECIFICATION.
  - 2) THE EXACT GROUPING OF TEMP TXs SHALL BE FINISHED DURING DERAILED ENGG. STAGE.
  - 3) AFTER GLADDING OF T/C CABLES ON JB. THE CABLE PAIR OF FIRST ELEMENT WILL BE DIRECTLY CONNECTED TO TT AND THE CABLE PAIR OF SECOND ELEMENT SHALL BE WIRED TO INPUT TBs FOR FUTURE USE.
  - 4) PLEASE NOTE THAT THIS CONFIGURATION IS SHOWN FOR SINGLE INPUT DIN RAIL MOUNTED TT. FOR DUAL INPUT TT BOTH THE ELEMENT OF T/C SHALL BE CONNECTED DIRECTLY TO TT WITHOUT INPUT TBs. HOWEVER 5 NOS OF INPUTS TBs ARE TO PROVIDED FOR EACH T/C FOR FUTURE USE.

FOR TENDER PURPOSE ONLY



**NTPC LIMITED**  
( A GOVERNMENT OF INDIA ENTERPRISE )  
ENGINEERING DIVISION

|         |                                                |                                                                                     |        |       |   |            |   |     |       |      |          |                                                                                          |       |                    |             |
|---------|------------------------------------------------|-------------------------------------------------------------------------------------|--------|-------|---|------------|---|-----|-------|------|----------|------------------------------------------------------------------------------------------|-------|--------------------|-------------|
|         |                                                |                                                                                     |        |       |   |            |   |     |       |      |          | PROJECT<br>TYPICAL THERMAL POWER PROJECT                                                 |       |                    |             |
| B       | CABLING OF 2ND RTD CHANGED TO MATCH COLOR CODE |  |        |       |   |            |   |     |       |      | 21.08.12 | TITLE<br>INTERFACING OF FIELD INSTRUMENTS<br>TYPICAL T/C CONNECTION WITH TEMP TXs IN JBs |       |                    |             |
| A       | FIRST ISSUE                                    |  |        |       |   |            |   |     |       |      | 29.04.08 |                                                                                          |       |                    |             |
| REV.NO. | DESCRIPTION                                    | DRAWN                                                                               | DESIGN | CHKD. | M | E          | C | C&I | ARCH. | APPD | DATE     | SIZE                                                                                     | SCALE | DRG. NO.           | REV NO.     |
|         |                                                |                                                                                     |        |       |   |            |   |     |       |      |          | A3                                                                                       | NTS   | 0000-999-POI-A-065 | B           |
|         |                                                |                                                                                     |        |       |   | CLEARED BY |   |     |       |      |          |                                                                                          |       |                    | SH 15 OF 15 |

SH 15 OF 15

|  |                                                                        |  |
|--|------------------------------------------------------------------------|--|
|  | <b>NTPC FGD PACKAGES-<br/>LOT-1A, 2 &amp; 3</b>                        |  |
|  | <b>C &amp; I TECHNICAL SPECIFICATION<br/>FOR COMPRESSED AIR SYSTEM</b> |  |

Estelar

**CODES AND STANDARDS**

| CLAUSE NO. | <div data-bbox="566 128 1094 155" data-label="Page-Header">GENERAL TECHNICAL REQUIREMENTS</div> <div data-bbox="1284 113 1425 184" data-label="Page-Header">  </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
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|            | <div data-bbox="391 825 1422 890" data-label="Section-Header"> <h3>REFERENCE CODES AND STANDARDS FOR CONTROL AND INSTRUMENTATION</h3> </div> <div data-bbox="391 921 1422 1058" data-label="Text"> <p>The design, manufacture, inspection, testing &amp; installation of all equipment and system covered under this specification shall conform to the latest editions of codes and standards mentioned below and all other applicable VDE, IEEE, ANSI, ASME, NEC, NEMA, ISA AND Indian Standards and their equivalents.</p> </div> <div data-bbox="391 1146 756 1176" data-label="Section-Header"> <h4>Temperature Measurements</h4> </div> <div data-bbox="391 1207 1422 1453" data-label="List-Group"> <ol style="list-style-type: none"> <li>1. Instrument and apparatus for temperature measurement - ASME PTC 19.3 (1974).</li> <li>2. Temperature measurement - Thermocouples ANSI MC 96.1 - 1982.</li> <li>3. Temperature measurement by electrical Resistance thermometers - IS:2806.</li> <li>4. Thermometer - element - Platinum resistance - IS:2848.</li> </ol> </div> <div data-bbox="391 1482 708 1512" data-label="Section-Header"> <h4>Pressure Measurements</h4> </div> <div data-bbox="391 1541 1422 1787" data-label="List-Group"> <ol style="list-style-type: none"> <li>1. <ol style="list-style-type: none"> <li>a) Instruments and apparatus for pressure measurement - ASME PTC 19.2 (1964).</li> <li>b) Electronic transmitters BS:6447.</li> </ol> </li> <li>2. Bourdon tube pressure and vacuum gauges - IS:3624 - 1966.</li> <li>3. Process operated switch devices (Pr. Switch) BS-6134.</li> </ol> </div> |

| CLAUSE NO. | GENERAL TECHNICAL REQUIREMENTS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |
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|            | <p><b>Flow Measurements</b></p> <p>Instruments and apparatus for flow measurements - ASME PTC 19.5 (1972) Interim supplement, Part-II.</p> <p>Measurement of fluid flow in closed conduits - BS-1042.</p> <p><b>Electronic Measuring Instrument &amp; Control Hardware/ Software</b></p> <ol style="list-style-type: none"> <li>Automatic null balancing electrical measuring instruments - ANSI C 39.4 (Rev. 1973): IS:9319.</li> <li>Safety requirements for electrical and electronic measuring and controlling instrument - ANSI C 39.5 - 1974.</li> <li>Compatibility of analog signals for electronic industrial process instruments - ISA - S 50.1 (1982) ANSI MC 12.1 - 1975.</li> <li>Dynamic response testing of process control instrumentation ISA - S 26 (1968).</li> <li>Surge Withstand Capability (SWC) tests - ANSI C 37.90 a/IEEE-472 or suitable class of IEC-255-4 equivalent to ANSI C37.90a/IEEE-472.</li> <li>Printed circuit boards - IPC TM - 650, IEC 326 C.</li> <li>General requirement and tests for printed wiring boards - IS 7405 (Part-I) 1973.</li> <li>Edge socket connectors - IEC 130-11.</li> <li>Requirements and methods of testing of wire wrap terminations DIN 41611 Part-2.</li> <li>Dimensions of attachment plugs &amp; receptacles - ANSI C 73 - 1973 (Supplement ANSI C 73 a - 1980).</li> <li>Direct acting electrical indicating instrument - IS:1248 - 1968 (R).</li> <li>Standard Digital Interface for Programmable Instrumentation - IEEE-488.2 - 1990.</li> <li>Information Processing Systems - Local Area Networks - Part 2 : Logical Link Control - IEEE-802.2 - 1989.</li> <li>Standard for Local Area Networks : Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1985.</li> <li>Supplements A, B, C and E to Carrier Sense Multiple Access with Collision Detection - IEEE-802.3 - 1988.</li> </ol> |                                                                                     |
|            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                     |

| CLAUSE NO. | GENERAL TECHNICAL REQUIREMENTS                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |
|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
|            | <ol style="list-style-type: none"> <li>16. Standard for Local Area Networks : Token - Passing Bus Access Method - IEEE-802.4 - 1985.</li> <li>17. Standard for Local Area Networks : Token - Ring Access Method and Physical Layer Specification - IEEE-802.5 - 1985.</li> <li>18. IEEE Guide to Software Requirements Specifications - IEEE-830 - 1984.</li> <li>19. Hardware Testing of Digital Process Computers - ISA RP55.1 - 1983.</li> <li>20. Electromagnetic Susceptibility of Process Control Instrumentation - SAMA PMC 33.1 - 1978.</li> <li>21. Interface Between the Data Terminal Equipment and Data Circuit - Terminating Equipment Employing Serial Binary Data Interchange - EIA-232-D-1987.</li> <li>22. Electromagnetic Compatibility for Industrial Process Measurement and Control Equipment, Part 3 : Radiated Electromagnetic Field Requirements - IEC 801-3-1984.</li> </ol> <p><b>Instrument Switches and Contact</b></p> <ol style="list-style-type: none"> <li>1. Contact rating - AC services NEMA ICS 2 - 1978 (with revision through May 1983), Part - 2-125, A6000.</li> <li>2. Contact rating - DC services NEMA ICS 2-1978 Part-2 125, N600.</li> </ol> <p><b>Enclosures</b></p> <ol style="list-style-type: none"> <li>1. Type of Enclosures - NEMA ICS Part - 6 - 1978 (with Rev. 1 4/80) through 110.22 (Type 4 to 13).</li> <li>2. Racks, panels and associated equipment - EIA : RS - 310 C- 1983 (ANSI C 83.9 - 1972).</li> <li>3. Protection class for Enclosures, cabinets, control panels &amp; desks - IS:2147 - 1962.</li> </ol> <p><b>Apparatus, enclosures and installation practices in hazardous area</b></p> <ol style="list-style-type: none"> <li>1. Classification of hazardous area - NFPA 70 - 1984, Article 500.</li> <li>2. Electrical Instruments in hazardous dust location - ISA - 512.11, 1973.</li> <li>3. Intrinsically safe apparatus - NFPA 493 1978.</li> <li>4. Purged and pressurised enclosure for electrical equipment in hazardous location - NFPA 496-1982.</li> <li>5. Enclosures for Industrial Controls and Systems - NEMA IS 1.1 - 1977.</li> </ol> |                                                                                     |
|            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                     |

| CLAUSE NO. | <div data-bbox="565 121 1096 153" data-label="Section-Header">GENERAL TECHNICAL REQUIREMENTS</div> <div data-bbox="1279 111 1427 180" data-label="Image"> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
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|            | <div data-bbox="391 216 621 247" data-label="Section-Header"><b>Sampling System</b></div> <div data-bbox="391 279 1425 558" data-label="List-Group"> <ol style="list-style-type: none"> <li>1. Stainless steel material of tubing and valves for sampling system - ASTM A 296-82, Grade 7 P 316.</li> <li>2. Submerged helical coil heat exchangers for sample coolers ASTM D11 92-1977.</li> <li>3. Water and steam in power cycle - ASME PTC 19.11.</li> <li>4. Standard methods of sampling system - ASTM D 1066-99.</li> </ol> </div> <div data-bbox="391 585 570 617" data-label="Section-Header"><b>Annunciators</b></div> <div data-bbox="391 646 1425 926" data-label="List-Group"> <ol style="list-style-type: none"> <li>1. Specifications and guides for the use of general purpose annunciators - ISA S 19.1, 1979.</li> <li>2. Surge withstand capability tests - ANSI C 37.90a - 1989/IEEE-472 or suitable class of IEC 255-4 equivalent to ANSI C37.90a 1989/IEEE-472</li> <li>3. Damp heat cycling test - IS:2106</li> <li>4. Specification for Electromagnetic Susceptibility - SAMA DMC 33, 1/78</li> </ol> </div> <div data-bbox="391 953 545 984" data-label="Section-Header"><b>Protections</b></div> <div data-bbox="391 1014 1425 1293" data-label="List-Group"> <ol style="list-style-type: none"> <li>1. Relays and relay system associated with electric power apparatus. ANSI C 37.90, 1 - 1989.</li> <li>2. General requirements &amp; tests for switching devices for control and auxiliary circuits including contactor relays - IS:6875 (Part-I) - 1973.</li> <li>3. Turbine water damage prevention - ASME TDP-1-1980.</li> <li>4. Boiler safety interlocks - NFPA 85 - 2011 or latest version.</li> </ol> </div> <div data-bbox="391 1320 553 1352" data-label="Section-Header"><b>UPS System</b></div> <div data-bbox="391 1381 1425 1759" data-label="List-Group"> <ol style="list-style-type: none"> <li>1. Practices and requirements for semi-conductor power rectifiers - ANSI C 34.2, 1973.</li> <li>2. Relays and relays system associated with electrical power apparatus - ANSI C 3.90 - 1983.</li> <li>3. Surge withstand capability test - ANSI C 37.90 1 -1989.</li> <li>4. Performance testing of UPS - IEC 146.</li> <li>5. Stationary cells &amp; Batteries Lead Acid type (with tubular positive plates) specification IS-1651-1991.</li> </ol> </div> |

| CLAUSE NO. | GENERAL TECHNICAL REQUIREMENTS <div data-bbox="1284 113 1427 184" style="float: right;">  </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
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|            | <ol style="list-style-type: none"> <li>6. Recommended practice for sizing large lead storage batteries for generating stations &amp; sub-stations - IEEE-485-1985.</li> <li>7. Printed Circuit Board - IPC TM 650, IEC 326C.</li> <li>8. General Requirements &amp; tests for printed wiring boards, IS:7405 (Part-I) 1973.</li> </ol> <p><b>Control Valves</b></p> <ol style="list-style-type: none"> <li>1. Control valve sizing - Compressible &amp; Incompressible fluids - ISA S 75.01-1985.</li> <li>2. Face to face dimensions of control valves - ANSI B 16.00 - 1973.</li> <li>3. ISA Hand Book of Control Valves - (ISBN : B: 1047-087664-234-2).</li> <li>4. Codes for pressure piping - ANSI B 31.1</li> <li>5. Control Valve leak class - ISA RP 39.6</li> </ol> <p><b>Process Connection &amp; Piping</b></p> <ol style="list-style-type: none"> <li>1. Codes for pressure piping "power piping" - ANSI B 31.1.</li> <li>2. Seamless carbon steel pipe ASTM - A - 106.</li> <li>3. Forged &amp; Rolled Alloy steel pipe flanges, forged fittings and valves and parts - ASTM - A - 182.</li> <li>4. Material for socket welded fittings - ASTM - A - 105.</li> <li>5. Seamless ferritic alloy steep pipe - ASTM - A - 335.</li> <li>6. Pipe fittings of wrought carbon steel and alloy steel - ASTM - A - 234.</li> <li>7. Composition bronze of ounce metal castings - ASTM - B - 62.</li> <li>8. Seamless Copper tube, bright annealed - ASTM - B - 168.</li> <li>9. Seamless copper tube - ASTM - B - 75.</li> <li>10. Dimension of fittings - ANSI - B - 16.11.</li> <li>11. Valves flanged and butt welding ends - ANSI - B - 16.34.</li> </ol> <p><b>Instrument Tubing</b></p> <ol style="list-style-type: none"> <li>1. Seamless carbon steel pipe - ASTM - A 106.</li> <li>2. Material of socketweld fittings - ASTM - A105.</li> <li>3. Dimensions of fittings - ANSI - B - 16.11.</li> </ol> |

| CLAUSE NO. | <div data-bbox="565 121 1096 153" data-label="Section-Header"> <p>GENERAL TECHNICAL REQUIREMENTS</p> </div> <div data-bbox="1279 109 1427 180" data-label="Image"> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
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|            | <p>4. Code for pressure piping, welding, hydrostatic testing - ANSI B 31.1.</p> <p><b>Cables</b></p> <ol style="list-style-type: none"> <li>1. Thermocouples extension wires/cables - ANSI MC 96.1 - 1992.</li> <li>2. Requirements for copper conductor-Wiring cables for telecommunications &amp; information processing system - VDE:0815.</li> <li>3. Colour coding of single or multi-pair cables - ICEA - S - 61-402 (third edition) NEMA WCS - 1979 with revisions thorough 2/83.</li> <li>4. Insulation &amp; Sheathing compounds for cables : VDE 0207 (Part-4, 5 &amp; 6).</li> <li>5. Guide design and installation of cable systems in power generating stations ( insulation, jacket materials) - IEEE Std. 422-1977.</li> <li>6. Rules for Testing insulated cables and flexible cables : VVDE - 0472</li> <li>7. Requirements of vertical flame propagation test - IEEE 383 - 1974 (R 1980)</li> <li>8. Standard specification for tinned soft or annealed copper wire for electrical purpose - ASTM B-33-81.</li> <li>9. Oxygen index and temperature index test - ASTM D - 2863.</li> <li>10. Smoke density measurement test - ASTM D - 2843.</li> <li>11. Acid gas generation test - IEC - 754 - 1.</li> <li>12. Swedish Chimney test - SEN - 4241475 (F3).</li> <li>13. Teflon (FEP) insulation &amp; sheath test - ASTM D - 2116.</li> <li>14. Thermocouple compensating cables - Testing requirements &amp; sampling plan IS:8784.</li> <li>15. PVC insulated electric cables for working voltage upto and including 1100 V - IS:1554 (Part-I).</li> </ol> <p><b>Cable Trays, Conduits</b></p> <ol style="list-style-type: none"> <li>1. Guide for design and installation of cable systems in power generating station (Cable trays, support systems, conduits) - IEEE Std. 422, 1977, NEMA VE-1 1979, NFPA 70-1984.</li> <li>2. -do- Test Standards. NEMA VE-1-1979.</li> <li>3. Zinc coating "hot dip" on assembled products for galvanising of carbon steel cable trays - ASTM A - 386-78.</li> </ol> |

| CLAUSE NO. | <div data-bbox="565 121 1096 153" data-label="Section-Header"> <p>GENERAL TECHNICAL REQUIREMENTS</p> </div> <div data-bbox="1276 109 1421 180" data-label="Image"> </div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
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|            | <div data-bbox="386 212 699 243" data-label="Section-Header"> <p><b>Public Address System</b></p> </div> <div data-bbox="386 268 1425 1062" data-label="List-Group"> <ol style="list-style-type: none"> <li>1. Specifications for loud speakers - IS:7741 (Part-I, II and III)</li> <li>2. Code of safety requirement for electric mains operated audio amplifiers - IS:1301</li> <li>3. Specification for Public Address Amplifiers - IS:10426.</li> <li>4. Code of practice for outdoor installation of PA system - IS:1982.</li> <li>5. Code of practice for installation for indoor amplifying and sound distribution system - IS:1881.</li> <li>6. Basic environmental testing procedures for electronic and electrical items - IS:9000.</li> <li>7. Characteristics and methods of measurements for sound system equipment - IS:9302</li> <li>8. Code of practice of electrical wiring installations (System voltage not exceeding 650 volts) - IS:732</li> <li>9. Rigid steel conduits for electric wiring - IS:9537 (Part-I and II)</li> <li>10. Fittings for rigid steel conduits for electrical wiring - IS:2667</li> <li>11. Degree of protection provided by enclosure for low voltage switchgear and control gear - IS:2147.</li> </ol> </div> <div data-bbox="386 1083 769 1115" data-label="Section-Header"> <p><b>Vibration Monitoring System</b></p> </div> <div data-bbox="386 1140 688 1236" data-label="List-Group"> <ol style="list-style-type: none"> <li>1. API 670 - 1994</li> <li>2. BS : 4675 Part-2</li> </ol> </div> |
|            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |



3 X 660 MW NABINAGAR FGD  
COMPRESSED AIR SYSTEM

SPECIFICATION NO. PE-TS-457-555-A001

VOLUME : II B

SECTION : E / ANNEXURE-I

REV 00

DATE: Dec., 19

SHEET: 1 OF 1

**ANNEXURE-I**

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



## SUB VENDOR LIST &amp; INSPECTION CATEGORISATION (ANNEXURE- II)

## COMPRESSED AIR SYSTEM

| SL No | Item                                | QP / Insp.Cat | Proposed Subvendor           | Place of Manufacturer     | Technical Limit                                    | Remarks                                                                                                                                                                                                                                                                                                                                   |
|-------|-------------------------------------|---------------|------------------------------|---------------------------|----------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1     | AIR DRYING PLANT (HOC TYPE)         | I             | ACIL                         | BELGIUM                   | ROTARY DRUM                                        | Testing at Atlas Copco Works Pune                                                                                                                                                                                                                                                                                                         |
|       |                                     |               | MELLCON                      | Delhi                     | Twin Tower type                                    |                                                                                                                                                                                                                                                                                                                                           |
|       |                                     |               | DELAIR                       | Gurgaon                   | Twin Tower type                                    |                                                                                                                                                                                                                                                                                                                                           |
|       |                                     |               | SUMMITS                      | Coimbtore                 | Twin Tower type                                    |                                                                                                                                                                                                                                                                                                                                           |
|       |                                     |               | Shakot                       | Noida                     | Twin Tower type                                    |                                                                                                                                                                                                                                                                                                                                           |
| 2     | AIR DRYING PLANT (REFRIGERANT TYPE) | I             | ACIL                         | BELGIUM                   |                                                    |                                                                                                                                                                                                                                                                                                                                           |
|       |                                     |               | MELLCON                      | Delhi                     |                                                    |                                                                                                                                                                                                                                                                                                                                           |
|       |                                     |               | DELAIR                       | Gurgaon                   |                                                    |                                                                                                                                                                                                                                                                                                                                           |
|       |                                     |               | SUMMITS                      | Coimbtore                 |                                                    |                                                                                                                                                                                                                                                                                                                                           |
|       |                                     |               | Shakot                       | Noida                     |                                                    |                                                                                                                                                                                                                                                                                                                                           |
|       |                                     |               | Savroe                       | Germany                   |                                                    |                                                                                                                                                                                                                                                                                                                                           |
|       |                                     |               | MTA                          | Italy                     |                                                    |                                                                                                                                                                                                                                                                                                                                           |
|       |                                     |               | Dominic Hunter               | U.K                       |                                                    |                                                                                                                                                                                                                                                                                                                                           |
| 3     | MS/GI Pipes – ERW IS 1239 / IS 3589 | III           | SAIL                         | Rourkela                  |                                                    | 1) Quantity < 200 meters Assorted sizes)<br>2) Material will be accepted on the basis of Main contractor COC supported by manufacturer TC as per relevant Code. In addition to above main contractor will certify availability of correlated identification marks on pipe wrt Manf TC and will also certify that pipes are free from rust |
|       |                                     |               | Jindal                       | Ghaziabad/Hissar          | upto 350NB                                         |                                                                                                                                                                                                                                                                                                                                           |
|       |                                     |               | Surya Roshni                 | Bahadurgarh               | upto 400 NB                                        |                                                                                                                                                                                                                                                                                                                                           |
|       |                                     |               | Tata IS 1239 Pipes           | Jamshedpur                | upto 150NB                                         |                                                                                                                                                                                                                                                                                                                                           |
|       |                                     |               | Maharashtra seamless IS 3589 | Raigad                    | 200 to 500 NB                                      |                                                                                                                                                                                                                                                                                                                                           |
|       |                                     |               | PSL                          | Chennai/Vizag/Kutch/Daman | Spiral Weld SAW as per IS 3589                     |                                                                                                                                                                                                                                                                                                                                           |
|       |                                     |               | Lalit Profile                | Thane                     | Spiral Weld SAW as per IS 3589                     |                                                                                                                                                                                                                                                                                                                                           |
|       |                                     |               | Samshi Pipes Industries      | Vadodara                  | Spiral Weld SAW as per IS 3589                     |                                                                                                                                                                                                                                                                                                                                           |
|       |                                     |               | Mukut Pipes                  | Rajpura                   | Longitudinal SAW (Single side weld) as per IS 3589 |                                                                                                                                                                                                                                                                                                                                           |
|       |                                     |               | Indus Tubes                  | G B Nagar                 | Upto 300 NB ERW Pipes as per IS 1239/3589          |                                                                                                                                                                                                                                                                                                                                           |
|       |                                     |               | Mann Ind                     | Indore                    | Spiral Weld SAW as per IS 3589                     |                                                                                                                                                                                                                                                                                                                                           |
|       |                                     |               | Surendra Engg                | Rajpura                   | Spiral Weld SAW as per IS 3589                     |                                                                                                                                                                                                                                                                                                                                           |

07.07.15  
(Harish Kumar)

| SL No | Item                   | QP / Insp.Cat | Proposed Subvendor                         | Place of Manufacturer    | Technical Limit                                                                                                                               | Remarks |
|-------|------------------------|---------------|--------------------------------------------|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|---------|
|       |                        |               | Pratibha Pipes & Structure Pvt Ltd         | Thane                    | Spiral Weld SAW as per IS 3589                                                                                                                |         |
|       |                        |               | JCO Gas Pipe                               | Chindwara                | Spiral Weld SAW as per IS 3589                                                                                                                |         |
|       |                        |               | Nukat Tanks and Vessels                    | Tarapur                  | Longitudinal SAW (Single side weld) as per IS 3589                                                                                            |         |
|       |                        |               | DADU Pipes                                 | Sikandrabad              | Upto 300 NB ERW Pipes as per IS 1239/3589                                                                                                     |         |
|       |                        |               | Good Luck Tubes                            | Sikandrabad              | Upto 300 NB                                                                                                                                   |         |
|       |                        |               | Advance Steel Tubes                        | Sahibabad                | Upto 300 NB                                                                                                                                   |         |
|       |                        |               | APL APPOLO Tubes                           | Sikandrabad              | Upto 300 NB                                                                                                                                   |         |
|       |                        |               | Hi Tech Pipes                              | Sikandrabad              | Upto 300 NB                                                                                                                                   |         |
|       |                        |               | Ratnamani                                  | Kutch/Ahmedabad/Chhatral | Upto 400 NB ERW Pipes as per IS 3589 and SAW as per IS 3589                                                                                   |         |
|       |                        |               | Welspun                                    | Anjar/Bharuch            | Upto 400 NB ERW Pipes as per IS 1239/3589 and SAW as per IS 3589                                                                              |         |
| 4     | Forged/formed fittings | III           | EBY                                        | Taloja                   |                                                                                                                                               |         |
|       |                        |               | Siddarth & Gautam                          | Faridabad                |                                                                                                                                               |         |
|       |                        |               | Pipefit                                    | Baroda                   |                                                                                                                                               |         |
|       |                        |               | MS Fittings                                | Kolkata                  |                                                                                                                                               |         |
|       |                        |               | Tube Products                              | Baroda                   |                                                                                                                                               |         |
|       |                        |               | Bharat Forge                               | Pune                     |                                                                                                                                               |         |
|       |                        |               | NL Hazra                                   | Kolkata                  |                                                                                                                                               |         |
| 5     | Ball Valve             | I             | Precision Engg                             | Nasik                    | upto 400NB 150 class                                                                                                                          |         |
|       |                        |               | Microfinish Valves Ltd                     | Hubli                    |                                                                                                                                               |         |
|       |                        |               | Weir BDK engg Industries                   | NEW DELHI                |                                                                                                                                               |         |
|       |                        |               | Flow chem. Industries                      | Ahemdabad                | upto 50 NB 800 Class: 350NB 150 class                                                                                                         |         |
|       |                        |               | Audco                                      | Chennai                  |                                                                                                                                               |         |
|       |                        |               | Akay India                                 | Hubli                    | upto 50NB 800 class                                                                                                                           |         |
|       |                        |               | A V Valves                                 | Agra                     |                                                                                                                                               |         |
|       |                        |               | Asian Industrial valves & Instruments Ltd. | Chennai                  |                                                                                                                                               |         |
|       |                        |               | ATAM Valves                                | Jalandhar                | (1) BALL VALVES: FCS/FSS - 1/2" to 2" #800 & CCS/CSS - 2.1/2" to 4" # 150 (2) BALL VALVES: GUN METAL VALVES SIZE 15 NB TO 80 NB - UPTO PN16.0 |         |
|       |                        |               | GM ENGINEERING                             | Rajkot                   |                                                                                                                                               |         |
|       |                        |               | Hawa Valves (India) Pvt. Ltd.              | Navi Mumbai              | Size up to 2" & #800 with MOC as FCS & FSS and for size from 65 NB to 150 NB & #150 with MOC as CCS and CSS.                                  |         |

  
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| SL No | Item                          | QP / Insp.Cat | Proposed Subvendor                   | Place of Manufacturer    | Technical Limit                                                                                                                                                                   | Remarks |
|-------|-------------------------------|---------------|--------------------------------------|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
|       |                               |               | INTERVALVE (INDIA) LTD.              | Pune                     | Steel ball Valves upto 50NB, #800 and 65NB to 150NB. #150                                                                                                                         |         |
|       |                               |               | NILON VALVES PRIVATE LIMITED         | Ahmedabad                |                                                                                                                                                                                   |         |
|       |                               |               | LEADER VALVES LTD.                   | Jalandhar                | CAST STEEL UPTO 200 MM, CLASS 150/300.                                                                                                                                            |         |
|       |                               |               | DEMBLA VALVES LTD.                   | Thane                    |                                                                                                                                                                                   |         |
|       |                               |               | SURYA VALVES AND INSTRUMENTS MFG CO. | Chennai                  | FOR CARBON STEEL/STAINLESS STEEL UPTO SIZE 200NB.                                                                                                                                 |         |
|       |                               |               | UNIFLOW                              | Chennai                  |                                                                                                                                                                                   |         |
|       |                               |               | VALTECH INDUSTRIES                   | Mumbai                   | FORGED CARBON & ALLOY STEEL BALL VALVES, SCREWED TYPE BALL VALVES RATING 800, SIZES UPTO 50 & CC & ALLOY STEEL BALL VALVES RATING 150, SIZES 65 TO 200 FLANGED TYPE.              |         |
|       |                               |               | VAAS AUTOMATION                      | NEW DELHI                |                                                                                                                                                                                   |         |
|       |                               |               | Belgaum Aqua Valve                   | Belgaum                  |                                                                                                                                                                                   |         |
|       |                               |               |                                      |                          |                                                                                                                                                                                   |         |
| 6     | CS/FS Gate/Globe/Check valves | III           | Fouress                              | Mumbai/ Aurangabad       |                                                                                                                                                                                   |         |
|       |                               |               | Weir BDK                             | NEW DELHI                |                                                                                                                                                                                   |         |
|       |                               |               | L & T Valves                         | Coimbatore/ Kancheepuram |                                                                                                                                                                                   |         |
|       |                               |               | Leader                               | Jullundhar               |                                                                                                                                                                                   |         |
|       |                               |               | KSB                                  | Coimbatore               |                                                                                                                                                                                   |         |
|       |                               |               | A V Valves                           | Agra                     |                                                                                                                                                                                   |         |
|       |                               |               | ATAM Valves                          | Jalandhar                | (1) Carbon Steel Gate Valves & non return valves: 15 NB to 50 NB (#800) & 65 NB to 300 NB (#150)<br>(2) Carbon Steel Globe Valves: 15 NB to 50 NB (#800) & 65 NB to 200 NB (#150) |         |
|       |                               |               | Fluidline valves                     | Ghaziabad                |                                                                                                                                                                                   |         |
|       |                               |               | GM ENGINEERING                       | Rajkot                   |                                                                                                                                                                                   |         |
|       |                               |               | INTERVALVE (INDIA) LTD.              | Pune                     | a) Steel Gate Valves: upto 50NB, #800 and 65NB to 150NB, #150 b) Steel Globe Valves: upto 50NB, #800 and 65NB to 100NB, #150 c) Supplier not registered for NR Valves             |         |
|       |                               |               | Niton Valves                         | Mumbai                   |                                                                                                                                                                                   |         |
|       |                               |               | NSSL Ltd.                            | Nagpur                   |                                                                                                                                                                                   |         |
|       |                               |               | Steel Strong valves Ltd.             | Navi Mumbai              |                                                                                                                                                                                   |         |

  
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| SL No | Item            | QP / Insp.Cat | Proposed Subvendor                                | Place of Manufacturer | Technical Limit                                                                                                                                                                         | Remarks |
|-------|-----------------|---------------|---------------------------------------------------|-----------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
|       |                 |               | VENUS PUMPS AND ENGG. WORKS                       | Kolkata               | CC/CSS-GATE-BBT-upto600NB CL upto300,GATE-PSBT upto250NB CL 1500,GLV-BBT-upto300NB CL upto600,SCNRV-BBT-upto600NB CL upto150,SCNRV-BBT-upto300NB CL 300,SCNRV-PSBT-upto150NB CL upto900 |         |
|       |                 |               | VALTECH INDUSTRIES                                | Mumbai                | CAST CARBON & ALLOY STEEL - VALVE/RATING/SIZE- GV/150/900, GV/300/400, GV/600/300, GV/GLV/NRV/900/250, GLV/300/300, GLV/150/350, SCNRV/150/700, SCNRV/300/350, SCNRV/600/250.           |         |
|       |                 |               | V K Valves Ltd.                                   | Jalandhar             |                                                                                                                                                                                         |         |
|       |                 |               | KBL                                               | Kondhapuri            |                                                                                                                                                                                         |         |
| 7     | Butterfly Valve | II            | KBL                                               | Kondhapuri            |                                                                                                                                                                                         |         |
|       |                 |               | Fouress                                           | Bangalore             |                                                                                                                                                                                         |         |
|       |                 |               | Audco                                             | Chennai               |                                                                                                                                                                                         |         |
|       |                 |               | Weir BDK                                          | NEW DELHI             |                                                                                                                                                                                         |         |
|       |                 |               | Tyco                                              | Halol                 |                                                                                                                                                                                         |         |
|       |                 |               | Inter Valve                                       | Pune                  |                                                                                                                                                                                         |         |
|       |                 |               | Advance Valves                                    | Noida                 |                                                                                                                                                                                         |         |
|       |                 |               | Fluidline valves                                  | Ghaziabad             |                                                                                                                                                                                         |         |
|       |                 |               | Instrumentation Ltd.                              | Palakkad              |                                                                                                                                                                                         |         |
|       |                 |               | R and D Multiples ( Metal Cast) Pvt. Ltd.         | Mumbai                |                                                                                                                                                                                         |         |
|       |                 |               | SURYA VALVES AND INSTRUMENTS MFG CO.              | Chennai               | FOR CI , CCS & CSS UPTO SIZE 750 NB.                                                                                                                                                    |         |
|       |                 |               | PENTAIR VALVES AND CONTROLS INDIA PRIVATE LIMITED | Navi Mumbai           |                                                                                                                                                                                         |         |
|       |                 |               | UPADHAYA VALVES MANUFACTURERS PRIVATE LIMITED,    | Kolkata               | MOC-Cast Iron, size from 65 NB to 350 NB having rating of PN10 as per BS EN 593.                                                                                                        |         |
|       |                 |               | VENUS PUMPS AND ENGG. WORKS                       | Kolkata               |                                                                                                                                                                                         |         |

  
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